Open Space Cluster Developments to Conservation Subdivisions: Standards and Management Plans Influencing Conservation Goals

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James Joshi Wynn

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JAMES JOSHI WYNN

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and the College of Arts and Sciences by

Nancy J. Manring

Associate Professor of Political Science

Benjamin M. Ogles

Dean, College of Arts and Sciences

ABSTRACT

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This thesis poses the question: Can goals for natural resource conservation and sustainability be better achieved through higher standards for the quantity, quality, configuration and management of the open space areas in conservation subdivisions? This thesis is based on an analysis of the standards in the literature that are used to designate the quantity, quality, configuration and management of the open space in conservation subdivisions, and their influence on the conservation goals of natural resource preservation and sustainability. Using a case study approach this thesis analyzes three conservation subdivisions and their respective municipal subdivision ordinances, including: their covenants, conditions and restrictions; development design guidelines; management plans; and site characteristics. Conclusions reached confirm that there are a variety of terms, standards and design and management approaches that can be advanced to influence natural resource conservation and sustainability goals. Each case study site and ordinance profiled has approaches and standards that can be used to inform future land use policy and planning to better achieve goals most valued in a particular location.

Approved: _____

Nancy J. Manring

Associate Professor of Political Science

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CHAPTER 1: INTRODUCTION

The annual rate of land development in the United States (US), increased from 1.4 million acres in the 1980's to 2.1 million acres in the 1990's; and 30% of all developed land in the US was developed in less than 20 years, from 1982-2001 (Benfield, 2005). Based on population growth and development densities, 68 million acres of land will be developed from 2000 to 2025 (Beach, 2002). Housing comprises 56% of the built environment (Leinberger, 2008). More than 80% of housing development in the past ten years has been in rural areas (Pejchar, Morgan, Caldwell, Palmer, & Daily, 2007). Rural and suburban land development is a leading cause of natural resource degradation and biodiversity loss (Milder, Lassoie, & Bedford, 2008). More than 90% of endangered and threatened species rely on private land for their habitat (Thompson, 2004). Development of rural land is an immediate threat to biodiversity and ecosystem services, and the global socioeconomic and ecological consequences are dramatic (Pejchar, et al., 2007).

Increased housing density is required to reduce sprawl (Kaplan, Austin, & Kaplan, 2004). Cluster developments with increased housing density have been promoted to combat sprawl since the early 1960's (Little, 1968; Whyte, 1964). Clustering of homes can direct development away from environmentally and culturally sensitive areas. Cluster developments such as conservation subdivisions provide an alternative to conventional subdivisions which are often seen as a culprit of sprawl's transformation of rural land (Austin & Kaplan, 2003). Conservation developments provide increased density that reduces the sprawling footprint of conventional residential developments (Ohm, 2000).

According to Milder, (2007), “The creation of clear definitions, guidelines, and standards could help mainstream conservation development both by legitimizing good projects in the eyes of regulators and environmentalists and by preventing the conservation development concept from being used to ‘greenwash’ projects with little conservation merit.” (Milder, 2007, p. 766). Zoning and subdivision ordinances need to be revised in order to set higher standards for the quantity, quality and configuration of open space (Arendt, 2004). Clear ordinance standards are essential in guiding development design so that the community’s conservation priorities will be understood (Arendt, 1999, in Charles J. Kilbert. Ed.). Ordinance language needs to include more specificity on the natural features to be preserved, ecological functions to be supported, and their relationship with natural features on adjacent lands (Kaplan, et al., 2004).

Management obligations and responsibilities for residents of conservation subdivisions differ from residents of conventional subdivisions (Austin & Kaplan, 2003). Misuse of open space may result in a loss of potential environmental benefits including the provision of habitat and the reduction of stormwater runoff (Mohamed, 2006). Concern has been expressed about whether a Home Owners Association (HOA) may have the required skills, knowledge, and appropriate management goals to manage conservation land effectively; and partnerships with natural resource professionals have been recommended (Austin & Kaplan, 2003; Milder, 2007; Thompson, 2004), as well as the incorporation of specific language into HOA bylaws for the management of natural areas (Austin & Kaplan, 2003). It has been suggested ordinances should be amended to require the submission of open space management plans to municipalities (Arendt, 1996).

A decade ago, few authors had begun to apply sustainable development principles to planning policies and regulations, although it was recognized as a priority for planning (Grant & Manuel, 1999). The concept of sustainability involves the integration of social, environmental and economic objectives (Beatley & Manning, 1997; Hanna, 2005). Conservation subdivisions are recognized as contributing to sustainability by protecting natural resources (MPEQB, 2000). Conservation design has been recognized as a tool for implementing sustainable development practices such as the sustainable management of stormwater (NIPCCW, 2003). In addition to maintaining landscape structure and function, there is a need to adopt planning principles that provide for social equity aspects of sustainable development such as the provision of affordable housing, and economic viability aspects such as onsite employment (Grant & Manuel, 1999). The concept of sustainability is emerging as an important theme in community planning (Hanna, 2005).

This thesis poses the question: Can goals for natural resource conservation and sustainability be better achieved through higher standards for the quantity, quality, configuration and management of the open space areas in conservation subdivisions? This thesis analyzes three conservation subdivisions and their respective municipal subdivision ordinances, as well as their: covenants, conditions and restrictions; development design guidelines; management plans; and site characteristics. This information will be used to make conclusions and recommendations that planners, communities, developers and researchers can consider when developing guidelines and standards for conservation subdivisions based on the conservation and sustainability goals that are most valued in a particular location.

CHAPTER 2: LITERATURE REVIEW

In order to provide an accurate description of the terminology and standards related to the development of conservation subdivisions, it is important to understand how these terms and standards have developed over time, as well as the potential implications and influences of related innovations in design, policy, and management. Approaches to management and sustainability can be codified in municipal policy including comprehensive plans, and zoning and subdivision ordinances, or used by site developers and residents in ways that can meet or exceed municipal policy standards.

Management guidelines drafted by developers of conservation subdivisions are often adopted by homeowners as part of legal agreements attached to land deeds which new homeowners agree to upon purchase, such as ‘covenants, codes, and restrictions’, and ‘development guidelines’ for both the open space and individual residential lots. Additional management guidelines can be established and monitored by land trusts or other agencies that may be asked to hold a ‘conservation easement’ on the open space. Municipalities, developers, and landowners adopting a stewardship ethic of ecologically responsible land management can also influence conservation and sustainability goals.

Policy standards and design approaches for the quantity, quality, configuration and management of open space, as well as related innovations including ‘new urbanism’ and ‘smart growth’ are discussed in the literature review. Three case studies are used to provide examples of the design, permitting and management of conservation subdivisions for consideration of their influences on natural resource conservation and sustainability.

Terms such as cluster development and conservation development are difficult to define because these terms are used to describe a variety of different developments. Several authors have attempted to make a distinction between ‘cluster developments’ or ‘open space developments’ and the more conservation oriented forms of development now being distinguished as conservation developments, including conservation subdivisions (Kaplan, et al., 2004; Milder, 2007; Pejchar, et al., 2007; SIRCDI, 2006). Others have used the following terms interchangeably: cluster development, open space development, conservation subdivision design (Mega, Lukermann, & Sykes, 1998); cluster development, open space development, conservation development (Blaine & Schear, 1999); cluster development, conservation design subdivisions, conservation development subdivisions (Church, 2000); and conservation design, conservation development, and conservation subdivision (NIPCCW, 2003). Another source has used conservation subdivision design interchangeably with open space design, referring to them as ‘green’ forms of the clustering approach to subdivision design (Gilroy, 2002).

Cluster developments have often been referred to as open space developments. The term ‘open space developments’ fails to describe accurately the natural areas included in these developments, or the intent of planners to designate more environmentally appropriate communities. The potential for misunderstandings of the meaning of terms like ‘open space’ has far-reaching social and environmental implications. Researchers have called for the planning profession to reexamine the use of the term ‘open space developments’ and replace it with ‘conservation development’ (Kaplan, et al., 2004).

According to Milder, 2007, “The creation of clear definitions, guidelines, and standards could help mainstream conservation development both by legitimizing good projects in the eyes of regulators and environmentalists and by preventing the conservation development concept from being used to ‘greenwash’ projects with little conservation merit.” (Milder, 2007, p. 766). It has been suggested that zoning and subdivision ordinances need to be revised in order to set higher standards for the ‘quantity’, ‘quality’ and ‘configuration’ of open space (Arendt, 2004).

The ‘quantity’ of open space is defined in the literature as the minimum percentage of a given parcel of land to be preserved (Arendt, [Ed.], 1994). The ‘quality’ of open space is defined as the maximum percentage of unbuildable land allowed to be included in the minimum required percentage of open space area (Arendt, 1996; MAPC, 2000), and the maximum percentage of impermeable surfaces and disturbed areas such as ball fields, allowed in the open space (MAPC, 2000). The ‘configuration’ of open space is defined as the shape of the open space relative to itself (undivided or fragmented), and in relation to open space on adjacent lands (Arendt, 1996).

In order to understand and evaluate the how the standards related to the permitting of conservation subdivisions can influence conservation goals, it is important to review some of the objectives, ordinances, and design approaches for early cluster developments. It is also important to consider how terminology and standards have developed over time. Potential implications and influences of related innovations in design, policy, and management, such as new urbanism and smart growth will be discussed, as well as approaches to management and sustainability, and how they relate to land use ethics.

Cluster Development: Cluster development was introduced in the US in 1928 with New Jersey's Radburn development (APA, 2006). Cluster development has been promoted to combat sprawl since the early 1960's, when it was recognized as a major new housing trend by the American Conservation Association (ACA), a non-profit devoted to nature preservation and outdoor recreation, and by the Open Space Action Institute (OSAI), a non-profit devoted to the preservation of open space in and around urban areas.

The work of the ACA and the OSAI in their promotion of cluster developments for open space preservation was influenced by a series of reports published by the Outdoor Recreation Resources Review Commission (ORRRC), in 1962 (Little, 1968; Whyte, 1964). The ORRRC reports recognized that the preservation and use of open space on private land was just as critical as public lands, and that the most important types of outdoor recreation were those found in people's everyday lives (Little, 1968).

The ACA published a report titled *Cluster Development* in 1964 that promoted this style of development for its potential to reduce the amount of site grading and municipal sewage infrastructure, provide connected open space between developments, improved stormwater management due to reduced impervious surfaces, and for its potential to provide for democratic self-governance. The ACA report acknowledged that the multiple terms in use to describe cluster development, including 'environmental planning', 'planned unit development', and 'density zoning', made it difficult to define and expressed concerns that standards could become lower as more were built. The ACA report included case studies of cluster developments, model ordinances, and articles of incorporation or 'covenants' for use by HOA's, civic officials, and citizen groups.

A 1963 New York State Cluster Enabling Act profiled in the ACA report authorized town and planning boards to modify zoning ordinances to encourage design flexibility in order to preserve the natural and scenic qualities of open space. The number of housing units was to be ‘density neutral’ - not to exceed that which could be permitted under the existing applicable zoning district. Specific conditions for the use, ownership, and maintenance of the open space were at the discretion of local planning authorities. Site plans for proposed cluster developments were to be subject to public hearings.

The 1963 Subdivision Open Space Regulations of Baltimore County, MD profiled in the ACA report included the goals to: preserve recreational open space close to home; preserve natural green space; encourage cooperative relationships among neighbors and cooperative participation in the care and use of the open space; promote public health and safety, morals, and welfare of residents, and also to help stabilize local property values. The ordinance mandated the inclusion of open space of a suitable size, location, shape and pedestrian accessibility for all future residential subdivisions in Baltimore County. The minimum quantity of open space could vary from 3 to 12% of the gross acreage, depending on the housing density. The quantity of open space was required to be at least 20,000 square feet, but no more than 3 acres for separate tracts of open space. However, this could vary at the discretion of the planning board. The quality of the open space was allowed to consist of no more than 50% storm drainage areas. Driveways and parking areas and were excluded from the open space. Ownership of the open space could be retained by the developer, or deeded to a local municipality. Maintenance and operations plans had to be submitted and approved and the open space had to be suitably managed.

The Community Unit and Density Development Ordinances from St. Louis, MO profiled in the ACA report included the goals to: promote public health and safety, morals, and the welfare of residents, provide for recreation areas and to preserve the natural beauty of St. Louis County. The ordinance applied only to properties of 20 acres or more, and stated that the number of housing units was required to be density neutral. The minimum quantity and quality of open space required could vary from 15 to 30% of the 'buildable' acreage, depending on the zoning district. The open space was allowed to consist of private recreation areas such as swimming pools or golf courses, or historic buildings or sites, parks, woodlands, riparian areas, or other areas worthy of preservation. Ownership of the open space was required to be deeded to 'trustees', with the title to be vested in lot owners in common and in perpetuity, for their sole benefit and use.

The ACA report profiled examples of five HOA covenants, codes and restrictions with provisions for automatic membership based on lot ownership, and the ability for the HOA to assess fees for the maintenance of open space and other common areas as well as to place liens on properties with delinquent payments. The 'model' covenants included only very brief, general statements about homeowner obligations to maintain park lands and recreational areas. One model ordinance indicated that the municipality would have authority to maintain storm drainage areas on the property. One model covenant included provisions for an Architectural Control Committee with discretion to approve home owner improvements, and another model covenant included a provision for giving second owners notice about their open space management obligations (Whyte, 1964).

The OSAI published a report for municipal officials and civic leaders titled *Challenge of the Land* in 1968 that promoted cluster development, and which included model cluster development ordinances. The OSAI put forth a challenge to shape future growth in order to create 'liveable communities' with natural recreational environments that would preserve woodlands and fishable streams and enable children to cycle or walk to school on wooded paths instead of having to be driven. The OSAI was critical of the terms cluster development and open space development, and proposed calling them green space developments. The OSAI report proposed the adoption of strict standards to guard against bad faith inspired by greed, and poor design. The OSAI also popularized the concept of 'stewardship' to promote preservation efforts by landowners (Little, 1968). The OSAI described the concept of stewardship as being broader or more comprehensive than just the ancient husbandry of agricultural land, and called for a more profound land ethic that recognized the conservation of natural areas to preserve natural processes, as well as for recreation and amenity values (Little, 1965). The OSAI promoted landscape architect Ian McHarg's approach for assessing and prioritizing areas for preservation of natural processes and for determining which areas may be deemed unbuildable.

A 1965 model clustering ordinance of Hillsborough, NJ profiled in the 1968 OSAI report included the goals to: enhance public welfare; and preserve natural water courses, trees, hilltops and scenic views. The minimum quantity of open space required was 20% of the gross acreage. The quality of the open space was specified to exclude streets. The responsibility for maintenance of the open space could be assigned to the HOA, a local municipality, church, or school.

A 1967 model clustering ordinance of Yorktown, NY profiled in the OSAI report included the goals to: preserve the natural and scenic qualities of open space; encourage design flexibility; and to promote the cost effective provision of streets and utilities. The ordinance applied only to properties of 20 acres or more. The minimum quantity of open space required was approximately 50% of the developed land area based on a required area of open space to be set aside for each housing unit. The quality of the required open space area did not have to include any unbuildable lands. Responsibility for maintenance of the open space could be assigned to the HOA or a local municipality. The ordinance specifies that residential homes are to be served by approved community water supply and sanitary sewer systems. Site plans for proposed cluster developments were to be subject to public hearings (Little, 1968).

The 1969 publication *Design with Nature* written by Ian McHarg and funded by The Conservation Foundation in Washington DC, introduced a critical approach to the conservation of open space in suburban residential developments. McHarg advocated mandatory cluster zoning, and recommended the creation of a conservation trust to receive and manage open space. McHarg suggested that conservation and development needed to use map layers of physiographic characteristics of the landscape to guide development, including transparent overlays of topography, floodplains, soils, surface and groundwater, wildlife habitat, forests, woodlands, and historic buildings. McHarg proposed that these physiographic characteristics, together with social and economic goals for farmland preservation, recreation, aesthetics, etc., could be used as part of public policy to create appropriately located and productive land uses (McHarg, 1969).

Ian McHarg may well have made the 21st century's most significant contribution to the field of ecological planning (Ndubisi, 2002). The work of the Natural Lands Trust (NLT) to promote conservation subdivision development is an adaptation of McHarg's ecological principles (Arendt, 1997).

A 2002 Wisconsin model cluster development ordinance has a minimum quantity and quality of open space of 60% of the gross land area, excluding streets, railway, and utility rights of way. Configuration standards state that at least 75% of the open space must be undivided, and maximum connection with open space on adjacent lands in encouraged, with a minimum width of 30 feet and a minimum size of 10,000 square feet. This model cluster ordinance also stipulates that the developer and the municipality must agree on a plan for maintenance of the open space (SEWRPC, 2002).

A 2006 American Planning Association model cluster development ordinance has a minimum quantity and quality of open space of 25% of the gross land area, including at least half of the unbuildable land. This model ordinance also offers a density bonus of up to 25% for either the provision of affordable housing, or for conveying land to a local government for public access (APA, 2006).

A 2006 US EPA model ordinance for open space cluster developments defines them as density neutral, with a required minimum quantity and quality of open space of 35% to 50% of the buildable land. Excluded from the minimum required open space area are existing and utility rights of way. Half of the open space must be preserved as natural 'green space', with access limited to walking and biking paths covering no more than 2% of the green space. The remaining half of the open space can be used for passive or active

recreation or stormwater management. Impervious cover for active recreational uses must not exceed 5% of the recreational open space area. The configuration standards require at least 75% of the open space to be undivided, with a minimum width of 100 feet, and maximum connection with open space on adjacent lands is encouraged (US EPA, 2006).

As recently as 1992, NLT staff were still referring to a development with 50% of the total property preserved in open space as a cluster development (Arendt, 1992); and the National Association of Home Builders' website currently displays a definition for cluster developments that defines them as having a required minimum quantity and quality of open space of 30% to 80% of the project area.[1]

The definition of a cluster development appears to be changing as the primary emphasis of conservation has shifted from the preservation of open space for recreation, to preservation of open space for the protection of natural, cultural and historic resources. This change also reflects a change in recreation priorities from organized team sports to more solitary recreational activities like hiking, biking, and nature observation activities. As a result of this evolution over time, the guidelines and standards for the quantity, quality, configuration and management of the open space have also changed. This is reflected in the literature on cluster developments, as well as in recent model ordinances.

Table 1 below compares standards for the quantity, quality, configuration and management of open space specified in various model cluster subdivision ordinances. The different ratios of the required quantity and quality of open space vary significantly. There is also a lack of consistency regarding configuration and management standards.

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1 Retrieved May 9, 2008, from http://www.nahb.org/generic.aspx?sectionID=630&genericContentID=19088

Table 1

Quantity, Quality, Configuration and Management Standards for Open Space in Model Cluster Subdivision Ordinances

Model cluster ordinance & date adopted	Quantity % Minimum open space required	Quality % Buildable land required in open space	Quality Land uses excluded from calculation of minimum required open space	Configuration Undivided & connected with adjacent open space	Management Management plan required
1963 MD	3% - 12%	N/A	Parking areas & driveways. Maximum 50% of open space may consist of storm drainage areas.	Not required	Yes
1964 MO	N/A	15% - 30%	N/A	Not required	No
1965 NJ	20%	N/A	Streets	Not required	No
1967 NY	About 50% of land area used for house lots.	N/A	N/A	Not required	No
2002 WI	60%	N/A	Street, railway, & utility rights of way.	75% of open space must be undivided	Yes
2006 APA	25%	N/A	N/A	Undivided	No
2006 EPA	N/A	35% to 50%	Street & utility rights of way. Maximum 50% of open space may consist of storm drainage areas or recreation areas.	Connected & 75% of open space must be undivided	Yes

The ability for cluster developments to conserve land in an interconnected network of open space has remained largely unfulfilled (Arendt, 1997), as they have been designed mostly for aesthetic value and recreational opportunities (Pejchar, et al., 2007); and have been focused on clustering to increase density rather than on preservation of the "best" land (Kaplan, et al., 2004). Zoning ordinances used to create cluster developments have been underutilized (MAPC, 2000), and have been claimed to contain vague or excessive requirements such as municipal water and sewer connections, discretionary permitting processes, minimum parcel sizes, and rigid house lot frontage and setback requirements (Arendt, [Ed.], 1994). The absence of comprehensive standards for cluster developments has resulted in minimal quantities of open space preserved, consisting of unbuildable areas, unusable land between parking lots, stormwater retention basins, active recreation areas such as tennis courts (Arendt, 1996), and utility rights of way (Arendt, 1999). A lack of sufficient land area preserved, and or an excess of non-native vegetation cover, can undermine the conservation capacity of clustered housing developments (Nilon, et al., 1995 as cited in Pejchar, et al., 2007).

Cluster developments may be created with a higher conservation value if more rigorous ecological guidelines are employed (Lenth, Knight, & Gilgert, 2006). As noted in Table 1, the quantity and quality of open space required in model cluster subdivision ordinances is highly variable, and standards related to the configuration, management, and sustainability of open space are inconsistent, although in general all of the standards have become higher or more consistent over time. Inconsistent standards can result in the failure to achieve conservation goals for natural resource protection and sustainability.

New Urbanism: New urban developments, also known as neo-traditional neighborhoods, have been referred to as the urban counterparts to the more suburban conservation subdivisions (SIRCDI, 2006). New urbanism's more formal designs are most appropriate for metropolitan areas along transportation nodes, and conservation subdivisions are more suited to less developed areas without municipal water or sewers (Arendt, 1996). The Congress for the New Urbanism was founded in the US in 1993.[2] This new urbanism design movement was incorporated as a non-profit organization to reestablish the art of community making based on citizen participation, and to address various social and economic impacts of community design decisions (Godschalk, 2004).

New urban development designs are defined as having characteristics similar to those of open space cluster developments, conservation developments, and conservation subdivisions: clustering to allow for full density development; reduced lots sizes and street lengths relative to conventional developments; and the protection of historic buildings and hydrologically sensitive areas within the open space. New urbanism seeks to involve citizens in a participatory planning and design process to create 'livable' community spaces (Berke, MacDonald, White, Holmes, Line, Oury & Ryznar, 2003). New urban developments have been acclaimed as being sustainable and have also been criticized for failure to adequately address sustainability by reducing their environmental impact and ecological footprint (Beatley and Manning, 1997; Berke, et al., 2003). Ecological footprint is defined as the area of land and water required to support a specific human population (Wackernagel & Rees, 1996).

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2 Retrieved June 11, 2008, from http://www.cnu.org/history

New urbanists and those buying and selling homes in these developments have labeled them environmentally responsible, sustainable, affordable, diverse, and equitable. However, some have expressed concerns that these developments may be promoting ethics and values that can undermine landscape function and create an image of racial and class segregation. It has been argued that new urbanist developments are affluent enclaves that do not do enough to address social or sustainability objectives, and could do more to restore the environment, incorporate energy efficient buildings, and provide spaces for food production and affordable housing. The sustainability of new urbanist developments has also been questioned due to larger than average house sizes that make more demands on building materials and energy, and smaller lot sizes that limit the ability of residents to grow their own food or to provide wildlife habitat (Grant, 2006).

Smart Growth: Smart growth planning and policy seeks to combat sprawl through reforms in growth management legislation in order to provide flexible design standards needed to create more 'livable', high density developments that protect open space and reduce dependence on the automobile. Smart growth drew its name from Maryland's statewide growth management policy, including a 1997 Smart Growth Management Act. Definitions of smart growth planning and policy differ according to the various interest groups that use the term to promote their own goals. Environmental groups have defined smart growth in terms of open space protection, resource preservation, and environmental justice. Development-oriented interests have defined smart growth to emphasize flexible design standards, expedited project reviews, and incentives such as density bonuses.

Planners have defined smart growth in terms reduced infrastructure costs and reduced automobile dependence. Although considerable overlap exists among the definitions according to competing interest groups, conflicts will remain unless there is more agreement on a smart growth definition and implementation strategies (Godschalk, 2004).

Land use regulation has long been associated with racial discrimination and class based exclusion. Zoning in particular has long been used as a tool for segregation and exclusion. Zoning has permitted the siting of undesirable land uses in African American and Latino neighborhoods, and zoning can have inflationary effects that result in higher housing prices. African American and Hispanic residents bear a disproportionately heavy burden from land use regulations that result in higher housing prices, as most rent their housing, and have lower incomes. Local governments adopting smart growth zoning must contend with this legacy, and may need to take steps to protect against gentrification and the displacement of minority residents (Pendall, Nelson, Dawkins, & Knaap, 2005). Smart growth advocates and planners should play a major role in the creation of new domestic policy that is driven by values of fairness and stewardship (Farmer, 2007).

Conservation Developments: Conservation development combines revenue generating land development with the functional protection of conservation resources. Conservation development projects are estimated to account for approximately 10% of private land conservation in the US and can include protection of biodiversity, ecosystem services, agricultural lands, historic and cultural resources, recreation areas and scenic landscapes. A critical conservation goal for conservation developments is to reduce offsite impacts

and minimize harm to surrounding landscapes through stormwater management practices, maintaining native vegetation and riparian buffers, and by limiting impervious surfaces and disturbance vectors including household pets and light pollution (Milder, 2007). Some have argued that the protection and restoration of native species is 'key' to adding ecological value in conservation developments, and that conservation goals will not be achieved unless conservation developments are designed to both protect and restore biodiversity and ecosystem services (Pejchar, et al., 2007).

A definition of conservation development has been proposed to include scientific assessments of a property's ecologically important assets to be protected and restored, ongoing stewardship of conservation land, equal or lower housing density relative to a region's conventional development, and provisions for the regional connectivity of conservation lands. Additionally, it has been suggested that conservation development regulations should identify a minimum ratio of conservation land to developed land.

The term conservation development includes 'conservation subdivisions'; and 'conservation-oriented planned development projects' which are large, master-planned communities that have 10 – 50% or more of their land set aside as conservation land and which may contain commercial businesses and a range of housing types (Milder, 2007). Although conservation-oriented planned development projects are beyond the scope of this study, these conservation developments include related design and development innovations like new urban developments and smart growth planning and policy principles that have been evaluated in the literature and which can provide insight into the typology and standards used to describe, design and permit conservation developments.

Conservation Subdivisions: Conservation subdivisions include similar conservation protection areas as do other conservation developments: critical wildlife habitat; mature woodlands; natural meadows; prime farmland; land with historical, cultural, or archaeological significance; and land configured in networks of interconnected open space (Arendt, 1999). The NLT, a non-profit conservation organization created in 1961 and located in Media, PA, began providing professional planning assistance to landowners in the late 1970's and to communities in the late 1980's. The concept of conservation subdivisions grew out of their work with municipalities to institutionalize land protection standards into municipal land use ordinances. The concept of conservation subdivision design involves using open space as the central organizing element in the design process for subdivisions by using base maps of resources including soils, slopes, vegetation, wetlands, floodplains, wildlife habitat, historic and cultural sites, etc., and additional elemental principles related to the physical layout of neighborhoods to create gathering spaces for social interaction (Arendt, 1996).

According to Randall Arendt, the person to whom coining of the term 'conservation subdivision design' is credited (MAPC, 2000); cluster ordinances typically require that 25 to 30% of a parcel be set aside as open space. However, conservation subdivision design "…sets much higher standards for the quantity, quality and configuration of the resulting open space." (Arendt, 1999, p. 148). In its purest form, conservation subdivision design designates a quantity and quality of 50% or more of the 'buildable' land as undivided open space (Arendt, 1996). A more recent design handbook for conservation subdivisions specifies that 40% to 60% of the buildable area is typically

required to be open space (SIRCDI, 2006). Others have defined the quantity of open space within a conservation subdivision as being 40% or more of a total parcel (Haines, 2002); or 50% or more of a parcel (Tibbetts, 1998; Williams, 2007), or a mix of quantity and quality of open space within the same publication, including 50% or more of the total land area, or 40% to 70% of the 'buildable land' (UCCES & NLT, 1999).

Conservation subdivisions have been described as being designed to achieve 'full density' or equal housing density as a region's conventional development. However, some conservation subdivision ordinances may include a 'density bonus' option which allows for additional homes to be built beyond the number in the local zoning ordinances as an economic incentive for developers to provide public services, such as affordable housing, public access to recreational facilities or trail networks, and to generate funds for endowments to provide for the ongoing maintenance of open space (Arendt, 1999).

A density bonus option is offered by one municipality mentioned in the literature that rewards developers who design 'single-loaded' streets to create special 'viewscapes' (Arendt, 1996). A 1999 NLT model ordinance offers a maximum of a 30% density bonus for conservation subdivisions that meet multiple density bonus objectives (Arendt, 1999). According to one source, conservation subdivisions can be built at up to 200% of the maximum housing density allowed by zoning (Milder, et al., 2008). Another source has specified that the 200% density bonus is not applicable to conservation subdivisions, but to higher density zones found in traditional neighborhood developments (Arendt, 1999). Traditional neighborhoods contain commercial businesses, as well as a range of housing types, with distinct zoning and design standards that are beyond the scope of this thesis.

According to Randall Arendt, conservation subdivisions can provide municipalities with the most cost effective way to conserve natural and other resources, greater influence over the character of subdivision development, and reduced demand on local governments to provide public open space. Additional benefits of conservation subdivisions include: lower development costs due to shorter street and utility runs, reduced size and cost of stormwater management facilities, and reduced costs for infrastructure maintenance (Arendt, 1999). Marketing and sales advantages have been noted due to the increased access to open space, as well as a greater appreciation rate for the homes. Developers have realized greater profits on conservation subdivisions than on conventional developments (Mohamed, 2006). Conservation subdivisions are recognized for their ability to preserve rural character and foster a sense of community (Ohm, 2000).

Some limitations of conservation subdivisions are noted in the literature, including the argument that they are not appropriate for all sites or all communities, and that they are perceived as being exclusive, targeted primarily at the higher end segment of the market, and contradictory to affordable housing policy. Some municipalities may be reluctant to develop ordinances conducive to conservation design without interest from developers, and developers may be unfamiliar with the design process and uncertain about the length of the permitting process. There is also concern that the amount of land conserved may be too small for some types of commercial agriculture, and that residents of these new developments may not accept the potential disturbance from noise, odors, dust or chemicals associated with large scale modern agriculture (SIRCDI, 2006). Conservation subdivisions may not reduce dependence on automobiles (Haines, 2002).

Conservation Design: Clear ordinance standards are essential in guiding development design so that the community's conservation priorities will be understood (Arendt, 1999, in Charles J. Kilbert. Ed.). The conservation design approach developed by the NTL results in the preservation of a higher percentage of land and a higher quality of open space than is provided for in typical cluster codes (Arendt, 1999). According to Arendt, "In contrast to the methods used in laying out conventional plans, *the process of designing conservation subdivisions begins by prioritizing the site features most worthy of protection and designing development areas around them.*" (Arendt, 1996, p. 106).

According to the NLT, the first and most important step in the conservation design process is the identification of the areas that are to be conserved (Arendt, 1996). This is done by producing a context map, which is a map showing the natural resource features located on adjoining lands and those features which cross property boundaries. Context maps can vary in scale depending on the size of the parcel. The second step is producing an analysis map of the existing resources on the site selected for a conservation subdivision. The analysis map includes 'primary conservation areas' that are areas which are deemed unbuildable due to wetlands, floodplains, steep slopes, and habitats for threatened or endangered species of wildlife. The analysis map also includes 'secondary conservation areas', that are buildable areas of a site which have natural, cultural, historic or scenic features deemed to be worthy of protection, such as mature woodlands, prime agricultural soils, and other areas which have been prioritized for preservation in a municipality's comprehensive plan.

Specific resource maps are proposed for use in the creation of the site context map and the existing resources map for the design of conservation subdivisions, including: floodplain maps from the Federal Emergency Management Agency; soils maps and aerial photographs from the USDA's Natural Resource Conservation Service; topographic maps from the US Geological Survey; National Wetlands Inventory maps from the US Fish and Wildlife Service; state Natural Diversity Inventory maps; and lists of historic sites published in the National Register of Historic Places.

Information layers from various resource maps are then integrated onto overlay sheets for the preparation of a final composite map of all the existing resources onsite. This map is used to tentatively demarcate the desired quantity of contiguous open space. The second step is the selection of house sites from the remaining buildable area. The third step is demarcating the streets and trails, and the fourth step is drawing the lot lines.

Additional procedural steps have been recommended for incorporation into conservation subdivision ordinances, including a pre-application meeting with municipal planning agency staff to discuss development objectives, standards, and the conservation subdivision application and permitting process. A site visit to walk the land with planning agency staff is another recommended step, as well the submission of an initial sketch plan showing general locations of the proposed development and conservation areas, followed by the design of a conceptual preliminary plan with general dimensions and locations. The opportunity for submission of a sketch plan provides a basis for communication and discussion with planning agency staff before large amounts of money are spent on engineering documents for a more detailed preliminary plan. It has been suggested that

subdivision ordinances be amended to include submission of existing resources maps, a pre-sketch conference and site visit with planning agency staff, initial sketch plans, the four step conservation design approach as noted above, and conservation subdivision standards for the quantity, quality and configuration of open space (Arendt, 1999).

The benefits of conservation design have been identified as falling into the following three categories: environmental and biodiversity benefits, economic benefits, and quality of life benefits – public spaces where residents can connect with nature and interact to build community (NIPCCW, 2003). Conservation subdivisions can protect water quality through the maintenance of buffers to waterways, best management practices for runoff water, shared stormwater management systems, shared drinking water systems, shared sewage systems, and reduced impervious surfaces used for roads and driveways (Ohm, 2000); and can thus provide for greater aquifer recharge, more environmentally sensitive onsite sewage treatment and disposal systems (MAPC, 2000), and the preservation of contiguous open space that is part of a regional, interconnected network of conservation lands for wildlife management (Arendt, 1999).

Management: Management obligations and responsibilities for residents of conservation subdivisions differ from residents of conventional subdivisions (Austin & Kaplan, 2003). Management decisions that can influence the conservation value of conservation subdivisions include the reduction of: the use of lawn chemicals (Austin & Kaplan, 2003; Bergstedt, Deyo, & Yungwirth, 1999; Thompson, 2004); disturbance vectors including domestic animals (Lenth, et al., 2006; Milder, 2007; Thompson, 2004), light pollution

(Milder, 2007): and human traffic via establishing trails (Lenth, et al., 2006). Other management decisions that may be addressed in the management plans for conservation subdivisions include active restoration of riparian areas, aquatic habitats, and native vegetation (Arendt, 1999), and the control of invasive species, restoration of historical natural processes such as grazing and fire (Lenth, et al., 2006; Thompson, 2004).

Misuse of open space may result in a loss of potential environmental benefits including the provision of habitat and reduction of stormwater runoff (Mohamed, 2006). Concern has been expressed about whether HOA's may have the required skills, knowledge, and appropriate management goals to effectively manage conservation land; and partnerships with natural resource professionals have been recommended (Austin & Kaplan, 2003; Milder, 2007; Thompson, 2004), as well as the incorporation of specific language into HOA's bylaws for natural areas management of (Austin & Kaplan, 2003). It has been suggested that municipal ordinances should be amended to require the submission of open space management plans (Arendt, 1996).

Thompson cites the work of economist Alfred Khan (1966) to argue that the conventional management of lawns results in a 'tyranny of small decisions' where the decisions of many individuals can have a result that is cumulatively less than optimal, and cites the work of Garrett Hardin (1968) to argue that such widespread irresponsible behavior results in a 'tragedy of the commons' where doing the 'right thing' can seem pointless (Thompson, 2004). Although it has been claimed that residents of conservation subdivisions are ill equipped for responsible management, their decisions will affect the success of these developments.

Land use planners and designers argue that people need education about the ecology of places where they live; but even if such education can change residents' attitudes, it does not often result in a change behavior. In order to create a land ethic, several barriers must be overcome before residents of green developments adopt more ecologically responsible behavior patterns. Residents need to have the knowledge to be able recognize environmental problems and overcome internal and external barriers, such as social pressure and incorrect cultural models, and real or perceived inconveniences. This requires both education and the fostering of environmentally friendly social norms.

The Prairie Crossing conservation development is cited as a successful model. Educational materials provided to residents by the developer are considered to be practical and geared towards use by homeowners, and because the site design and development guidelines help to make residents aware of the environmental impacts of their management decisions and create an ecological cultural model for the community. A cultural model has been created resulting in residents sharing experiences, seeds, and helping each other overcome concerns that such management may be too difficult.

The stormwater drainage system routes water above ground through the development and into a lake which is to be managed to remain 'swimable' and fishable. The residents can see directly how over-fertilization with lawn chemicals results in algae blooms in the lake and how it detracts from the ecosystem services that the lake provides. Additionally, the developer has established a large native prairie in the open space, and residents are required to maintain a minimum of 20% of their own lot landscapes in native prairie plantings, with assistance provided by the developer (Thompson, 2004).

Sustainability: The concept of sustainability involves the integration of environmental, economic, and social objectives, and is emerging as an important organizing theme in community planning (Hanna, 2005). Although it has been stated that few authors have begun to apply sustainable development principles to planning policies and regulations, it has been recognized as a priority for planning. Sustainable development enables residents to meet their subsistence needs for shelter, participation, security and a clean environment (Grant & Manuel, 1999). Sustainability is also equated with reducing the environmental impact and ecological footprint of residential developments (Godschalk, 2004). The land use policy implications of sustainability are tremendous and suggest substantial changes in management practices, reductions in the exploitation of natural resources such as soil and water, and a strong need for developing renewable energy sources (Beatley, 1994).

Conservation subdivisions are recognized as contributing to sustainability by protecting natural resources, reducing impervious surfaces, and by reducing individual septic systems (MPEQB, 2000). Conservation design has been recognized as a tool for implementing sustainable development practices such as sustainable stormwater management techniques. It has been suggested that more sustainable site design would be possible through conservation design if parking codes were updated to establish maximum ratios for impermeable parking spaces. Parking lots are sometimes oversized as a result of municipal parking codes, making them more expensive to build and maintain and resulting in more impervious cover, increased runoff of stormwater, and decreased groundwater recharge (NIPCCW, 2003).

In addition to maintaining landscape structure and function, there is a need to adopt planning principles that address social equity aspects of sustainable development such as the inclusion of affordable housing, and economic viability aspects such as onsite employment. Some argue that sustainable communities should limit not only impermeable surfaces, but also imports of energy, water and food; and suggest that sustainable planning policies could encourage affordable housing, energy efficient design, alternative energy, and encourage people to walk, bike, and use mass transit. Local municipal planning offers possibilities for moving away from unsustainable lifestyles by changing patterns of land use, transportation, and resource consumption through increased density and less auto and resource dependence. These sustainable design approaches can be greatly enhanced by changes in individual behavior such as through local -vs- global consumption and by driving less (Wackernagel & Rees, 1996).

Long-term sustainability requires that landscapes remain productive, with a large proportion of residents working at or near their homes (Grant & Manuel, 1999).

Enhancing sustainability involves the development of both local food and energy production systems within the community (Van der Ryn & Calthorpe, 1986). Suburban landscapes have been criticized as being unproductive and inefficient because they fail to include onsite food and fuel production, thereby wasting energy used in transportation. Although these unproductive conventional suburban landscapes require about the same amount of homeowner labor to maintain, they require production of food and fuel offsite.

An added advantage of neighborhood food and fuel production is that these crops can be arranged in a more diverse and healthy ecological balance than large-scale mono-

crop agriculture, making it possible to avoid the use of expensive and environmentally destructive pesticides (Corbett & Corbett, 2000). Sustainability can also be enhanced through the recycling of waste and waste water for the production of fruit trees along streets as well as for vegetable production (Van der Ryn & Calthorpe, 1986). Failure to compost food waste onsite deprives farmers and households of a valuable organic fertilizer and results in offsite disposal, which can make offsite landfill areas 12-15% larger in size (Pothukuchi & Kaufman, 2000).

There are numerous examples of conservation subdivisions that have been designed to incorporate food and or fuel production, such as Farmcolony developed in the mid 1970's in VA (Arendt, 1999); GreenWay currently under development in NC,[3] and Troy Gardens in Madison, WI, developed in 2006-2007.[4] Troy Gardens also includes affordable housing (Campbell & Salus, 2003).

Local housing policy influences the availability of affordable rentals within neighborhoods. The US has been experiencing segregation by income as the result of the development of gated communities that exclude affordable housing. Some authors have advocated mandatory inclusion of affordable housing in new developments at a ratio of one affordable house or rental unit for every ten built and sold at prices above those deemed affordable. This one-in-ten approach is becoming popular, and has the advantage of providing role models and a social support system for low income residents while at the same time mitigating against social isolation of the wealthy. Such affordable housing

3 Retrieved June 20, 2008, from http://www.greenwaynews.com/
4 Retrieved June 20, 2008, from http://www.troygardens.net/team.html

mandates are typically rejected by developers and middle-class HOA's, but such spatial equity is the foundation for responsible planning (Duany, Plater-Zyberk, & Speck, 2000).

Another approach to increase affordable housing is to provide developers with a density bonus for including affordable housing. It has been suggested that the best way to encourage municipalities to create ordinances that ensure affordable housing is to make the receipt of federal transportation funding contingent upon the recipient municipalities adopting 'inclusionary housing ordinances' that mandate or offer a density bonus to provide affordable housing (Leinberger, 2008). The adoption of an agenda of sustainable places by the planning field "...represents both an evolution in the spirit of growth management and an expansion of the subjects of concern." (Beatley & Manning, 1997, p. 19). There is also a close link between concepts of sustainability and ethical land use obligations to future generations (Beatley & Manning, 1997).

Ethical Land Use: Ethical land use has been defined as "…the study of the ethical and moral bases of actions and policies intended to influence the use and management of land and land resources." (Beatley, 1994, p. 11). It has been argued that public land use policy and planning decisions involve an ethical or moral choice, because the allocation of land for different uses has tremendous environmental and social impacts. The impacts range from ozone and CO2 pollution related to undue reliance on automobiles to economic segregation and social isolation of different social and economic groups (Beatley, 1994). Aldo Leopold has been credited with being the first to propose an ethic governing people's relationship with the land and its animals, plants, soil and waters (Arendt, 1996).

A land use ethic involves consideration of characteristics of the land as well as ecological limits related to the management of land (Beatley, 1994). Land use ethics limit individual actions that could cause long-term environmental damage (Arendt, 1996; Beatley, 1994).

The concept of a land use ethic represents an expansion of the moral community that an individual is obligated to, from individual responsibilities to other individuals and society, as is characterized by institutions for democratic self-governance (Arendt, 1996), to a relevant moral community that is biological, temporal, and geographical in scope. Ethical land use involves consideration of moral obligations to minimize harm to human and non-human communities, present as well as future generations, and local as well as distant geographical communities that could be adversely affected by land use decisions.

The following questions related to land use have been posed for consideration of ethical obligations: Does a homebuyer have a moral obligation to conduct research in order to determine whether a home was constructed at the expense of an irreplaceable ecosystem, or in a way that disrupted or destroyed the function of ecosystem services that could result in harm to others, such as by filling in a floodplain and displacing floodwaters elsewhere? Does a homebuyer have a moral obligation to seek a residence in a racially and economically balanced community? Should the developer of a site with a large, pristine wetland area have a responsibility to minimize impacts to the wetlands by clustering development on upland areas of a site if the failure to do so would result in harm to others through displacing floodwaters, unabated pollution, or harm to aquatic resources and the livelihoods of those harvesting them? (Beatley, 1994).

Equity and social justice issues are receiving considerable attention in planning. According to the American Institute of Certified Planners (AICP) Code: "A planner must strive to expand choice and opportunity for all persons, recognizing a special responsibility to plan for the needs of disadvantaged groups and persons, and must urge the alteration of policies, and decisions which oppose such needs" (AICP, 1989, p.1, as cited in Beatley, 1994, p. 8). Values and goals related to land stewardship ethics and sustainability are a recurring theme in the recent history of the land use planning field in general, and more specifically in smart growth planning, new urbanism, conservation subdivisions, and in the municipal ordinances that influence their development.

Model Conservation Subdivision Ordinances: Several model ordinances have been developed for conservation subdivisions based on initial model ordinances produced by the NLT. Each of these model ordinances has unique goals and standards related to the quantity, quality, configuration and management of open space to meet conservation objectives in conservation subdivisions. Some model ordinances also contain social objectives for sustainability that are beyond the preservation of ecosystem services, such as goals for providing affordable housing, public access, and or endowments for long term management of open space easements. Several model ordinances for conservation subdivisions are discussed below. Information on model conservation subdivision ordinance standards for the quantity, quality, configuration and management of open space, and for sustainability, is summarized in Table 2 and Table 3 below.

The NLT model ordinances propose a minimum of 50% of the buildable land be set aside as open space. Excluded from this open space is land within parking areas, surface utility rights of way, and the 10% of the buildable area that would normally be dedicated to street rights of way. Surface storm drainage or sewage treatment areas may not count towards open space unless useable for recreation (Arendt, 1996; Arendt, 1999). According to the 1996 NLT model ordinance, the amount of land that may be dedicated to active recreation areas such as ball fields, tennis courts, fairways, etc. has been proposed to comprise no more than 50% of a parcel's open space area (Arendt, 1996). The 1999 NLT model ordinance standards limit active recreation areas to no more than 50% of a parcel's open space or five acres, whichever area is less, but golf courses may comprise up to 50% of the open space (Arendt, 1999). The two NLT model conservation subdivision ordinances stipulate that the configuration of open space shall be undivided, and where possible, connected with open space on adjoining lands. On sites where the open space is divided into separate parcels, no parcel shall be less that 3 acres in size or have a length-to-width ratio greater than 4:1 (Arendt, 1996; Arendt, 1999), or generally have a width less than 75 feet (Arendt, 1999).

The NLT has prepared a maintenance and operations plan for the management of open space in conservation subdivisions that developers may use as a model for land stewardship to satisfy potential municipal requirements for such a plan. It has been suggested that municipal ordinances should be amended to require the submission of open space management plans that establish management objectives, define maintenance responsibilities, and outline management procedures (Arendt, 1996).

A 1996 NLT model ordinance does not require that a specific open space management plan be submitted, but does require the submission of a 'narrative' describing open space use and maintenance responsibilities. The ordinance requires the open space to be managed by a responsible party and states that the responsible party may levy fees for this purpose (Arendt, 1996). A 1999 NLT model ordinance requires that an operation and maintenance plan be submitted at the time a preliminary development plan is submitted. The ordinance states that the plan may be based on a model operation and maintenance plan prepared by the NLT (Arendt, 1999).

The two NLT model conservation subdivision ordinances offer a density bonus for the provision of affordable housing to families with earnings near the county median income level, in the amount of one additional lot or housing unit for each affordable housing unit constructed, either onsite or offsite. Additional density bonuses are available for developments that provide a maintenance endowment or public access beyond that which may be required by the municipality. Combined density bonus options may provide developers a maximum dwelling unit increase of 15% (Arendt, 1996; Arendt, 1999). The 1996 NLT model ordinance states that a municipality may require up to 10% of the total parcel area to be dedicated for public access trail systems through the open space (Arendt, 1996).

A 2000 Massachusetts model conservation subdivision ordinance states that 50% of the total parcel shall be designated as open space, as long as the area of wetlands within the open space does not exceed the percent of the total parcel that is wetlands. Configuration of the open space shall be 'connected', but this may be waived the

discretion of the county planning board. The ordinance does not require a management plan for open space to be submitted, but states that owners must make provisions for the long term protection of the open space, and should adopt open space operation and maintenance plans. The ordinance states that possible goals for conservation subdivision developments can include diversified housing stock and affordable housing for both low and moderate income residents. The ordinance offers a housing density bonus of up to 25% for additional open space preserved beyond the required minimum (5% for each additional 10% open space set aside), a density bonus of up 10% for providing housing for senior citizens (55 years and older) in the amount of one additional unit for every two units provided, and a density bonus of up to 10% for providing affordable housing in the amount of one additional unit for every two units provided (MAPC, 2000).

A 2000 Minnesota model conservation subdivision ordinance states that 50% of the total parcel shall be designated as open space, but only 50% of that open space may consist of wetlands or floodplains. Configuration requirements specify that open space shall be undivided, and where possible, connected with open space on adjoining lands. The ordinance does not require an open space management plan to be submitted, but management plans are to be discussed at the pre-application meeting with the zoning administrator, and developers must submit a conservation easement that specifies any entities responsible for open space maintenance that includes maintenance standards. Driveways in excess of 10 feet must be permeable, and streets may be paved with permeable paving. Adjacent or abutting public trail systems shall be connected through the conservation subdivision in order to provide for public access (MPEQB, 2000).

A 2000 Wisconsin model ordinance for conservation subdivisions has a minimum quantity and quality of open space of 60% of the total parcel, but only 50% of the open space may consist of wetlands or floodplains. Road rights of way are excluded from the open space. Configuration requirements specify that natural habitat portions of the open space shall be kept as intact as possible, and connect with open space on adjoining lands. The model ordinance does not require that an open space management plan be submitted. However, there is a requirement for the open space to be managed consistent with its intended purposes. The ordinance has a goal to accommodate a variety of income and age groups, and offers a density bonus of up to 20%, at a rate of a 5% density bonus for each, for the provision of one or more of the following public policy objectives: affordable housing (25% of all units must be affordable to qualify), providing for public access to open space or recreational facilities, creating an endowment sufficient to cover open space maintenance costs, and for reusing historic buildings (Ohm, 2000).

A 2001 Georgia model conservation subdivision ordinance specifies a minimum quantity and quality of open space of 40% of the total parcel, and at least 25% of the open space must be comprised of buildable land. Unbuildable land that must be included in the open space is defined as wetlands, lands within the 100 year floodplain, and slopes greater than 25% (of at least 5000 contiguous square feet), archaeological sites, cemeteries, 75 foot wide riparian zones along waterways, and habitats of threatened or endangered species. Above ground utility easements, street rights of way, and active recreation areas (ball fields and golf courses) are excluded from the required open space calculation. Active recreation areas are limited to no more than 10% of the open space.

Active recreation areas as well as stormwater and sewage treatment facilities may not be located within primary conservation areas. Paths in the open space must not be paved. The ordinance does not offer a specific density bonus option, but it does allow the developer to base density on a conventional yield plan calculation that does not exclude unbuildable areas, which the model ordinance contends can sometimes result in a defacto density bonus relative to some developments that must exclude unbuildable lands in the conventional yield plan calculation. At least 75% of the open space must be contiguous, and it should be oriented to connect with open space on adjacent lands. This model ordinance requires that a detailed operation and maintenance plan be submitted by the developer prior to approval of a land disturbance permit (Wenger & Fowler, 2001).

A 2004 New Jersey model conservation subdivision ordinance specifies a minimum quantity and quality of open space of 50% of the total parcel, with active recreation areas such as golf courses excluded from the calculation of the minimum required open space. Open space may not be located within individual residential lots. The ordinance states that conservation subdivisions must be density neutral, and therefore no density bonus options are offered. The ordinance has a definition of primary conservation areas that consists of unbuildable land including wetlands, water bodies, floodplains, and ‘steep slopes’. Configuration requirements specify that at least 75% of the open space must be contiguous, the open space may not be divided into more than three separate areas, and it shall be oriented to connect with open space on adjacent lands. This model ordinance requires a detailed operation and maintenance plan to be submitted by the developer prior to approval of a preliminary development plan (NJPC, 2004).

A comparison of the various model ordinances reveals that although NLT staff was responsible for coining the term ‘conservation subdivision’, and for setting the initial high standards for the quantity, quality, configuration and management of open space, subsequent model ordinances have in general proposed to their respective municipalities the adoption of lower standards for the quantity, quality, configuration and management of open space, as evidenced by the data outlined in tables below.

Table 2 compares the quantity and quality standards specified in various model conservation subdivision ordinances. The NLT quantity and quality standards are slightly higher than other model ordinances. Although the general minimum quantity of open space area required to be set aside is relatively consistent, other model ordinances require the preservation of less buildable land, and less unbuildable land within primary conservation areas which generally consist of wetlands, water bodies and waterways, land within the 100 year floodplain and steep slopes in excess of 25%.

Table 3 compares configuration, management and sustainability standards specified in various model conservation subdivision development ordinances. The NLT configuration standards and the more recent NTL management plan standards are only slightly higher that other model ordinances. There is also a lack of consistency regarding the types of land uses to be excluded from the minimum open space calculation. Only two other model ordinances, MA and WI, have adopted density bonus options for affordable housing, similar to those initially proposed by the NLT, which address this social equity objective of sustainable development.

Table 2

Quantity and Quality Standards for Open Space in Model Conservation Subdivision Ordinances

Model conservation subdivision ordinance & date adopted	Quantity % Minimum open space required	Quality % Buildable land required in open space	Quality % Unbuildable land to be included in open space	Quality Land uses excluded from calculation of minimum required open space area	Quality % Open space that may be unbuildable land
NLT, 1996	N/A	50%	100%	Parking areas, surface utility & street rights of way. Maximum 50% of open space may be active recreation areas.	N/A
NLT, 1999	N/A	50%	100%	Parking areas, surface utility & street rights of way. Maximum 50% of open space may be active recreation areas. [or max. of 5 acres]).	N/A
MA, 2000	50%	N/A	50%	Wetlands exceeding % of total wetlands.	N/A
MN, 2000	50%	N/A	N/A	50% of wetlands or floodplains.	50%
WI, 2000	50%	N/A	N/A	Street rights of way. 50% of wetlands or floodplains.	50%
GA, 2001	40%	25%	100%	Surface utility & street rights of way. Active recreation areas.	75%
NJ, 2004	50%	N/A	N/A	Active recreation areas.	N/A

Table 3

Configuration, Management, and Sustainability Standards in Model Conservation Subdivision Ordinances

Model conservation subdivision ordinance & date adopted	Configuration Undivided & connected with adjacent open space	Management Management plan required	Sustainability Sustainability standards
NLT, 1996	Yes	Partial	Density bonus for: affordable housing (on or offsite); maintenance endowment; & public access. Additional public access trail provision.
NLT, 1999	Yes	Yes	Density bonus for: affordable housing (on or offsite); maintenance endowment; & public access.
MA, 2000	Yes	Recommended	Density bonus for: affordable housing & senior housing.
MN, 2000	Yes	Partial	Driveways exceeding 10 feet in length must be permeable; streets may use permeable paving. Public access trail provision.
WI, 2000	Yes	Partial	Density bonus for affordable housing.
GA, 2001	75% of open space must be undivided. Connectivity goal.	Yes	Limits on paving of paths in open space.
NJ, 2004	75% of open space must be undivided. Connectivity goal.	Yes	N/A

The change in terminology from cluster developments to conservation subdivisions reflects a change in planning goals and standards for the quantity, quality, configuration and management of open space. Cluster developments, conservation developments, conservation subdivisions, and smart growth have all experienced conflicting or confusing definitions and terminology.

For example, Milder's definition of conservation developments includes conservation subdivisions, which he has indicated can have up to a 200% density increase over conventional developments in the same zoning district (Milder, 2007). However, others have proposed a definition for conservation developments which specifies that these developments have equal or lower housing density than a region's conventional development (Pejchar, et al., 2007). A conservation development or a conservation subdivision can be considered a cluster development, but a cluster development may not meet the definition of a conservation subdivision in regard to the generally higher standards set for the quantity, quality, configuration and management of the open space. Not all conservation subdivisions may be considered conservation developments if one accepts the definition proposed by Pejchar, et al., (2007), which implies that conservation developments must be density neutral. Milder defines conservation subdivisions as having a density at or near that allowed by local zoning codes, and he categorizes two other distinct forms of conservation developments that are not conservation subdivisions: one substantially less dense than allowed by zoning 'conservation and limited development projects', and one built at a substantially higher density than conservation subdivisions 'conservation oriented planned development projects' (Milder, 2007).

The 1964 ACA report titled *Cluster Development*, which exemplified early cluster developments and ordinance language, did not acknowledge the potential for cluster developments to be built at higher than conventional municipal zoning densities, opportunities to use the open space for sewage treatment and disposal, land trust ownership of open space, or individual ownership of open space in 'conservancy lots'. The quantity and quality of open space designated in the ACA report's model ordinances for cluster developments varied widely, from a minimum of 20,000 square feet or 3% of the gross acreage to a minimum of 30% of the buildable land. A distinction made at the time, as exemplified in the ordinance for St. Louis, MO, that the quality of land to be preserved should not include unbuildable land, has been incorporated into more recent model subdivision ordinances and design guidelines for conservation subdivisions. Active recreational facilities such as swimming pools or golf courses were allowed to be included, in their entirety, in the calculation of required open space, which is not the case for some modern conservation subdivisions according to examples from the literature. The configuration of open space either onsite or in relation to adjacent lands was not addressed by the model ordinances profiled in the ACA report.

The amount of land within the open space of a conservation subdivision that may be dedicated to active recreation areas such as ball fields, tennis courts, and golf courses has been proposed to comprise up to half of a parcel's open space (Arendt, 1996). However, the 1999 NLT model zoning ordinance standards limit active recreation areas to no more than half of a parcel's open space or five acres, whichever area is less, but golf courses may comprise up to half of the open space (Arendt, 1999). Some model

ordinances for conservation subdivisions do not have restrictions on the amount or ratio of open space that may be dedicated to active recreation (MAPC, 2000; MPEQB, 2000; Ohm, 2000). Other model conservation subdivision ordinances exclude active recreation areas from the minimum required open space (NJPC, 2004; Wenger & Fowler, 2001).

According to various authors, the quantity and quality of land to be preserved in conservation subdivisions has been stated to range from a minimum of 40% or more of a total development parcel (Haines, 2002), to 50% of the buildable acreage (Arendt, 1996). Model ordinances for conservation subdivisions have similarly variable definitions for the quantity and quality of land to be preserved as do those found in the literature, ranging from a minimum of 40% of the total parcel, with only 25% of the open space consisting of unbuildable lands and other primary conservation areas (Wenger & Fowler, 2001), to a minimum of 50% of the buildable land, after excluding 10% of the buildable area that is normally dedicated to street rights of way (Arendt 1996; Arendt 1999).

One important distinction that can address some inconsistencies in the way standards for the quantity and quality of open space are communicated within and between various articles on the subject of conservation subdivisions is that a minimum open space requirement of 50% of the buildable land can become 40% of the buildable land after a building density bonus is awarded which is achieved through utilization of 10% of the open space. Therefore, one can see how these two figures can be used interchangeably by different authors to describe the quantity and quality of open space. Furthermore, a generalization can be made of such developments to state that they commonly preserve from 40% to 60% of the gross parcel acreage. All of this can be

correctly stated based on a single standard. However, the minimum quantity of land to be preserved in conservation subdivisions may seem ambiguous to those unfamiliar with the standards or the way that density bonuses may be subtracted from the open space.

Management decisions by homeowners can influence conservation goals and the conservation value of conservation subdivisions. Management plans were not required by the model ordinances in the ACA report, other than a requirement that current and future residents be informed of their respective management obligations. Onsite stormwater management, public participation and democratic self governance were recognized as potential benefits of cluster development, but the early cluster developments and model ordinances profiled in the ACA report were not promoted as being sustainable.

Although modern, model cluster development ordinances have begun to incorporate higher standards for quantity, quality, configuration, management, and sustainability of open space and developed areas within conservation subdivisions, they are neither as high nor as consistent as model ordinances for conservation subdivisions. However, because the model ordinances for conservation subdivisions themselves are inconsistent, there is a need to analyze and discuss the differences between the multiple approaches and standards used in order to better understand how these various standards and approaches can influence conservation goals. Additionally, because planning policies and regulations in general and model conservation subdivision ordinances in particular have only begun to consistently and comprehensively apply the broader economic and social objectives of sustainable development principles, there is a critical gap in the policy and planning literature that can be partially addressed by this thesis.

CHAPTER 3: RESEARCH METHODOLOGY

Using a case study approach; this thesis analyzed three conservation subdivisions and their respective municipal subdivision ordinances that have not been discussed in detail in the peer-reviewed academic literature or practitioner publications. These case studies and subdivision ordinances were reviewed in order to gain insight into how the standards and design approaches for new conservation subdivisions can influence the goals of natural resource conservation and sustainability. Each case study site and ordinance has unique approaches and standards which can provide examples that can be analyzed in order to inform future policy and planning to meet resource conservation and sustainability goals.

The case studies of new conservation subdivisions and their respective municipal subdivision ordinances were analyzed according to criteria derived from the literature in order to compare how they have addressed the quantity, quality, configuration and management of open space, and how these various approaches and standards can influence the conservation goals of natural resource preservation and sustainability.

Selection criteria were used to ensure that each site could meet a common definition for conservation subdivisions. Each site had to have at least 50% of the total parcel area dedicated to open space, which represents an average of the amounts cited in the literature (Arendt, 1999; Haines, 2002; Ohm, 2000; Williams, 2007). The total parcel area dedicated to open space is a ratio that was readily obtainable for the selection of case study sites, unlike the actual percentage land defined as ‘buildable’ for each location, which was not readily obtainable from the site developers or planning agency staff.

Representatives of the developers and planning staff from the municipalities of each of the selected case study sites were contacted in order to obtain the primary data. Specifically, the data used for analysis of the case study sites included their respective: zoning and subdivision ordinances; covenants, conditions and restrictions; development design guidelines; management plans; conservation easement agreements; websites; and their respective design approaches or development standards related to sustainability.

Based on my own preliminary research, I have created a database of 150 cluster developments mentioned in the literature and which I found by searching the websites of developers that have created conservation subdivisions that are discussed in the literature. I also conducted web searches for other developments which would meet a common definition for a conservation subdivision. Additionally, I have written to researchers who have published articles about cluster and conservation subdivisions that have not been mentioned by name, and they have provided me with the names of those subdivisions. From this list of 150 developments, I conducted web searches for those sites which were not discussed in detail in the research literature or publications reviewed for this proposal.

My intention was to obtain a list of remotely accessible new conservation subdivision developments that could be evaluated in order to augment the narrative analysis of how the terminology and standards have changed from those of early cluster developments, and to profile in case studies how these new developments are being designed, permitted, and managed in different locations. I identified six developments that met a common definition for conservation subdivisions, and which also had websites that advertised new lots or homes for sale. Three of these conservation subdivisions were

selected as case studies for further data collection and analysis, based on geographic distribution (eastern, central and western US), and the ability to obtain the following information for each site: HOA covenants, codes and restrictions; development design guidelines; open space management plans; and ordinances in municipalities where each of the case study site developments are located.

One of the six potential case study sites was removed from further consideration because the contact details on the website were invalid. The telephone number was no longer in service, and repeated email inquiries to the developer's email addresses to verify that lots were still being sold went unanswered. A second potential case study site was removed from further consideration because the developer had not yet drafted the covenants, codes and restrictions, and had no written management plans yet for the site. A third and final site was removed from further consideration because the developer was not interested in sharing any information on the management plans for the private site. The million dollar starting prices for the remaining undeveloped lots may have made this site unrepresentative of most other conservation subdivisions discussed in the literature.

Three case study sites and their respective local municipal ordinances have been analyzed and discussed in order to make comparisons and conclusions about various design and development approaches and standards for the quantity, quality, configuration and management of the open space in these new conservation subdivisions, and how they may influence goals for natural resource conservation and sustainability.

For each case study site, criteria for analysis of these conservation subdivisions for the quantity, quality, configuration and management of open space, and sustainability approaches included:

- The ratio of open space to the total parcel area in these conservation subdivisions.
- The ratio of buildable or unconstrained area to unbuildable area for each property, or housing density onsite relative to a district's conventional development density.
- Configuration of open space: contiguous and or connected to adjacent open space.
- Provisions for onsite resource management, such as homeowner maintenance fees, native landscaping, removal of invasive (non-native) species, restoration of historic processes such as burning or grazing, organic farming and gardening provisions, as well as provisions for limiting the impacts of household pets, lawn chemicals, light pollution, and human intrusion into wildlife habitat.
- Features or approaches relative to sustainability, such as onsite water supply, onsite waste treatment, onsite stormwater management, limits on the amount of impermeable surfaces, and approaches taken by developers to provide for what they define as 'affordable housing' or 'energy efficient' buildings, and appliances.

For each case study site, criteria for analysis of the local ordinances for quantity, quality, configuration and management of open space, and sustainability, included:

- The percentage of open space area required within conservation subdivisions.
- The maximum percentage unbuildable area allowed within the open space, the maximum amount of paved surface area and or active recreational areas allowed within the open space, and other land uses to be excluded from the open space.
- Housing density standards relative to a district's conventional development.
- Standards for open space configuration such as whether it must be contiguous (undivided), and or oriented to connect with open space on adjacent lands.
- Management standards for lots and open space in conservation subdivisions.
- Density bonus options to achieve goals for conservation and or sustainability.
- Standards relative to sustainability shall include provisions for: onsite stormwater management, water supply, and waste treatment; limits on the amount of impermeable surfaces; and goals for the provision of 'affordable housing', 'public access', or 'management endowments' as defined by the respective municipalities.

CHAPTER 4: CONSERVATION SUBDIVISION CASE STUDIES

Hickory Nut Forest Preserve (HNF) located in Henderson County, NC, is situated on 61 acres and contains 17 lots with an average lots size of 1.2 acres. The quantity of open space is 35 acres, or about 61% of the total acreage. The exact quality of open space (% buildable land) was not obtainable from the site developer or municipal planning staff. The only unbuildable areas appear to be the stream and a 30 foot setback from the stream and road.[5] The housing density for the HNF is below the conventional zoning for the site 'limited', based on land suitability for sewage systems. The configuration of open space is undivided, and it connects with open space on adjacent lands. The conservation easement is held by a local land trust, the Carolina Mountain Land Conservancy. The prices for lots in this conservation subdivision start at $149,000 for a 1.3 acre lot.

Figure 1. Hickory Nut Forest and scenic view of skyline[6]

5 Email communication. Received May 2, 2008, from co-owner of Hickory Nut Forest.
6 Retrieved May 1, 2008, from http://www.hickorynutforest.com/index.html

Figure 2. Hickory Nut Forest development and conservation easement[7]

7 Retrieved April 8, 2008, from http://www.hickorynutforest.com/html/homesites.html

Figure 3. Hickory Nut Forest and adjacent conservation lands[8]

The HNF conservation land is owned by the adjacent Little Bearwallow Mountain Natural Area. The conservation easement was donated to the Carolina Mountain Land Conservancy, with plans to donate the land to the HOA in the next few years.[9] The stated purpose of the conservation easement agreement is the protection of natural habitat, scenic qualities, and water quality, and to prevent any use of the easement that would interfere with the preservation goals. The land trust that holds the conservation easement has no management plan for the open space, but the terms of the conservation easement agreement outline conservation goals, landowner rights, and prohibited activities.

8 Retrieved April 8, 2008, from http://www.hickorynutforest.com/html/location.html
9 Email communication. May 2, 2008, from Co-owner of Hickory Nut Forest.

The landowner is permitted to construct trails for hiking or horseback riding, reconstruct a historic cabin, maintain an existing road, install utilities under the road, and construct stairs, railings, footbridges, benches, picnic tables, and fire rings. Construction of wells or a springhouse and a water collection tank is also a permitted, as is fishing and camping. Timber harvesting is permitted in accordance with a conservation based management plan prepared by a registered forester, qualified biologist, or the North Carolina Division of Forest Resources. The removal of dead or damaged trees that present an imminent hazard is also permitted. The restoration of wetlands and riparian areas is permitted in order to restore the natural hydrology or enhance wetlands or riparian habitats, when consistent with a management plan prepared by a qualified professional and approved by the Carolina Mountain Land Conservancy.

The introduction of non-native plants or animals is prohibited, except in gardens and around structures. Herbicides are allowed for weed control, but the use of fertilizers is discouraged. Prohibited land uses include: The use of motorized vehicles for recreational purposes, commercial timber harvesting, commercial agriculture, grazing, and animal husbandry. This conservation easement agreement also prohibits impervious surfaces and agricultural activities within 50 feet of Hickory Creek or its tributaries.[10]

The covenants, codes and restrictions established by the developer and agreed to by the residents have provisions for the assessment of homeowner fees and the creation of an endowment for maintenance and insurance. The covenants assign maintenance responsibility to the HOA board. The covenants outline the preservation objective for the

10 Hickory Nut Forest Conservation Easement Rights and Restrictions. (2006). Received April 14, 2008, from Carolina Mountain Land Conservancy.

conservation easement, use of common areas, homeowner obligations and responsibilities and design and development guidelines. The preservation objective specifies the goals of: preserving the site in a natural state, preventing excessive grading and vegetation removal and ensuring that improvements to the land, including landscaping, are located and configured with the existing terrain and natural vegetation. General use of the common areas is for parks and recreation activities such as walking, jogging, or biking on trails.

Management responsibilities include the maintenance of open space, swales and storm drainage systems, roadways, trails, foot bridges, signage, lighting, irrigation, and mowing, planting, pruning, and fertilizing of landscaping. The covenants also assign the following specific obligations to homeowners on their improved or unimproved lots: keeping the land free of 'weeds' and containing sediment from construction or land disturbance, preventing obstruction of drainage channels, and regular mowing, pruning, and watering of developed lots. Homeowners are required to provide sufficient paved parking areas to prevent damage to vegetation, and are required to limit any onsite composting to sanitary containers that are screened from public view. The covenants stipulate that homeowners may not maintain plants or animals in any way that emits foul odors, or cause any loud noise that will disturb the peace, except for security purposes.

The covenants encourage the 'sustainable' design and construction of buildings for energy conservation and environmental quality considerations such as runoff water quality, air emissions, and light pollution. The design and development guidelines state that the HOA's Design Review Committee shall publish landscaping and building guidelines and require that homeowners seek their approval for improvements including

exterior illumination, swimming pools, tennis courts, and solar heating devices, etc. Homeowners are permitted to generate income onsite through the rental of their primary housing units, but only if done for a period of six months or more, and they may also rent an ancillary structure 'guest house', but only to a single family, and only for pre-approved, specified amounts of time.[11]

The developer has produced design guidelines for use by homeowners, landscapers, builders and other contractors in the design and development of the individual home sites. Guidelines will be used by the Design Review Committee (DRC) of the HOA to determine the standards for building and landscaping. Homeowners are required to retain the services of a 'professional team' to present a preliminary conceptual plan to the DRC, and subsequently more detailed plans to include the following design elements: Site Analysis - special features including topography, solar orientation, vegetation, etc.; Site Plan - house and driveway location and relationship to lot and street; Grading Plan - excavation limits, and measures for tree protection; Erosion Control Plan; Landscape Plan - proposed plantings, improvements, and drainage areas; Utilities and Service Plan; and Architectural Plan - materials, massing, and colors.[12]

Figure 4 below shows the 'improvement zones' for private lots at HNF, including: the owner discretion zone and construction clearing zone within 20' from residential buildings, the central construction and staging area, the 10' maximum driveway width with a 10' 'disturbance zone' on either side and a 15' x 15' landscaping zone on either side of the driveway entrance, and the private property line for the individual lot.

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11 Declaration of Covenants, Conditions and Restrictions for Hickory Nut Forest. (2006). Henderson County Register of Deeds Office. Book 1290, Page 79-127.

12 Retrieved April 8, 2008, from http://www.hickorynutforest.com/html/covenants.html

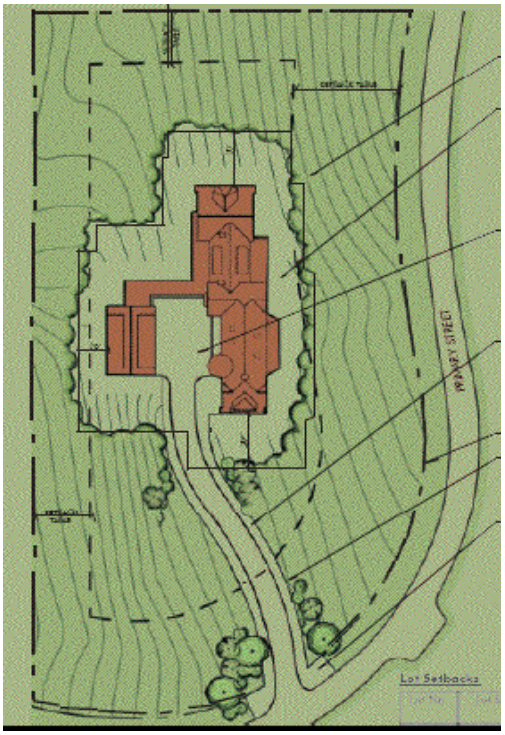

Figure 4. Hickory Nut Forest improvement zones for private lots[13]

Property owners at HNF provide their own well and septic systems. Utilities (electric and telephone) are underground. The website for this 'Eco-community' states a goal to generate a surplus of energy onsite from sources including: photovoltaic panels, passive solar, wind power, micro-hydro, and geothermal heat pumps. All homes will be EnergyStar, 'HERS rated' and certified as 'HealthyBuiltHomes.' Home design features include: local, 'sustainable' and recycled building materials, super-insulated walls, solar heating, non-toxic paints, radiant flooring, thermal mass, and water recycling.[14]

13 Retrieved April 8, 2008, from http://www.hickorynutforest.com/html/covenants.html
14 Retrieved May 2, 2008, from http://www.hickorynutforest.com/html/vision.html

The Henderson County, NC zoning ordinance states that open space must not include more than 50% primary conservation areas (unbuildable lands), nor may it be entirely composed of secondary conservation areas. Open space may include golf courses and recreational areas. The ordinance stipulates that open space lands used to offset deficiencies in lot sizes (below minimum permitted size), for either conventional or clustered developments, are required to remain in their natural or vegetated state; and a maintenance agreement must be filed with the deed for the property and a copy must be submitted to the North Carolina Division of Environmental Management. The ordinance states that the areas which are built upon must be located and designed to minimize stormwater runoff, and encourages the use of permeable paving and vegetated swales for the control of erosion, sedimentation and pollution from stormwater runoff.

A density bonus that allows for smaller minimum lots sizes, and or increases in the percentage of land that may be composed of structures (impermeable) or 'built upon land', is available when best management practices for natural drainage and filtering, such as permeable paving and vegetated swales, are used in particular watershed zones. Dimensional requirements for minimum street rights of ways or building setbacks from lot lines may be reduced by 10% in certain overlay zones if 10% or more but less than 20% of the land is set aside as open space, or reduced by 20% if 20% or more but less than 30% of the land is open space, or reduced by 30% if 30% or more of the land is set aside as open space. Similarly, building heights may be correspondingly increased in their maximum requirements for the same percentages of land set aside as open space.[15]

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15 Henderson County Zoning District Regulations April 7, 2008. Retrieved from http://www.hendersoncountync.org/planning/projects/ldc/articles/art2.pdf

The Henderson County, NC conservation subdivision ordinance requires 25% of the project area to be open space. Unbuildable lands (wetlands, floodways, and slopes greater than 30%) may be included in the open space. At least 50% of the open space is required to be undivided and oriented to connect with open space on adjacent land. Permitted uses of the open space include the preservation of: natural, cultural and archeological resources; farmland; stormwater management; water, sewer and septic systems; underground utilities; and areas for both passive and active recreation. Impervious surfaces for parking are limited to no more than 12% of the open space area. Developers must provide an open space management plan to be approved by the county subdivision administrator. The ordinance offers a 'density bonus' of an additional 10% of housing units for the preservation of 31-40% open space, a density bonus of 15% for the preservation of 41-50% open space, or a 20% density bonus for 51% or more open space. A housing density bonus of 5% is an option for open space dedicated to agriculture.[16]

Snow Crest Ranch (SCR), located near Tetonia in Teton County, ID is situated on 91.69 acres and has a total of 36 residential lots with an average lot size of 1.13 acres. The quantity of open space is 48.57 acres, or about 53% of the total parcel's land area. The exact quality of open space (% buildable land) was not obtainable from the developer or the municipal planning staff. The only unbuildable land appears to be 1 acre pond.[17] The housing density is neutral relative to conventional zoning, based on a housing density

16 Henderson County Land Development Code Chapter 200A: Conservation Subdivision Option. Retrieved April 10, 2008, from http://www.hendersoncountync.org/planning/projects/ldc/articles/art3.pdf

17 Final Plat from 2007 Approved Master Plan for Snow Crest Ranch. Retrieved May 13, 2008, from http://www.co.teton.id.us/plats/Recorded%20Subdivisions/S/Snow%20Crest%20Ranch/

'yield plan' of 36 - 2.5 acre lots. Configuration of open space is undivided and connected with open space on adjacent lands. The conservation easement is held by the SCR HOA. The prices for lots in this conservation subdivision start at $270,000 for a one acre lot.[18]

Figure 5. Snow Crest Ranch site plan[19]

18 Retrieved May 1, 2008, from http://www.snowcrestranch.com/
19 Snow Crest Ranch Master Plan Map. Retrieved May 22, 2008, from http://www.snowcrestranch.com/

Figure 6. Snow Crest Ranch homes and view from home onsite[20]

20 Snow Crest Ranch photo gallery and virtual tour. Retrieved May 22, 2008, from http://www.snowcrestranch.com/realestate-opportunities.php

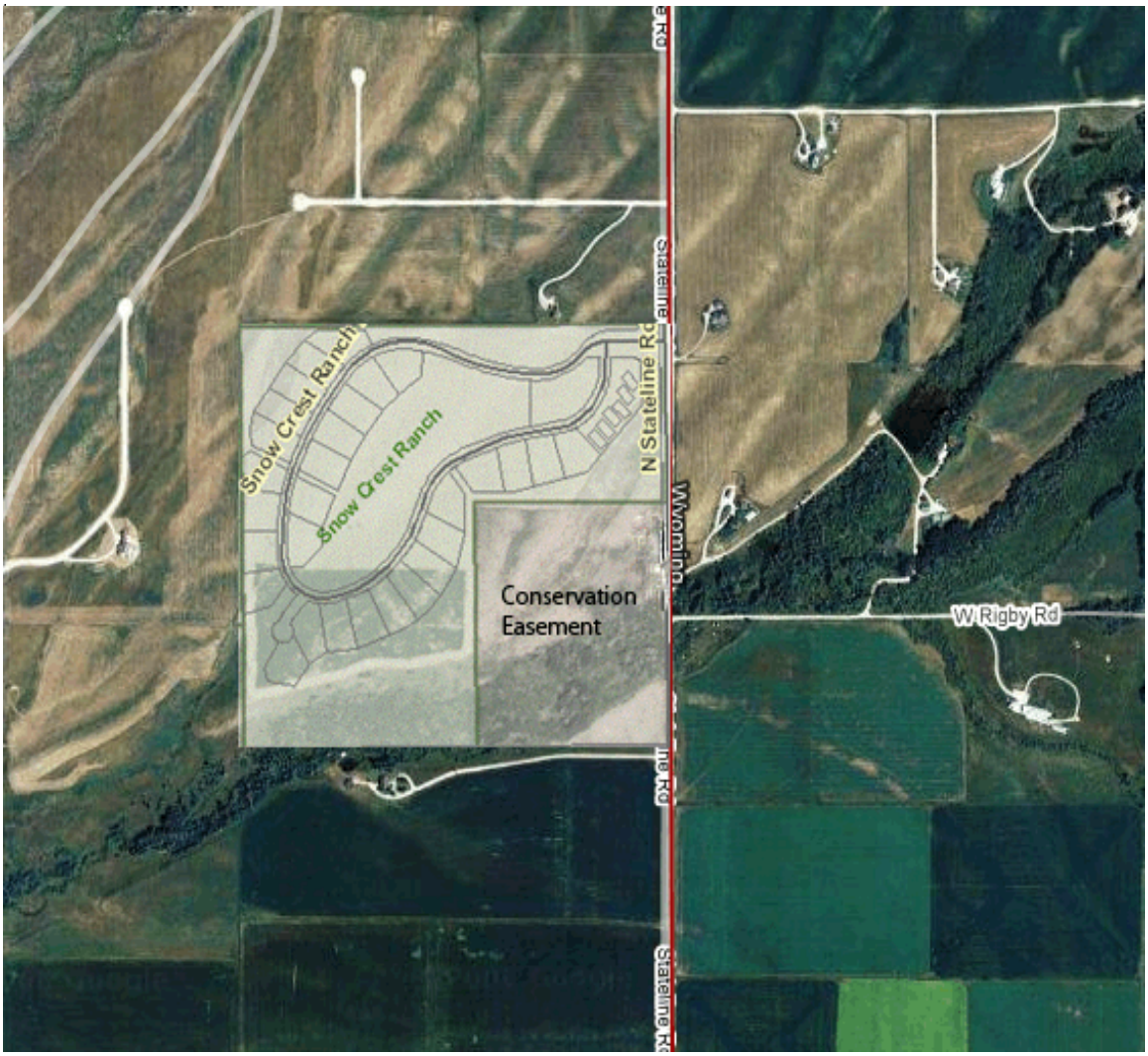

Figure 7. Snow Crest Ranch context map (ID to left of state line, WY to the right)[21]

21 Snow Crest Ranch Site Context Map. Base layer. Retrieved May 22, 2008, from http://wyoming.hometownlocator.com/Maps/CountyMap,CFIPS,039,c,Teton.cfm Site plan layer superimposed on aerial base layer. Retrieved May 22, 2008, from http://www.co.teton.id.us:81/Public%20Map/default.aspx

The covenants, codes and restrictions established by the developer and agreed to by the residents contain a management plan for SCR that includes a voluntary mitigation assessment of $400 per lot for the upgrade and maintenance of the country roads accessing the development.[22] The covenants state that the HOA has the authority to collect fees and dues and is responsible for the maintenance of the open space, roads, irrigation, fencing, fire control facilities, and for the control of noxious weeds. Landowners are responsible for control of noxious weeds on their lots as specified by the county and state. Noxious weed species are specified in the covenants including: Canada thistle, musk thistle, spotted knapweed, and yellow toadflax. Covenants state that the HOA must provide all lot owners with the publication *Welcome Home: A Home Owners' Handbook for Living in Teton Valley*, which includes information about protection of wildlife habitats, noxious weed control, and other natural resources issues.

The covenants include residential lighting restrictions to reduce light pollution, and prohibit landowners from feeding wildlife other than songbirds, and prohibit feeding of birds in months when bears are active. (Garbage containers must be bear-proof and emptied weekly). Residents are permitted to have 4 household pets, to be restrained or leashed at all times.[23] The covenants discourage introduction of non-native vegetation, prohibit landscaping with plants deemed to be harmful to native species, and prohibit the use of chemical pesticides and herbicides except for weed control as required by law. Guidelines discourage disturbance of wildlife, and prohibit hunting and keeping livestock on private lots or on the open space including: cattle, chickens, pigs, horses, and sheep.

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22 Development Agreement for Peacock Ranch, PUD. Teton County, ID. May 19, 2006.
23 Retrieved April 10, 2008, from http://www.snowcrestranch.com/pdf/ccrs.pdf

The HOA design guidelines have been produced as an appendix to the covenants for use by SCR property owners in the development of their individual residential lots. The design guidelines are used by a Committee for Design Review (CDR), established by the HOA, in approving plans for residential buildings and landscaping. Guidelines state that homeowners shall to retain the services of 'qualified design professionals' to present a conceptual plan to the CDR, and subsequently more detailed plans to include the following design elements: Site Plan - special features including topography, site drainage, location of house and driveway, stream corridors and utilities; Grading Plan - excavation limits; Landscape Plan - proposed plantings, grading, drainage and lighting locations; Architectural Plans - materials and exterior lighting.

The design guidelines state that residents may not fence or pave land, or alter vegetation without approval from the CDR. The guidelines specify minimum and maximum building footprints, require annual inspection or cleaning of septic systems, and recommend the use of water saving appliances. Wood piles and compost piles must be screened from view, and solar collectors are to be installed flush with roofs or walls. Solar orientation of windows is suggested, and energy conservation minimum standards for roofs and walls are specified as R-49, and R-21, respectively. The guidelines allow for the provision of onsite housing for 'support staff' within the single family dwellings. Property owners provide their own well and septic systems. Utilities (electric and telephone) will be located underground along the roadways.[24]

24 Retrieved April 10, 2008, from http://www.snowcrestranch.com/pdf/design_guidelines.pdf

The Teton County, ID zoning ordinance has natural resource conservation goals to preserve open space, mitigate impacts on water supply and sewage disposal, and to ensure compatible integration of agricultural lands with residential and other land uses. The ordinance recommends clustering of homes in wetland overlay zones (within 400 feet of the high watermark of waterways), to protect wetland open space areas and the viability of waterways. The ordinance requires clustering in subdivisions located on the Teton River. The ordinance also allows for buildings in cluster developments in Hillside overlay zones to exceed the conventional 30 foot maximum height limits for the zone.[25]

The Teton County, ID subdivision ordinance has goals for encouraging compact development and preserving open space, rural character, wildlife habitat and migration routes, riparian areas, scenic areas, skylines, and a goal to provide affordable housing. This ordinance requires that land within an overlay district designated as an 'Urban Reserve Area' have 20% of the gross acreage dedicated as open space, and land within a 'Rural Reserve Area' to have 50% of the gross acreage dedicated as open space. Configuration of the open space must be arranged in a maximum of two internally contiguous parcels, and be oriented so as to connect with open space on adjacent lands. The open space may be held by a municipality, land trust, HOA, or contained within one or more large private lots for the primary purpose of its protection and maintenance.

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25 Teton County Zoning Ordinance Title 8. Retrieved June 14, 2008, from http://tetoncountyidaho.gov/uploads/CodeTitle_8_%206-12-06.pdf?pkCode=16

Residential developments within overlay districts for wetlands, floodplains, wildlife, and scenic corridors must have a qualified professional prepare a natural resource analysis of existing site conditions, and assess the impacts and mitigation measures related to protecting wetlands, riparian areas, wildlife habitat and existing vegetation. The goals for preservation of watercourses, trees, and historic areas are noted for all such developments, and there are specific standards to minimize light pollution. Developers must provide an open space management plan that specifies a funding source and ensures that the open space will be maintained for its intended use. Open space management plans for agriculture must demonstrate available sources of irrigation water. Covenants must include provisions for maintenance of open space and lighting, and must contain a right to farm provision protecting the rights of existing farms on adjacent lands.

Developments in Urban Reserve Areas must provide a community recreation facility, or have 10% of the units be multi-family rental units (for at least 10 years), or have 10% of the homes include accessory dwelling units. Wetlands, floodplains, golf courses, or land contained within developed lots can only be counted as contributing half of their area to the minimum required open space. The ordinance states that clustering of all subdivisions will be required after an unspecified date to be determined in the future.[26] Public comments are part of a public hearing process for the acceptance of new developments which is advertised in advance as a legal notice in a local newspaper.[27]

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26 Teton County Subdivision Ordinance Title 9 Chapter 5 PUD Regulations. Retrieved May 9, 2008, from http://tetoncountyidaho.gov/pdf/ClarionPUD/TetonCoPUDRegulationDRAFT4-7-08.pdf

27 Minutes of the Board of County Commissioners, Teton County, ID. June 26, 2006.

Sugar Creek Preserve (SCP), located near Lafayette in Walworth County, WI is situated on a total of 259.6 acres and contains 52 residential lots averaging 1.3 acres each. The quantity of open space is 177 acres, or approximately 68% of the total parcel area. The exact quality of open space (% buildable land) was not obtainable from the developer or the local planning staff, but the housing density for the SCP is below the conventional site zoning 'limited' based on a housing density 'yield plan' of 175 - 1.48 acre lots. Configuration of open space is undivided and connected to open space on adjacent lands. Conservation easement is held by a local land trust, the Geneva Lake Conservancy.[28] Prices for lots in this conservation subdivision start at $89,000 for a one acre lot.

Figure 8. Sugar Creek Preserve, views of open space[29]

28 Retrieved May 15, 2008, from http://www.genevalakeconservancy.org/OurActivities/News%20Archive/newsaward.htm

29 Retrieved May 1, 2008, from http://www.sugarcreekpreserve.com/gallery.html (Images 10, 12, 27, 32).

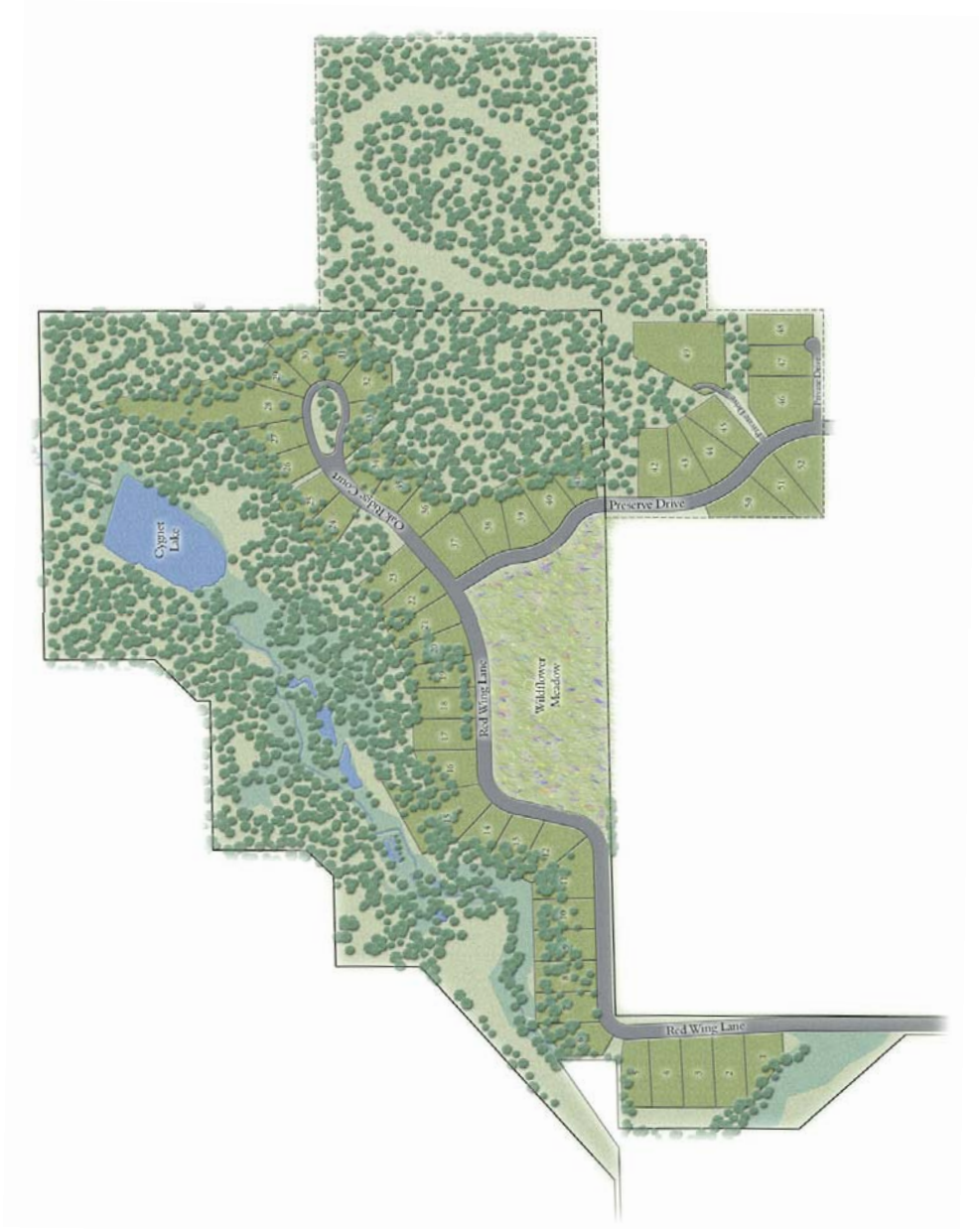

Figure 9. Sugar Creek Preserve site plan[30]

30 Retrieved April 8, 2008, from http://www.sugarcreekpreserve.com/images/land.jpg

Figure 10. Sugar Creek Preserve context and environmental corridors map[31]

31 Retrieved May 30, 2008, from http://webapps.co.walworth.wi.us/wwwwebsite/countysite/viewer.htm

The SCP conservation easement agreement outlines conservation goals, landowner rights, and prohibited activities. The purpose of the conservation easement agreement is to protect, maintain, and manage the land to enhance conservation values. Goals entail increased native vegetation and improved water quality and wildlife habitat. The easement agreement specifies that trails are to remain unpaved, as is a parking lot, which is to be designed to prevent stormwater runoff, vehicle fluids, and road oil from leaving the parking area. Vegetable gardens, compost piles, and commercial agriculture are prohibited in the open space, as is animal husbandry or livestock production, mineral exploration, and mining. Household pets are permitted on the trails, but motorized recreational vehicles are prohibited. Disturbance of wildlife or vegetation is prohibited unless done according to the professional restoration and maintenance plan.

The easement agreement binds the landowner to adherence to a conservation plan for the restoration and maintenance of the land that has been prepared by a professional environmental consulting company.[32] The conservation plan for the restoration and maintenance of the land addresses management of woodlands, a wetland, wet meadows, savannah and prairie, and includes a stormwater management plan and restoration guide. The onsite stormwater management plan calls for the use of vegetated swales, rain gardens and rock crib structures to absorb rainwater on the residential lots, and a restored 15 acre meadow of native wildflowers to also be used as a stormwater collection area. The developer informed the county that no horses or livestock will be allowed onsite.[33]

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32 Grant of Conservation Easement. Received May 8, 2008, from developer of Sugar Creek Preserve.

33 Development plan presentation to the Walworth County Zoning Agency, March 18, 2004. Received May 2, 2008, from developer of Sugar Creek Preserve.

The restoration guide to assist the HOA in the preservation, restoration and maintenance activities describes how the historical uses of the land have degraded the site's natural resources causing soil erosion and invasion of non-native species, and explains the need for restoration. The guide includes a detailed inventory of existing native and invasive plant species, and outlines plans for: the removal of invasive plants, the reintroduction of specific native plants, the restoration of the historic process of fire through prescribed burns (guided by sound scientific facts and stewardship practices), and the involvement of natural resource agencies representing the interests of the public.

The restoration guide outlines the establishment of an HOA conservation committee to oversee the restoration work, including erosion control, removal of woody vegetation from an onsite dam, and wildlife management. Restoration and maintenance activities are prioritized, and detailed recordkeeping of restoration activities is prescribed. The guide includes proposed educational activities for residents, to be coordinated by the HOA conservation committee. Educational activities are focused on nature observation, restoration, and practical implementation of this information on both the open space and on residential lots, including: native landscaping; rainwater collection, storage and management; and limiting the use of fertilizers, pesticides, and herbicides. The restoration guide includes numerous sources of information and resources for residents.[34]

The conservation plan for the site outlines conservation goals including the improvement of water quality, wildlife habitat, recreational trails, and giving residents an opportunity to experience and learn about the site's natural resources and to build community through their efforts to care for the living landscape. The plan calls for a

34 Sugar Creek Preserve Restoration Guide. Received May 21, 2008, from site environmental consultancy.

'homeowner's handbook' to be distributed to all homeowners in order to explain the conservation goals for the site, educate residents about onsite ecosystems and their management, guide residents in establishing rain gardens and native landscapes, and explain the need to restrict household pets and flower picking to protect wildlife habitat. The plan establishes measureable goals and a timeline for conservation efforts, such as increased resident awareness and participation, and provides for monitoring and recordkeeping of these stated goals, including annual surveys and interviews to guide future improvements for the accomplishment of the stated conservation goals.[35]

The covenants state that the HOA has authority to collect fees and dues and is responsible for maintenance of the open space, roads, entranceways, landscaped areas, a dam and lake, storm water management systems, and snow removal. Home owners are responsible for mowing of lawns and for the control of noxious weeds on their lots. Chemicals used to treat plants must not contaminate water quality or the environment. Residents may not alter vegetation, except during construction, or for the removal of non-native species. Vegetable gardens are only allowed behind homes, and can comprise no more than 20% of the rear lot. Tennis courts are allowed on lots larger than 100,000 square feet. Using motorized watercraft and constructing piers on the lake are prohibited. The use of motorized recreational vehicles is prohibited on lots and on the open space.

The covenants include design guidelines for use by the HOA's Architectural Review Committee (ARC) to determine building standards. The guidelines specify minimum building footprints and require a minimum two car garage for all residences. Homeowners are required to present a preliminary conceptual plan to the ARC, and

35 Sugar Creek Preserve Conservation Plan. Received May 21, 2008, from site environmental consultancy.

subsequently more detailed plans to include the following design elements: Site Plan: special features including topography (minimum of 2' intervals), site drainage, location of house and driveway, and trees within 40' of the building footprint that are 6" in diameter or larger; Grading Plan: excavation limits; Landscape Plan: Proposed native plantings, best management practices must be used to for erosion control, (swales and rain gardens designed by a 'qualified landscape architect' are strongly encouraged to control and filter stormwater runoff). Fencing Plan: perimeter fencing is not allowed; Exterior Lighting Plan: lighting directed downwards and not to infringe on neighbors. Utilities are to be located underground.[36] Wells and septic systems are to be onsite.[37]

The Walworth County, WI conservation subdivision regulations are the result of a county land use plan, adopted in April of 2001, which contained a recommendation to pursue conservation development design, and a state of Wisconsin (Smart Growth) comprehensive planning law to encourage the use of conservation development design. A 'Growing Greener' workshop was held for Walworth County, WI sponsored by various public and private organizations, in 2001. Presenters included Randall Arendt of the NLT, and a chairperson working on a conservation development ordinance for the nearby Town of Caledonia. Randall Arendt was later hired by Walworth County to help amend their subdivision ordinance to facilitate conservation development design. After seven more workshops and two public hearings an ordinance amendment was produced.[38]

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36 Declaration of Restrictions and Covenants for Sugar Creek Preserve. Received April 10, 2008, from Keefe Real Estate, Inc.

37 Email communication. August 16, 2008, from Keefe Real Estate, Inc..

38 Retrieved April 10, 2008, from http://www.co.walworth.wi.us/Land%20Management/Website/images/Forms/Conservation%20Development%20Design.pdf

The Walworth County, WI zoning ordinance contains standards for the quantity and quality of the open space based on whether the land is located in one of the following zoning districts: residential, agricultural, or conservancy; and also based on the specific density zone within each zoning district. This results in a range of standards for the quantity and quality of the open space, from 20% or 33% or 50% or 60% of the total area, to 60% of the net buildable area. The quantity and quality of open space can have multiple possible variations based on the parcel location and the density specified in the zoning ordinance. A maximum of 50% of the open space may be contained within private 'conservancy lots' of 10 acres or more in size, and up to 50% of the open space may be used for equestrian facilities. Allowed open space uses include agriculture, horticulture, forestry, or plant nurseries. Livestock operations that may emit odors are prohibited.[39]

The county subdivision ordinance states that the area of the open space occupied by improvements for storm drainage or sewage treatment may not contribute towards the minimum required open space unless the land may also be used for recreational purposes. Configuration standards state that open space should be undivided, three acres or more in size, have a length-to-width ratio less than 4:1, or have a width no less than 75 feet.[40]

Different combinations of zoning districts and densities specified in the zoning ordinance offer multiple options for construction of accessory dwellings and businesses. Developers are offered a density bonus incentive of up to an additional 20% of the

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39 Ordinance Amendment for Conservation Development Design. June 18, 2004. Shoreland Zoning and Zoning Ordinance. Walworth County, Wisconsin. Retrieved May, 16, 2008, from http://www.co.walworth.wi.us/Land%20Management/Website/images/Forms/Cons%20Dev%20Ord%20Amend.pdf

40 Proposed Amendment for Conservation Development Design: Subdivision Ordinance, Walworth County, Wisconsin. June 18, 2004. Retrieved May 2, 2008, from http://www.co.walworth.wi.us/Land%20Management/Website/images/Forms/Subd%20Ord%20Amendment.pdf

conventional residential density for a combination of various county objectives such as: endowments for open space maintenance costs (of undivided open space), affordable housing, dedication of land to a municipality for public parks, or other agencies or non-profits with conservation objectives, or for preservation of archaeological sites, or historic sites on the National Register of Historic Places, or for the preservation of land in excess of 10% of the minimum required for the particular zoning district. The density bonus may not be subtracted from the minimum open space required.[41]

The stated purpose of the subdivision ordinance includes protection of natural resources identified in the county land use plan, and in a regional habitat and natural areas protection plan. Further purposes include wetland restoration, woodland reforestation, prairie reclamation, minimizing runoff, the utilization of stormwater to replenish groundwater supplies, and the establishment of networks of interconnected open space. The process for permitting begins with an initial pre-application conference, after which the applicant submits a site context map, an existing resources map, and a sketch plan including a narrative of the proposed open space ownership and an operation and management plan. The applicant must submit a determination of the buildable land based on guidelines provided in the ordinance which exclude the following areas from consideration as buildable: utility, street, and railway rights of way, wetlands, floodlands, ponds and stream channels, and slopes of 20% or more. Additionally, the following areas must be preserved, to the greatest extent possible, as part of the primary conservation

41 Ordinance Amendment for Conservation Development Design. June 18, 2004. Shoreland Zoning and Zoning Ordinance. Walworth County, Wisconsin. Retrieved May, 16, 2008, from http://www.co.walworth.wi.us/Land%20Management/Website/images/Forms/Cons%20Dev%20Ord%20Amend.pdf

areas of each site: archaeological and burial sites, slopes 12% or more with dense woody vegetation, and specific conservation habitat and open space areas identified by the county. A public site inspection is then scheduled, where participants are provided with copies of the existing resources map. A town and county pre-application conference is then held in order to get intergovernmental concurrence on the design, and then the county land use and resource management department reviews the sketch plan against the ordinance criteria. The site context map and the existing resources map must be created according to set parameters including scale, delineation of features such as topography, and habitat types from specified government agency maps and aerial photos, as well as public lands and roads, utility easements, floodplains, natural habitat areas, etc. The existing resources map must also include soil types from specified government agency maps, sites of historical or archaeological significance, and all information required to determine density, including the delineation of net buildable areas.[42]

42 Proposed Amendment for Conservation Development Design: Subdivision Ordinance, Walworth County, Wisconsin. June 18, 2004. Retrieved May 2, 2008, from http://www.co.walworth.wi.us/Land%20Management/Website/images/Forms/Subd%20Ord%20Amendment.pdf

CHAPTER 5: ANALYSIS AND DISCUSSION

The case study sites profiled above have a range of approaches to the quantity, quality and configuration of open space, as well as a range of provisions for management and sustainability related to the open space and developed areas within each subdivision. The municipal ordinances also vary regarding the inclusion of standards for the above characteristics in relation to the respective developments, and in relation to each other. These approaches and standards are compared and summarized in tables and text below. Additionally, the influences of these various approaches and standards on the goals for natural resource conservation and sustainability will be discussed.

The quantity and quality of open space protected under a conservation easement at HNF consists of 61% of the gross parcel acreage, or just more than 50% of the site's buildable land based on communications with the site co-owner and developer. This site could be considered a 'conservation and limited development project', because it has been built at a lower housing density than allowed by zoning. The development and open space areas of the HNF have been subdivided from adjacent conservation land. Configuration of the open space is undivided, and it connects with open space on adjacent lands. The quantity, quality and configuration of open space in this development are consistent with common definitions for conservation subdivisions in the literature, even though the municipal zoning and subdivision ordinance standards for the quantity, quality and configuration of open space do not meet common definitions for conservation subdivisions, or those proposed in most model conservation subdivision ordinances.

The quantity of open space at SCR is about 53% of the gross acreage, exceeding the minimum 50% of the gross acreage stipulated in the local municipal ordinance for the Rural Reserve Area that the site is located in. Configuration of open space is undivided and connected with open space on adjacent lands, which is consistent with the standards in the local municipal ordinance. The quantity, quality and configuration of open space in this development are consistent with common definitions for conservation subdivisions in the literature and those proposed in most model conservation subdivision ordinances.

The SCP development project was approved by Walworth County, WI before the county adopted its subdivision amendment for conservation development design. However, the quantity of the open space preserved at the site, 68% of the gross parcel acreage, is consistent with that as defined in the literature for a conservation subdivision. The quality of open space, or the specific amount of unbuildable land, was not specified as a prerequisite to the prior conventional yield plan zoning calculation that the SCP was originally permitted under. Based on the conventional yield plan zoning of 175 lots of 1.48 acres each, SCP would qualify as a ‘conservation and limited development project’, built at well below the permitted density for the site, with only 52 residential lots. Configuration of the open space is undivided and connected to open space on adjacent lands, and is consistent with general provisions in the municipal subdivision ordinance.

Table 4 below compares the quantity and configuration of open space in conservation subdivision case study sites, and the housing density in conservation subdivision case study sites relative to conventional zoning. The percentage of buildable land was not required by the municipalities to calculate housing density.

Table 4

Quantity and Configuration of Open Space, and Housing Density in Conservation Subdivision Case Study Sites Relative to Conventional Zoning

Case study site	Quantity % open space of total parcel	Configuration Undivided & connected with adjacent open space	Housing Density Housing density of total parcel relative to conventional zoning
Hickory Nut Forest Henderson County, NC	61%	Yes	Below
Snow Crest Ranch Teton County, ID	53%	Yes	Neutral
Sugar Creek Preserve Walworth County, WI	68%	Yes	Below

Table 5 below compares the quantity, quality and configuration standards for open space in municipal zoning and subdivision ordinances.

Table 5

Quantity, Quality and Configuration Standards for Open Space in Municipal Zoning and Subdivision Ordinances

Case study sites & municipality responsible for permitting	Quantity % Minimum open space required (of total parcel).	Quality % Buildable land required in open space	Quality Types of land uses excluded from open space	Configuration Undivided & connected with adjacent open space
Hickory Nut Forest. Henderson County, NC	25%	N/A	Maximum 50% of open space may consist of unbuildable land.	Partial. (At least 50% of open space must be undivided & connected).
Snow Crest Ranch. Teton County, ID	20% in urban areas 50% in rural areas	N/A	Maximum 50% of open space may consist of wetlands, floodplains, golf courses, or land contained within developed lots.	Yes
Sugar Creek Preserve. Walworth County, WI	20% - 60%	0% to 60% (Surface storm drainage or sewage treatment areas may not count towards open space unless useable for recreation).	Maximum 50% of open space may be contained within 'conservancy lots', or may be equestrian facilities. Livestock operations that may emit odors.	Partial. Undivided only. (Open space must be a minimum of 3 acres, with a length to width ratio of less than 4:1, & have a minimum width of 75 feet).

Management decisions by homeowners can influence conservation goals and the conservation value of conservation subdivisions. Management plans have been developed to varying degrees for each of the case study sites, even though the case study sites may have been permitted before the respective local municipal ordinances were adopted. Each of the respective municipalities requires the submission of open space management plans.

All of the case study sites have guidelines for the assessment of homeowner maintenance fees. All of the case study sites have guidelines for native landscaping. Two of the sites, HNF and SPC, have guidelines for the restoration of wetland areas and either riparian areas or native vegetation, and HNF also has guidelines for the restoration of fire or prescribed burns. Only one site, SCR, has guidelines specifically prohibiting chemical herbicides and pesticides. However, the SCP has guidelines that discourage their use, and the HNF has guidelines that discourage the use of fertilizers (presumably chemical fertilizers). Two of the sites, HNF and SPC, have guidelines that prohibit the use of motorized recreational vehicles. All three case study sites have provisions to limit residential light pollution, which is also required by the Teton County, ID subdivision ordinance. Two of the sites, SCR and SPC, have guidelines to restrain pets. The HNF has guidelines that prohibit the introduction of non-native animals, except around houses, but no specific provisions to restrain them. The SCR has guidelines that specifically discourage the disturbance of wildlife, and the SCP has guidelines that specifically limit the picking of wildflowers, and prohibit mineral exploration and mining. Limitations on the disturbance impacts of human trails were not mentioned in the respective municipal ordinances, nor were they strongly addressed in the case study management plans.

Education as a component of natural resource management was addressed to varying degrees in all of the case study sites. The SCR and SCP sites utilized practical publications and other resources provided to both HOAs and to individual residents by land trust partners and site developers. Guidelines requiring resident involvement in on-lot conservation activities from habitat preservation to native landscaping and rainwater management have also been recognized as a critical tool for practical education. The HNF design guidelines produced by the developer include very specific limitations on what individuals may do on their own lots regarding disturbance of the native vegetation. The designation of 'landscaping zones' and 'disturbance zones' or 'owner discretion zones' within 15 to 20 feet of the building footprint is a uniquely high standard for maximizing the habitat conservation goals and conservation capacity of the site. Provisions for management at HNF and SCP are defined in conservation easement agreements with local land trusts that can be a professional partner in the development of ongoing natural resource management plans, and an independent third party that can assist with habitat management compliance monitoring.

Tables 6 and Table 7 below summarize management provisions for conservation subdivision case study sites and management plan standards in municipal subdivision ordinances. HOA covenants and their design guidelines, as well as land trust easement agreements outline landowner management obligations and limitations on land use. Municipal ordinances all require submission of a management plan.

Table 6

Management Provisions for Conservation Subdivision Case Study Sites

Case study site	Management provisions (and the agreements defining them)
Hickory Nut Forest. Henderson County, NC	Homeowner maintenance fees (HOA Covenants) Native landscaping provisions (Land Trust Easement) Restoration of wetlands & riparian areas (Land Trust Easement) Use of fertilizers is discouraged (Land Trust Easement) Residential light pollution discouraged (HOA Covenants) Prohibition on agriculture & animal husbandry (Land Trust Easement) Prohibition of non-native species introduction (Land Trust Easement) Prohibition of motorized recreational vehicles (Land Trust Easement)
Snow Crest Ranch. Teton County, ID	Homeowner maintenance fees (HOA Covenants) Native landscaping provisions (HOA Covenants) Responsibility for removal of invasive species (HOA Covenants) Limit on light pollution (HOA Covenants) Limit on pets & disturbance to wildlife (HOA covenants) Prohibition on livestock & animal husbandry (HOA Covenants) Prohibition of chemical herbicides & pesticides (HOA Covenants)
Sugar Creek Preserve. Walworth County, WI	Homeowner maintenance fees (HOA Covenants) Native landscaping provisions (Land Trust Easement) Responsibility for removal of invasive species (Land Trust Easement) Restoration of fire – prescribed burns (Land Trust Easement) Restoration of wetlands & native vegetation (Land Trust Easement) Use of herbicides & pesticides is discouraged (Land Trust Easement) Limits on paving for trails and parking area (HOA Covenants) Limit on light pollution, garden size, & lot fencing (HOA Covenants) Limit on disturbance by pets & flower picking (Land Trust Easement) Prohibition of mineral exploration & mining (Land Trust Easement) Prohibition of agriculture & animal husbandry (Land Trust Easement) Prohibition of motorized recreational vehicles (Land Trust Easement)

Table 7

Management Plan Standards in Municipal Subdivision Ordinances

Case study site and municipality responsible for permitting	Management plan required by the municipality as part of permitting process
Hickory Nut Forest. Henderson County, NC	Yes
Snow Crest Ranch. Teton County, ID	Yes
Sugar Creek Preserve. Walworth County, WI	Yes

Conservation goals and standards include 'sustainable development' approaches that were largely absent from early cluster subdivision approaches and ordinances, and which are only partly incorporated into model ordinances for conservation subdivisions. Nevertheless, design and development approaches that incorporate sustainability are present in the three case study sites including: energy efficient buildings; onsite energy production; and the provisions for onsite income through rental of homes, rooms, or accessory dwellings, which also present an opportunity to provide affordable housing.

The HNF has guidelines for sustainability, including provisions for onsite water supply, waste disposal and recycling, onsite energy production, energy efficient building design, as well as accessory buildings that can provide affordable housing and onsite income generation. The limits on commercial timber harvesting, agriculture and animal husbandry limit the onsite income and food production potential, and make it difficult to minimize the ecological footprint of the residents in regard to offsite impacts for work

and food. However, the primary goal of onsite habitat protection is well served by the high standards set for the sustainable resource management at this case study site. The local municipal ordinance requires developed areas in conservation subdivisions to be designed to minimize stormwater runoff, and encourages the use of permeable paving and vegetated swales, and provides a density bonus that allows for smaller minimum lot sizes, and or an increased percentage of land that may be built upon when these best management practices are used in a particular watershed overlay zone.

The covenants for SCR have features relevant to sustainability as noted in the case study profile, including: onsite water supply and sewage treatment; limits on the amount of impermeable surfaces including limits on paving and maximum building footprints; recommendations for the use of water saving appliances and the solar orientation of windows; standards for energy efficient buildings, and the ability to offer onsite housing for 'support staff' within the single family dwellings which has the potential to provide onsite income as well as affordable housing. However, the covenant's design guidelines prohibit keeping livestock on private lots or open space. This limits onsite food production capacity which is a recognized component of sustainable community design. The local municipal ordinance has allowances for rental units and accessory dwellings that could provide onsite income and affordable housing. However, the provision only applies to Urban Reserves Areas, and they are optional, so there is no requirement to provide them.

The location of a rain garden on each residential lot at SCP, as well as required control of noxious weeds on each residential lot, provides residents with a hands-on

opportunity and responsibility to participate in the site's sustainable stormwater management approach. The prohibition of commercial agriculture and livestock production, as well as limitations on lot fencing and garden sizes limit the potential for onsite food production that is a component of sustainable communities.

Tables 8 and Table 9 below summarize sustainability approaches at conservation subdivision case study sites and sustainability standards in the respective municipal subdivision ordinances.

Table 8

Sustainability Approaches at Conservation Subdivision Case Study Sites

Case study site and location	Sustainability approaches
Hickory Nut Forest Henderson County, NC	Onsite water supply, sewage treatment, stormwater management, energy production, & water recycling; energy efficient building design; & accessory dwelling units that can possibly provide onsite income generation & affordable housing.
Snow Crest Ranch Teton County, ID	Onsite water supply & sewage treatment; limits on impermeable surfaces; energy efficient building standards & water saving appliances; solar orientation of windows; & onsite housing for 'support staff'.
Sugar Creek Preserve Walworth County, WI	Onsite water supply, sewage treatment, & stormwater management; limits on impermeable surfaces.

Table 9

Sustainability Standards in Municipal Subdivision Ordinances

Case study site and municipality responsible for permitting	Sustainability standards
Hickory Nut Forest. Henderson County, NC	Onsite water supply & sewage treatment; stormwater management; & limits on impermeable surfaces.
Snow Crest Ranch. Teton County, ID	Onsite water supply & sewage treatment; public hearings as part of the permitting process; & community recreation facilities, or optional accessory dwellings or multi-family rental units in some zoning areas.
Sugar Creek Preserve. Walworth County, WI	Onsite sewage treatment; stormwater management; limits on impermeable surfaces; density bonus for open space maintenance endowments, affordable housing, & public access; & public site inspection as part of the permitting process.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

Based on the lack of consistent standards for the quantity, quality, configuration and management of open space in early model cluster development ordinances, it comes as no surprise that some have been unsatisfied with the natural resource conservation value of subdivisions created under cluster development standards. Current model ordinances for conservation subdivisions have higher and less variable standards for the quantity, quality, configuration and management than those for cluster developments, but that does not prevent the terms cluster development and conservation subdivision from being confused and used interchangeably by developers, municipalities, or other entities.

An example of this confusion in terminology is the name of the conservation subdivision option of the ordinance for Henderson County, NC which requires only a minimum 25% of a project area to be preserved as open space, allows unbuildable land and both active and passive recreation areas to be included in the minimum required open space area, and allows only a minimum of 50% of the open space to be configured in a contiguous tract. This ordinance could more appropriately be termed a cluster ordinance, based on its standards for the quantity, quality and configuration of open space. However, this ordinance does have standards that are included in some but not all of the model conservation subdivision ordinances, and some of the Henderson County, NC ordinance standards could be added to model conservation subdivision ordinances in order to improve their effectiveness in meeting conservation goals, such as: the requirement for a management plan; density bonus options for the preservation of additional open space or for the protection of agricultural land; and a limit on impermeable surface area.

The term ‘conservation subdivision’ and the original high standards for the quantity, quality, configuration and management of open space in these developments were initially proposed and defined by NLT staff and model ordinances. Although these high standards can meet many of the conservation goals that have been identified in the literature, there are no doubt additional natural resource conservation goals that could be added over time which will necessitate consideration of expanded or ‘higher’ standards. Subsequent model ordinances, based on the NLT model ordinances, have adopted their own standards for the quantity, quality, configuration and management of open space that in general are not as high as those initially proposed by the NLT. The adoption of even lower standards for the quantity, quality, configuration and management of open space in actual municipal ordinances and developments will no doubt reinforce or increase concerns about ‘greenwashing’ if those ordinances and developments are deemed by the public to fail to meet various natural resource conservation or sustainability goals.

Insufficient quantity of open space can undermine the conservation capacity of clustered housing developments. One way to ensure that a maximum amount of land is preserved through the use of conservation subdivisions is to make them a mandatory requirement for all subdivision developments, in specific overlay zones, or in all areas.

The quantity of open space that can be preserved in conservation subdivisions can depend on the standards for the quality of land required to be included in the open space. Those standards that do not require the inclusion of buildable land within the minimum required open space may permit less open space to be preserved than when 50% or more of the buildable land is required to be included in the minimum required open space.

Similarly, those standards that do not require the addition of unbuildable lands to the minimum required open space may permit less open space to be preserved than when all or part of the unbuildable land must be added to the minimum required open space.

The highest quantity and quality of open space is preserved by ordinances that require a minimum of 50% or more of the buildable land and all of the unbuildable lands to be included in the open space, and which either offer no density bonus options, or which allow the increased housing density to be achieved through smaller lots rather than by subtracting bonus lots from the open space. Ordinances that offer density bonuses for increases in the total open space percentage, beyond the minimum required, can also encourage the preservation of larger open space areas, which can provide greater conservation value via the protection of more natural resources and ecosystem services.

Ordinances with expanded definitions of what is considered unbuildable, such as those which include habitats for threatened or endangered species or high quality agricultural soils can potentially preserve a greater quantity of open space. Ordinances which have expanded definitions of land uses to be excluded from the minimum open space calculations, such as surface utility rights of way and active recreation areas, can preserve a higher quality of open space which can result in greater conservation capacity.

Municipal ordinance standards can be improved to better achieve natural resource conservation goals for open space by requiring that the open space be undivided, be configured to connect with open space on adjacent lands, and have minimum widths or minimum length to width ratios so as not to restrict the migration corridors for wildlife and to help isolate human sensitive species from potential human related disturbances.

Municipalities which identify primary and secondary conservation areas and the optimal configuration of open space areas on private property in advance, as part of their comprehensive plans, are in a better position to influence a more optimal configuration of open space areas in future applications for conservation subdivisions, and can thereby better achieve their conservation goals for interconnected networks of open space.

Management decisions can influence the natural resource conservation value of conservation subdivisions. Management plans need to provide for the protection and restoration of biodiversity and ecosystem services in order to achieve natural resource conservation goals. It is recommended that municipal ordinances be amended to require the submission of open space management plans in order to achieve conservation goals.

Municipal ordinances that require the submission of open space management plans are only part of the solution to addressing environmental problems and encouraging more environmentally responsible land use. As the case studies show, the commitment of landowners and developers to the creation of exemplary management plans and design guidelines can meet and exceed ordinance standards for the management of open space.

Residents of conservation subdivisions need to have sufficient knowledge and experience to be able to recognize and solve environmental problems. This can be facilitated by education and management approaches that promote active participation and more environmentally friendly social norms. Requirements for stewardship on residential lots can engage residents in more environmentally responsible behavior and can foster cooperative participation in the care and use of the land as envisioned in early

model ordinances for cluster developments. Stewardship guidelines can help to establish ecological cultural models that can improve the conservation capacity of developments.

Municipal ordinances that offer the option of a density bonus for the dedication of conservation easements to organizations with conservation objectives can encourage effective partnerships with natural resource management professionals and the involvement of natural resource agencies representing the interests of the general public. Together with the help of natural resource professionals, exemplary design approaches can be implemented in order to help make residents aware of the environmental impacts of their behavior. This can also help to create a land ethic of responsible stewardship.

Ethical land use involves restraint from optimal resource exploitation solely for short term economic profits. Ethical land use places limits on human behavior that could compromise conservation goals for natural resource preservation and sustainability. Conservation subdivision design approaches and their respective municipal ordinances are establishing many such limits in the interest of natural resource preservation and sustainability, and home buyers have readily accepted these limits. Further articulation of high standards which reflect these ethical limitations on natural resource exploitation can address public concerns and perceptions about the sustainability of these developments. Limitations on disturbance vectors to wildlife habitat and the use of fertilizers, herbicides or pesticides that contribute to the contamination of surface and groundwater are areas where landowners, developers, land trusts, natural resource professionals, municipalities, and HOAs can play an important role in better achieving natural resource conservation and sustainability goals involving the protection and restoration of ecosystem services.

It has been stated that the concept of sustainability is emerging as an important theme in community planning, and that in addition to maintaining landscape structure and function, there is a need to adopt planning principles that provide for social equity aspects of sustainable development such as the inclusion of affordable housing. The inclusion of affordable housing in conservation subdivision developments can influence the ability to realize greater social equity by providing low income community members with increased access to natural resource areas for recreation, education, and quality of life.

Although affordable housing has been addressed in the literature on conservation subdivisions, and has been advocated in some model ordinances, it does not appear to be a consistent component in model ordinances for conservation subdivisions, municipal ordinances for conservation subdivisions, or in conservation subdivisions themselves. Since one of the limitations of conservation subdivisions is the perception that they are exclusive or contradictory to affordable housing policy, it is important for municipalities to offer mandates or incentives for the inclusion of affordable housing in order to prevent segregation by income, as well as the perception of it, which can limit the use of these developments to address other natural resource conservation and sustainability goals.

A density bonus option for the inclusion of affordable housing units is one approach that is used to address this social equity aspect of sustainable development. Examples for such density bonus options are provided in model ordinances for conservation subdivisions from the NLT and from the state of MA, as well as from the Walworth County, WI zoning ordinance. It has been suggested that it should be a requirement for at least one in every ten homes constructed as part of new subdivision

developments to be affordable. A specific approach proposed by this author is for municipalities to require the inclusion of affordable housing at a rate based on the percentage of low income residents that are present in their respective county, based on current economic statistics. The option to construct accessory dwellings and or multi-family rental units can be an additional but perhaps less effective means of addressing the need for affordable housing, as well as a means to diversify housing stock. Inclusion of affordable housing provisions in conservation subdivision ordinances could be achieved via a requirement that a minimum percentage of all homes or rental units be affordable, or via a density bonus option for the inclusion of affordable housing, or by allowing the construction of accessory dwellings. All of these options could help to address sustainability goals, prevent segregation by income, and prevent the perception that conservation subdivisions are unsustainable and contrary to affordable housing policy. However, it appears that the most effective way for a municipality to ensure that affordable housing units are provided, in perpetuity, is to require their inclusion and to put in place safeguards to ensure that a set number of the homes which are sold and subsequently resold are in fact made available exclusively to low income residents.

It is also important to consider that the option to provide affordable housing offsite, as has been proposed in some model conservation subdivision ordinances, could undermine other social equity aspects such as the opportunity to provide low income community members with increased access to natural resource areas for recreation, education, and quality of life. It has been noted that the inclusion of affordable housing in new developments can have the advantage of providing role models and a social support

system for low income residents while at the same time mitigating against social isolation of the wealthy. Certainly the opportunity to engage low income residents in cooperative participation and environmentally friendly behavior patterns that can help establish ecological cultural models and social norms can not only improve the conservation capacity of conservation subdivisions, but it can promote public access and citizen participation which are important social equity aspects of sustainable development.

Developers and municipalities seeking to address, and to be perceived to be addressing, social equity aspects of sustainable development will also need to include additional approaches and standards to promote public access and citizen participation. Public access aspects of sustainable development that can be realized through conservation subdivisions include the dedication of open space to municipalities for public parks and recreation such as public trails. Citizen participation aspects of sustainable development can also be ensured through requirements for public hearings, public site walks, and public site inspections as part of the design and permitting process.

Additionally, citizen participation opportunities for democratic self governance, as envisioned in the promotion of early cluster developments, can be realized through conservation subdivisions by the establishment of HOAs. Standards and guidelines can influence how HOAs can sustainably and ethically preserve and manage their respective natural resources. Standards and guidelines can provide for the education of residents and help limit their land use patterns to more effectively provide for natural processes such as onsite water and waste treatment and recycling, and food and energy production required to meet the needs of current and future generations and human and non-human forms of

life, both onsite and offsite. The inclusion of onsite water supply, onsite waste treatment, and onsite food and energy production represents an expansion of the types of ecosystem services that residents can govern relative to early cluster developments, and with this governance comes responsibilities and obligations for sustainable management.

It has been stated that a critical goal for conservation development is minimizing the detrimental impacts to the surrounding landscape. This goal can be only partially addressed through the municipal ordinance standards and ecological design approaches that have traditionally been associated with sustainability in the literature and model ordinances for conservation subdivisions, such as stormwater management, onsite water supply and onsite waste treatment, and limitations on the amount of paved surface areas.

A very important and underutilized ecosystem service provided by productive landscapes is the potential for onsite food production, as well as onsite renewable energy production and carbon sequestration which can also provide for some degree of onsite employment, or at least can reduce the cost of residential food and energy needs to the extent that time and miles required for offsite employment and shopping can be reduced. Restrictions on the amount of area allowed for vegetable gardens and on the keeping of livestock will need to be reconsidered in order to balance conservation goals for onsite habitat protection with the sustainability goal of reducing offsite ecological impacts related to meeting future residential food, energy, and waste treatment needs.

With increasing shortages of global resources, growing concerns about global warming, alternative safe and renewable sources of energy, and the global ecological footprint of both modern developments and their residents; the issue of sustainability will

need to be increasingly prioritized in the design of new residential developments, in the goals for municipal comprehensive plans, and in conservation subdivision ordinance standards. These new standards can be drawn from the successful approaches used in existing conservation subdivisions. The conservation subdivisions and municipal ordinances profiled in the three case studies for this thesis display a range of standards for the quantity, quality, configuration and management of open space; and a range of requirements that promote various sustainable development goals. These and other ordinances will need to be regularly monitored, evaluated, and revised in order to maintain high standards and incorporate best practices to better achieve natural resource protection and sustainability goals to meet expanded expectations for ethical stewardship.

Suggested areas for future research, in order to monitor, evaluate, and ensure that conservation subdivisions are meeting the expanding goals for natural resource conservation and sustainability are as follows: There needs to be an assessment of whether conservation subdivisions contribute to a reduction in vehicle miles traveled. Perhaps a closer look at this issue would reveal that single use residential zoning simply cannot consistently or sustainably meet the needs of residents for shelter, participation, security, employment, and a clean environment. There may be a certain minimum distance from nearby commercial development or mass transit which renders some conservation subdivisions so much more ‘unsustainable’ than others that residential developments without pedestrian or mass transit access to commercial developments become undesirable and will result in the need for re-zoning. This minimum distance will also vary relative to changing fuel prices and ethical concerns about ecological impact.

Analysis of the ecological footprint of onsite energy and onsite food consumption relative to offsite demands on resources would be another useful area for future research. For example, a conservation subdivision with large homes that are not energy efficient, but which preserves an average of 5 acres of onsite habitat per dwelling may in fact consume more offsite resources and destroy more offsite habitat over time than a conventional development with smaller, more energy efficient homes. Similarly, a conservation subdivision which produces half or all of its food and energy onsite may be found to meet offsite natural resource conservation goals more effectively than a conservation subdivision that is only focused on the onsite habitat protection aspects of natural resource conservation, even if the open space is part of an interconnected network of conservation lands.

Another potential area for future research is an evaluation of the attitudes and behavior of residents of conservation subdivisions over time, in order to determine which 'high' standards and educational or design approaches are most effective in promoting a stewardship ethic, and in promoting lifestyle changes among residents which result in their pursuit of more sustainable patterns of land use and natural resource consumption.

Finally, other areas for future research could include: how effective different HOAs are at actual land use management; how effective onsite waste treatment is at preventing the contamination of groundwater resources; an evaluation of how well conservation subdivisions have restored their open space areas relative to historical conditions; or an evaluation of the most effective means of community education in use to promote the diffusion and the adoption of conservation subdivision ordinances.

Perhaps one of the most compelling aspects of the use of higher standards and a more a sustainable approach to new conservation subdivisions is the potential for the relatively rapid adoption of these standards at little or no cost to the public unlike many other forms of open space preservation such as fee simple purchase or through the purchase of development rights. With growing support from citizens and local, state and federal agencies, the adoption of higher standards in zoning and subdivision ordinances to mandate or encourage conservation subdivisions has the potential to preserve nearly half of all the land to that is projected to be consumed for residential development - as interconnected and accessible open space networks with productive ecosystem services.

High standards for conservation and sustainability can influence social and environmental goals by reducing the number of affluent enclaves, the rates of exclusion of low income residents, as well as reducing the ecological footprint of new communities. This can also help to spread values of equity and ethical stewardship over larger areas.

Because planning policies and regulations in general and conservation subdivision ordinances in particular have only begun to consistently and comprehensively apply the broader ecological, economic and social objectives of sustainable development, there is a critical gap in the policy and planning literature that will require additional research. Hopefully the information presented in this thesis can be used by academics, planners, landowners, developers, and the public to promote high standards for the quantity, quality, and configuration of open space in conservation subdivisions, as well as more effective approaches to address expanding resource conservation and sustainability goals.

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