MODELING LAND SUITABILITY FOR THE TOM'S CREEK BASIN, BLACKSBURG USING GEOGRAPHIC INFORMATION SYSTEM

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(ABSTRACT)

The objective of this paper is to describe a framework for land use analysis that incorporates Geographic Information System (GIS) and to conduct a land suitability analysis for the Tom’s Creek Basin in the town of Blacksburg using the proposed GIS. The land use planning program proposed by Kaiser, Godschalk, and Chapin, Jr. (1995) which incorporates GIS is defined as the framework for a planner to develop land use plans in this study.

Land Suitability analysis, a sum-of-weighted factors technique, often criticized for the number of value judgments or assumptions required during the analysis is used to identify the developability of the land. However, suitability analysis can be made more comprehensive for identifying the location and area of zones suitable for a particular use by incorporating more professional and public input, refraining from aggregating information too far, and including GIS in the analysis process.

The land suitability analysis for the Tom’s Creek Basin identifies prime areas for future residential development in a number of parcels along Meadowbrook Drive and in the area between Tom’s Creek Road, Meadowbrook Drive, Shadow Lake Road, and US 460 Bypass. The suitability analysis identifies incompatibility in the Basin areas currently zoned residential or university with the land suitability findings. The suitability analysis findings for the Tom’s Creek Basin concurs with the replacement of the existing zoning districts by the new proposed zoning districts of Rural Residential, Rural Residential II, and Creek Valley Overlay Districts for developing land use in the Basin which is more environmentally sensitive.
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1 INTRODUCTION

1.1 Purpose

The complexity of the planning process and the large amount of information required in land use planning often lead to decisions that are not comprehensive and lack community consensus. A computerized information system to aid the planners and community leaders making better land use decisions would be extremely useful. Such an information system should serve as a decision-support system that complies, organizes and analyzes data to enable planners and the community identify, understand, and deal with new trying situations.

The purpose of this paper is to describe a framework for land use analysis that incorporates Geographic Information System (GIS) and to conduct a land suitability analysis for the Tom’s Creek Basin in the town of Blacksburg using the proposed GIS. The land suitability analysis identifies the areas suitable for residential and commercial development and those more suitable for environmental protection and agricultural purposes. Land use modeling involves abstracting from reality those components and relationships that are hypothesized as crucial to good land use decisions, that is, the social, market, and ecological values attached to land.

The Tom’s Creek Basin located in northwest section of Blacksburg is approximately 6.4 square miles (4097 acres) in size. It is composed of eighty six (13.87% of all the parcels) parcels that are ten acres or more in size. These eighty six parcels comprise 78.36% of the entire acreage in this area and most are currently vacant or in low intensity agricultural use. The Tom’s Creek Basin is rural in character and is the least developed area in Blacksburg. As such, it is an area where future growth could be accommodated under the correct environmental controls.

A major planning issue with the Tom’s Creek Basin is how to protect the natural environment of the area but allow residential development which does not lead to urban sprawl. A survey of the residents in the study area and the town of Blacksburg indicates the desire to preserve the area’s scenic vistas, steep slopes, floodplains, wildlife and most
importantly open space (Tom’s Creek Survey Results, 1994).

1.2 Major Paper Organization

The organization of this major paper consists of five sections. In the first section, a brief discussion of the planning process and urban change content theories and a land use planning program framework for a planner to conduct the activities of land use planning is presented. This section also describes the role of GIS and its linkages to the land use planning model and the functionality of GIS. Finally, the methods for conducting land use modeling using GIS are discussed.

The second section includes a discussion of the purpose, approaches, and methods for conducting land suitability analysis. This chapter serves as framework for conducting land suitability analysis for the Tom’s Creek Basin.

The third section contains a discussion of the Tom’s Creek Basin characteristics and proposed zoning and design standards for the Basin to identify factors critical for the land suitability analysis. This section also describes the methodology for conducting the Tom’s Creek Basin land suitability analysis. The fourth section describes the findings from the land suitability analysis. The last section lists the conclusions and summary from this study.
2 LAND USE PLANNING AND GIS

Land use planning, according to Kaiser, Godschalk, and Chapin, Jr. (1995), basically involves an effort to influence the direction of land use change. This effort is carried out through the preparation and implementation of future land use plans and policies, review and approval of development projects, recommendation of capital improvement projects, and community participation in ongoing local government decision-making and problem solving. Further, land use planning is an intellectual and a sociopolitical activity that is guided by a mixture of community values, professional standards, legal precedents, political tactics, and long range visions.

“No single theory of planning or urban change adequately describes the complex and dynamic reality of land use planning practice under conditions of competition, change, and reciprocity (Kaiser, Godschalk, and Chapin, Jr., 1995).” In practice a synthesis of planning process and urban change theories directs land use planning.

2.1 Planning Process and Urban Change Theories

Planning process theories describe the procedural models used to conduct planning activities. Some of the most widely used process theories are:

- The rational theory model, a structured decision-making process, is one of the most well known and widely used processes for long range planning. The hallmarks of the rational theory model are clarity of objectives, explicitness of evaluation, a high degree of comprehensiveness of overview, and whenever possible quantification of values for mathematical analysis.

- The “incrementalist approach” differs from the rational model by seeking to adapt decision-making strategies to the limited cognitive capacities of decision-makers and to reduce the scope and cost of information collection and computation (Etzioni, 1967). Herein, the decision-maker focuses only on those policies which incrementally differ from existing policies and only a few policy alternatives are considered.
Further, only the important consequences are evaluated regarding the policy alternatives.

- The rational-adaptive model is a synthesis of rational and incrementalist theories that incorporate techniques of consensus building and citizen participation. In the ‘rational-adaptive’ model, plan making is primarily a rational analysis and design based activity while plan implementation is primarily an incremental administrative and political based activity (Kaiser, Godschalk, and Chapin, Jr., 1995).

Urban change theories provide important but incomplete models of urban change content, but serve as the guiding elements behind the formulation of land use planning and policy. According to Kaiser, Godschalk, and Chapin, Jr. (1995), land use planners need to consider three sets of land use values - social use, market, and ecological values. “Social use values express the weight that people give to various arrangements of land use as settings for living their lives. This value sees land use as a facilitator of desirable activity patterns and social aspirations. Market values express the weight that people give to land as a commodity. This value sees land use as a real estate profit medium. Ecological values express the importance people give to the natural systems on the land. This value sees land use as a potential environmental threat to be mitigated (Kaiser, Godschalk, and Chapin, Jr., 1995).”

2.2 The Land Use Planning Program

Based on the rational-adaptive model and guided by urban change theories, Kaiser, Godschalk, and Chapin, Jr. (1995) proposed a land use planning program that serves as a framework for the planner to manage land use and provide services to the various land use stakeholders. The four functions of the land use planning program are - intelligence, advance plan making, problem solving, and managing development. The four functions of the land use planning program and their relationships to one another are shown in Figure 2.1.
Figure 2.1: The Land Use Planning Program Functions and Their Linkages
Source: Kaiser, Godschalk, and Chapin, Jr., 1995
2.2.1 Intelligence Function

The intelligence function requires the building and maintaining of an information system which is essential for advance planning, problem solving, and development management. For the intelligence function, information is required for the economy, population, land use, environmental features and systems, community facilities and infrastructure, and existing land use controls and policies. The information system should transform data into patterns of facts, estimates, projections, values, and criteria for decision making.

2.2.2 Advance Planning Function

The advance planning function consists of policy planning and management planning. The policy plan requires land classification and land use design plans that describe the future goal form and general policies about government action to achieve the goal form. The management plan is a program of procedures and standards for regulating development, a schedule for funding and building community facilities and infrastructure, and a set of incentives for development decisions. Further, the advance planning function also includes an evaluation component that consists of an assessment of alternatives, including the no-intervention or no-change in policy alternative.

The land classification plan focuses on specifying the location and timing of future urban development and protecting ‘critical areas’, particularly environmentally vulnerable areas, productive agricultural and forest lands, and residential neighborhoods, from development. The land use design plan is more specific than the land classification plan about the future land use pattern as a goal form.

According to Kaiser, Godschalk, and Chapin, Jr. (1995), the process of designing either a land classification or urban land use plan consists of five tasks for each land use sector. The sequence and the relationships amongst the five tasks is shown in Figure 2.2.
Figure 2.2: Five Tasks for Land Classification and Urban Land Use Design
Source: Kaiser, Godschalk, and Chapin, Jr., 1995

2.2.3 Problem Solving and Development Management Functions

The problem solving function addresses land use conflicts or problems that are not anticipated adequately through advance planning. The development management function refers to the adoption, enactment, and enforcing of land use or a comprehensive plan, ordinances, capital improvements and other government actions. It also includes the review and approval of proposed development and feedback to the intelligence, advance planning, and problem solving functions.

2.3 Geographic Information Systems

According to Kaiser, Godschalk, and Chapin, Jr. (1995), the purpose of an information system for planning purposes is to generate information and support discourse and decision about the planning area’s population, economy, environment, land
use, infrastructure, and community facilities. Information and decision on each of these issues for an area is built by:

- describing the history and current status;
- monitoring, recording, and interpreting the changes;
- diagnosing the planning and development problems;
- forecasting the future status;
- assessing the supply/demand balance;
- modeling relationships, impacts, and contingencies; and
- presenting information to planners, public, and decision makers.

Information systems with functional capabilities of querying, analysis, modeling, and display and reporting of information would be extremely useful as decision support for land use planning. Geographic Information System having such functional capabilities is increasingly being used by planning agencies for mapping and record keeping to analysis purposes in land use planning.

Geographic Information Systems (GIS) is a computerized system that allows a sequence of functions that achieve data entry, storage, display, analysis, and generation of new data that is spatially referenced. GIS is ‘geographic’ because it links various form of data with a particular geographic space; ‘informational’ since it contains a broad array of data, characteristics, or attribute pertaining to a location; and ‘systematic’ because there is a linked set of computer programs that permit the capture, storage, retrieval, manipulation, and display of data and geographic space (Carstensen, 1995).

2.3.1 GIS Functionality

The basic functions and capabilities of GIS can be categorized into data capture and verification, data storage and management, analysis, and data display. The different analytical functions supported by GIS are:

- **Reclassification.** Reclassification basically converts existing data to new data based on categorization provided by the user. This function simplifies the data and is used in
modeling to delineate categories that meet certain criteria.

- **Overlay.** Overlay allows the two or more maps that are spatially registered to create a new spatial relationship based on a particular attribute or criteria.

- **Cartographic Neighborhoods.** This function uses spatial proximity as a major analysis tool wherein a value at a given location is compared to those surrounding it or measures distance from a given location. Buffering is one of the cartographic neighborhood functions which are used for measuring distance to and from target features or to delineate targets areas that are within a certain zone of influence from a target. Surface derivative function like interpolation; gradient and aspect calculations, sun intensity, watershed analysis, and viewshed analysis belong in this category.

- **Connectivity-Network Analysis.** This function allows modeling actual or potential movement of good, services, and information through a set of connected linear database objects. Some applications are optimal routing model to find the best possible route through a network based on certain criteria or allocation models to delimit areas based on demand levels and other criteria.

- **Querying and Data Retrieval.** GIS allows data retrieval for both attribute and spatial data and can be used to simply retrieve data from the database to produce reports or as complex as the selection of particular objects based on their relationships with other objects. This function also allows one to set a window and view data at different scales, turn on and off certain data layers, and alter symbolism to design effective maps.

### 2.4 Modeling Land Use: Considerations

To model land use, four perspectives must be considered: 1) land as a functional space for various uses; 2) land as a setting for activity systems; 3) land as a commodity to be developed; and 4) land as a perceptual image (Kaiser, Godschalk, and Chapin, Jr., 1995). Further, information on population, economy, environment, and infrastructure and community facilities is essential in modeling land use.
Functional space refers to the various uses or functions suitable for a parcel according to its characteristics. Functional space characteristics associated with a parcel are parcel identity (location, ownership, zoning, area, and assessed value of land), environment (slope, land cover, floodplain, soil type, wetlands, and hazard), structure (building type, ground coverage, number of stories, assessed value of improvements, floor area, height, and condition), and space use (existing use, number of units, number of employees, intensity, number of residents, and planned future use). The functional space characteristics of parcels enables calculating the land supply available for development.

Activity patterns are the reoccurring ways in which households, firms, and institutions pursue their daily affairs within urban and regional areas. Activity systems help in understanding household and business locational decisions and problems with existing land use. Activity pattern studies can be done for transportation, recreation, social, and business activities.

Developability of land is its capacity to be put into use based on the parcel characteristics and market forces. Imageability of landscapes is their ability to provide a visible system for orientation, esthetic appeal, and social symbolism. Imageability can be used both to evaluate existing environments and to illustrate alternative future development scenarios.

2.4.1 Information Required to Model Developability

Population and economy. The population and economy largely determine future overall land use and community facility needs, future levels of stress on environmental resources, and the amount of development pressure and pace of urban development to be accommodated and addressed. Based on the size, composition, and spatial distribution of the population and economic activity one can determine the future space requirements and for projecting future need for transportation, community facilities, and public services.

Several approaches are suitable for calculating population growth and making economic projections. The choice of the technique depends upon the availability of
historical data series for the study area, level of detail and accuracy required in the projection, staff capability, and time available to perform the analysis.

Environment. The environment is not only a source of land for future development but it is also a set of resources to be conserved, natural functions to be maintained, and hazards to be avoided to achieve sustainable development. Formulating a balance in development and environment to achieve sustainable development is challenging and yet essential. An environmental inventory consisting of land (soil and geology, topography and slope, and land cover and vegetation), water (surface streams and lakes, underground aquifers, floodplains and wetlands, and water quality), air quality, and habitats need to be developed wherein GIS can be used to determine the supply and location of land for each land use. Herein, data are collected in attribute files that are keyed to map locations through identification codes.

With GIS one can perform the slope analysis required to generate drainage basins and viewsheds, conduct water quality analysis, create soils potentials map which identifies potential development areas where soil are suitable for building foundations, septic tanks, roads, and underground utilities and non-development lands with prime agricultural and wetland soils, and land suitability analysis to identify land suitable for a particular land use. Further, a number of environmental analysis like environmental impact analysis (studying environmental impact due to an individual development project), cumulative impact assessment (track the aggregate effects of individual impacts on the environment), critical area analysis (conservation of environmentally sensitive areas), and hazard analysis (natural and man made hazards) can be conducted. A community using GIS could develop a land use policy by simulating possible environmental impacts based on proposed alternative land use policies.

Infrastructure and Community Facilities. Urban land must have access to the network of public and quasi-public structures and services necessary for day to day operation, minimum health and safety, and desired quality of life. Infrastructure refers to public water and sewer facilities, highways, and public transportation whereas community facilities refer to schools, parks, airports, parking lots, fire and police stations, libraries,
waste water treatment plants, and other facilities that citizens actually visit. The three most important public facilities for development are transportation, water and sewer facilities. Facilities like schools and park and recreation facilities are also important.

Information on each facility's design capacity, present operating capacity, service area, cost of operation, and condition are required for effective planning. Resource allocation models can be generated to identify the operating efficiency of each facility using GIS. This information will aid in identifying where future development should take place, what facilities need to be improved, or where new facilities need to be developed.

2.5 Developability Analysis: Framework

Modeling relationships and conversion of the data to information is the next step in developability analysis. Developability analysis guides decisions about where to direct future growth while perceptual analysis provides feedback on how citizens view the built environment.

Based on the information generated from developability and perceptual analyses, a facts component describing the existing and projected conditions and their causes and a values component stating goals and objectives can be formulated. The facts and values components can then aid in developing a land use plan through the land use planning process described in Section 2.2. Simulations for alternative land use plans can be generated using GIS that show each plan's impact on the environment, and infrastructure and community facilities. This can aid in developing land use plan that conforms to the community's goals and objectives.

2.5.1 Developability Analysis

Developability analysis evaluates the land supply to locate areas suitable and desirable for future development and redevelopment. Developability analysis aims at maintaining a balance between the demand for developed urban land and the supply of available development sites during the planning period. Four types of analysis can be used to assess land developability wherein GIS functionality can be applied to model
relationships and produce information:

- **Land Suitability analysis** identifies locations within the planning area best suited to a particular type of land use. It involves overlaying maps of suitability measures to generate relative suitability scores for all sites. This method of analysis aims to be objective but requires considerable subjectivity since the choice of land suitability factors, values, and weights requires value judgments. A detailed discussion of land suitability analysis is described in the next chapter.

- **Carrying Capacity analysis** compares the demands of land uses with capacity of natural and man-made system to meet these demands. It involves deriving the level of adverse effect that is ‘unacceptable’ and critical thresholds of population or development at which that level is reached as the basis for recommendations on growth limits. When carrying capacity analyses are used to consider total populations supportable within a jurisdiction, then multiple limiting factors need to be considered. This approach is complicated by two considerations. First, what is ‘unacceptable’. What a community is willing to tolerate because of population growth is based largely on the values of the community. Thus, the approach though based on scientific information, involves considerable judgmental decisions. The second consideration is that human intervention can increase the population limit for a given level of acceptable quality.

- **Commited land analysis** identifies locations where excess community service capacity exists and where cost of additional distribution for each new customer is no greater than the value of increased efficiency in producing the service. It involves delineating the boundaries of service areas for each public service and then overlaying the maps to show aggregate committed lands.

- **Market forecast analysis** attempts to project future land development. It is based on projections of past trends, population and economic growth and information on development regulations, land use plans, parcel characteristics, and forthcoming development proposal to estimate location, type, amount, and cost of future development.
All these four analysis techniques require considerable information that is often unavailable, involves considerable subjectivity, and are based on a number of questionable assumptions. This paper focuses on land suitability analysis for the Tom’s Creek basin because environmental issues were identified as critical in developing this area. The land suitability analysis identifies the areas suitable for residential and commercial development and those more suitable for environmental protection and agricultural purposes. Information generated from the land suitability analysis can then be used for conducting future carrying capacity, committed land, and market forecast analyses. Further, the scope of this study was limited due to time constraints and data for conducting the other three analyses was unavailable.
3 LAND SUITABILITY ANALYSIS

Land use suitability analysis is an important tool in land use planning and development. The basic assumption of land suitability analysis is that land has an intrinsic suitability for particular land uses that can be determined by combining information on individual factors. Thus, the objective of land suitability analysis is to determine the appropriate locations for certain uses based on the intrinsic characteristics of land (McHarg, 1969). Appropriate uses are determined by identifying the natural features which can indicate the vulnerability of certain areas to development and targeting those areas which can support for development without environmental damage (Randolph, 1995).

Land capability refers to the physical capacity of land to support development whereas land suitability is the physical capacity plus the social acceptability and economic feasibility of development. According to Randolph (1995), it is usually difficult to distinguish between capacity and acceptability, so related studies, whether they go beyond natural factors or not, are often labeled suitability studies. The land suitability analysis for the Tom’s Creek Basin though primarily based on the land’s physical attributes is not considered land capability analysis because the analysis considered as a suitability factor the proposed conservation district for the Basin which was developed through community involvement.

Suitability studies display information in individual maps and combine the information by overlaying maps either by hand or by computer programs to produce a composite. The value of the composite is based on the comprehensiveness, accuracy, and precision of the database from which it was developed. This analytical approach can be applied towards siting studies for a specific land use or for comprehensive planning which involves identifying suitable locations for specific land uses and specifying potential land use conflicts when a certain location is suitable for more than one land use.
3.1 Land Suitability Analysis: Approaches

The basic procedure used in most land suitability studies is the same: determination of objectives and data needs, generation of data and inventory maps, and combining them to form a composite. However, several variations exist in developing the composite. An outline of the different land suitability analysis approaches is discussed below, paraphrased from Randolph (1995) and drawn from Hopkins (1977).

3.1.1 Gestalt Method

This method differs from most other land suitability methods because it does not rely on the combination of specific factors to form a composite. Using aerial photographs or site surveys, it divides the area under study into homogeneous units and implicitly specifies the units’ relative suitability for a particular use based on the image of the land. The rationale for the method is the assumption that the nature of land cannot be described by a sum of its factors but by its ‘gestalt’ or total appearance. The method’s disadvantage is that it relies entirely on the perceptions, judgment, and experience of the analyst. Thus, results may be difficult to explain, validate, justify, or replicate.

3.1.2 Ordinal Combination Method

The ordinal combination method is perhaps the most common land suitability method. Maps of specific factors are divided into subfactors or classes of similar conditions or value. The subfactors are rated against one another in terms of their suitability for the specific use being investigated, and this suitability is indicated by a shade of gray or color. The darker the shade, the less suitable is the subfactor for that use. Transparent overlays for all factor maps are produced. A composite is made by overlaying these transparencies which shows areas suitable for development in light shades and those less suitable in dark shades.

This technique has two inherent problems. First, factors influencing land suitability are assumed to be of equal weight. Herein, the relative importance of one factor versus another is not considered. Second, the technique combines individual factors that are
considered independent. However, some factors together act synergistically or interactively to produce limitations or values that are greater than the simple sum of their individual effects. For example, the occurrence of certain slope, soils, and underlying geologic materials can cause severe slope stability problems. Despite these shortcomings, this method produces a reasonable composite of the critical factors that may affect an area's suitability for development.

3.1.3 Linear Combination Method

The linear combination method attempts to solve one of the problems of the ordinal combination method by weighing factors by their relative importance. This method assigns numeric values to denote the relative suitability of subfactors and the relative importance of factors to the land use under question. By multiplying subfactor numbers by the factor weights, commensurate terms can be assigned to each subfactor. Overlaying the factor maps a composite number can be determined for each distinct area by simply adding the subfactor terms. The use of computers for this method is preferred because more factors can be manipulated than by hand.

This method has problems in the subjectivity involved in assigning values to subfactors and weights to individual factors. Involving more professional and public input in the process of assigning value is one way suggested to broaden the basis for judgments. Another alternative is to refrain from aggregating information too far and to present suitability maps by factor, and let the client, the public, or elected officials make judgments on each factor's importance.

3.1.4 Intermediate Factor Combination Method

This method solves the factor interdependence problem where interactive factors are initially combined into intermediate interpretive maps. For example, basic data maps on soils, slope, geology, and other factors that act interactively are first obtained and then combined to form interpretive maps on soil stability, erosion potential, etc. by using the ordinal combination method. The interpretive maps are then used in the same way as they are used in the linear combination method.
3.2 Land Suitability Analysis: Methods of Combining and Display

The four land suitability analytical approaches can be applied by a number of quantitative methods and display techniques— from simple hand drawn maps and overlays to complex computer models and computer generated maps. An outline description of three methods of combination and display is discussed (paraphrased from Randolph, 1995).

3.2.1 Hand Produced Overlay

The initial applications of land suitability analysis used the ordinal combination method to combine hand drawn overlay maps. Areas of each factor map were shaded corresponding to their suitability for the land use under study - darker areas were less suitable. Transparency maps of a number of factors were overlaid to produce the composite suitability.

This approach suffers from the shortcomings of the ordinal method and is restricted to three or four simple overlays. If more overlays are combined, relative suitability of darker areas tend to get lost. Further, the process of producing hand maps being so tedious it does not support conducting overlay iterations based on different assumptions. Thus, there is a tendency in hand drawn overlay studies to carry the analysis to a single result.

3.2.2 Hand Produced Data File

Carl Steinitz (1976) and his associates developed a method which allows iterative and continuing analysis that reflect varying assumptions and conditions. In this method instead of just coloring the subfactors for a particular factor with various shades of the same color, individual overlay maps are produced for each subfactor. The base map and overlay can be reproduced or photographed and different possible combinations can be tried out. While this method eliminates some constraints of the hand drawn method, it is suitable to small studies and limits in the number of overlays that can be combined still exist.
3.2.3 **Computer Based Analysis Systems**

Computer based analysis systems like GIS can perform iterative analysis, combine several factors weighted in different ways, and a number of analytical operations that can greatly enhance land suitability analysis. Spatial data available in raster or vector format can be processed by numerous GIS analytical tools to develop a comprehensive land suitability analysis.

Tomlin (in Randolph, 1995) describes the capabilities of ‘digital cartographic modeling’ as three levels of operations. First, ‘point-characterizing’ operations can compute output values for points on an overlay as a function of their input value or their location to produce a new overlay; also input values of one overlay can be combined with those of another to produce an output overlay. This type of analysis is common to most land suitability studies. Second, ‘neighborhood-characterizing’ operations can compute output values of points as a function of their distance from other points. For example, a steepness overlay can be generated from an elevation overlay by calculating percent slope based on the difference in elevation between adjacent points. Finally, ‘region-characterizing’ operations can compute an output value of say, point A as a function of input values for points lying within the same region as point A on one or more overlays. For example, operations can compute the area and perimeter of the region containing point A.

3.3 **Land Suitability Analysis: Critique**

Land suitability analysis, is basically a sum-of-weighted factors technique. It has been criticized for the number of value judgments or assumptions required to conduct the analysis. Value judgments come in play when determining what factors are most critical for each land use, what relative values to assign to subfactors, and how to determine relative importance of the different factors. Thus, in land suitability analysis it is very important to clearly specify reasons for making the different assumptions.

One alternative suggested to alleviate the effects of subjectivity in the analysis is to
involve more professional and public input in the process of assigning value to broaden the basis for judgments. Surveys, focus groups, and public meetings can be held to obtain the opinions of professionals and community.

Another alternative is to refrain from aggregating information too far and to present suitability maps by factor and to let the client, the public, or elected officials make judgments on each factor’s importance. Thus, it may be not necessary to produce an ‘ultimate plan’ in a suitability study. The Tioga Road land suitability study conducted by the Harvard School of Design was an effort in that direction where information on individual environmental components were not combined (Randolph, 1995).

The computational capability of GIS can be used in developing a number of land suitability iterations based on a number of different assumptions. The output of the different iterations can then be evaluated by the community and professionals to develop an appropriate factor rating system for the land suitability analysis. Thus, involving greater community participation and use of GIS in the analysis process can lead to more comprehensive land suitability analysis.
4 METHODOLOGY OF THE TOM’S CREEK BASIN LAND SUITABILITY ANALYSIS

Land suitability analysis was used to identify the developability of land in the Tom’s Creek Basin in this paper. Areas suitable for residential and neighborhood commercial development, and those best set aside for environmental reasons or agricultural purposes were identified. The information generated from this type of land suitability analysis could then be used to perform other analyses and develop a land use plan for the environmentally sensitive Tom’s Creek Basin.

Land suitability analysis was done by applying the intermediate factor combination method using a computer assisted digital mapping system for the analysis and display. ARC/INFO, a predominantly vector based GIS software operating in a UNIX environment with enhanced functionality and faster processing compared to other GIS software, was used for the land suitability analysis. To identify the critical factors that need to be considered for the land suitability analysis, a study of the environmental and physical characteristics and infrastructure facilities in the Tom’s Creek Basin was conducted. The vision for future development of the Basin and the proposed zoning regulations to implement the vision developed by the community and the Town Planning staff were reviewed to guide the land suitability analysis and identify the critical factors.

4.1 Tom’s Creek Basin: Characteristics

The Tom’s Creek Basin area, a unique resource in the Town of Blacksburg, is approximately 6.4 square miles (4097 acres) in size. It comprises approximately one third of the Town’s land area. Located in northwest section of Blacksburg, it is bounded by Prices Fork Road to the south, US 460 Bypass to the east, and the corporate limits of Blacksburg to the north and west (figure 4.1). Major roads serving the area include Tom’s Creek Road, Glade Road, Meadowbrook Drive, and Shadow Lake Road. The Tom’s Creek Basin is rural in character and is the least developed area in the Town. Consequently, it serves as an area where future growth could be accommodated.
Figure 4.1: Relative location of the Tom’s Creek Basin
4.1.1 Existing Land Use

Currently, land use in most of the area in the Tom’s Creek Basin is agricultural. Low intensity agricultural uses such as raising hay and livestock grazing are prevalent in the area and contribute to the rural quality and open character of the Basin. Approximately 3170 acres (77.37%) of the land use is either in agriculture or vacant. This comprises approximately almost half of the town’s existing open land. Single family houses and farmsteads with outbuildings dot the Basin, primarily along the existing streets. More intense single family neighborhoods with approximately four homes per acre are located along Glade Road near the US 460 Bypass. Currently no commercial establishments are present in the Basin. Figure 4.2 shows the current zoning for the Tom’s Creek Basin.

4.1.2 Parcel Size and Distribution

In the Basin eighty six parcels (13.87% of all the 620 parcels) are ten acres or more in size. They represent 78.36% of the entire acreage in this area. Of the remaining 534 parcels, 321 are less than one acre in size. Table 4.1 shows the parcel size distribution statistics and Figure 4.3 shows the distribution of the different parcel sizes in the Basin. Most of the 321 smaller parcels are clustered around Glade Road near US 460 Bypass where the intense single family residential development exists. Currently, most of the parcels ten acres or more in size are either vacant or used for low intensity agricultural purposes. These large tracts are seen as critical to the Basin’s future development. Land owners of these parcels possess transfer of development rights option as per the new proposed Rural Residential II zoning district for the Basin.

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Number of parcels</th>
<th>Total Area</th>
<th>Minimum parcel area</th>
<th>Maximum parcel area</th>
<th>Mean parcel area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>321 (51.77%)</td>
<td>153.851 (3.75%)</td>
<td>0.002</td>
<td>0.993</td>
<td>0.479</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>92 (14.84%)</td>
<td>134.451 (3.28%)</td>
<td>1.019</td>
<td>1.999</td>
<td>1.461</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>121 (19.52%)</td>
<td>598.490 (14.61%)</td>
<td>2.005</td>
<td>9.745</td>
<td>4.946</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>47 (7.58%)</td>
<td>706.158 (17.24%)</td>
<td>10.277</td>
<td>23.706</td>
<td>15.025</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>32 (5.16%)</td>
<td>1375.361 (33.57%)</td>
<td>25.012</td>
<td>97.453</td>
<td>42.980</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>7 (1.13%)</td>
<td>1128.801 (27.54%)</td>
<td>112.220</td>
<td>231.658</td>
<td>161.257</td>
</tr>
</tbody>
</table>

Source: Parcel Size Distribution Map

23
Scale 1" = 3418'

Figure 4.2: Existing Zoning in the Basin
Source: 1991 Zoning Map provided by Planning & Engg. Dept.
Scale 1" = 3418'

Figure 4.3: Parcel Size Distribution in the Basin
Source: Parcel Map provided by Planning & Engg. Dept.
4.1.3 Hydrological Features

Tom’s Creek, its contributing tributaries, associated floodplain, and wetlands comprise the hydrological feature in this area (Figure 4.4). The Creek empties into the New River in Montgomery County. Most of the land adjacent to the creek is undeveloped. The Creek serves as a storm water runoff for the Basin and a potential source for trout fishing and recreation.

4.1.4 Topography

The land is characterized by rolling terrain with areas of moderate slope with some areas of steep slopes at the foot of the Brush Mountain and some areas abutting the floodplain (Figure 4.5). Most of the land has slopes ranging from zero percent to less than fifteen percent (majority with a slope less than five percent). Brush Mountain and the George Washington-Jefferson National Forest located on Blacksburg’s north western boundary with Montgomery County is a dominant scenic feature. No public access currently exists to the National Forest from the Town side.

4.1.5 Soils and Karst Features

The Groseclose and Poplimento soils representing forty percent of the total acreage are the major soil type in the Tom’s Creek Basin (Figure 4.6). Berks-Weikert, Duffield-Ernest, Frederick and Vertrees, and Weaver soils together covering approximately thirty five percent of the area in the Basin are the other soils that occupy considerable area. The other remaining soils and their coverage area in the Basin is shown in Table 4.2.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Area</th>
<th>Soil Type</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groseclose &amp; Poplimento</td>
<td>1674.328</td>
<td>Jefferson</td>
<td>223.049</td>
</tr>
<tr>
<td>Berks-Weikert</td>
<td>511.799</td>
<td>Caseyville-Opequon-Rock</td>
<td>182.531</td>
</tr>
<tr>
<td>Frederick &amp; Vertrees</td>
<td>335.220</td>
<td>McGary &amp; Purdy</td>
<td>81.925</td>
</tr>
<tr>
<td>Weaver</td>
<td>323.629</td>
<td>Craigsville</td>
<td>46.167</td>
</tr>
<tr>
<td>Duffield-Ernest</td>
<td>304.617</td>
<td>Berks-Groseclose</td>
<td>21.814</td>
</tr>
<tr>
<td>Berks-Clymer</td>
<td>234.340</td>
<td>Carbo &amp; Chilhowie</td>
<td>21.654</td>
</tr>
<tr>
<td>Berks-Lowell-Rayne</td>
<td>218.867</td>
<td>(5.02%)</td>
<td></td>
</tr>
</tbody>
</table>

Source: Soils Map
Scale 1" = 3418'

Figure 4.4: Hydrological Features
Source: Digitized from USGS 1:24000 Topo. & FEMA Maps
Scale 1" = 3418'

Figure 4.5: Slope Variation in the Basin
Source: USGS 1:24000 Topographic Maps
Scale 1" = 3418'

Figure 4.6: Soil Type Distribution in the Basin
Source: Soil Survey of Montgomery County, VA
In the Basin majority of the bedrock foundation is formed in limestone, shale, and sandstone. Such area is prone to karst features but the basin has only one karst feature (Figure 4.7).

The Groseclose and Poplimento, and Duffield soils are deep, well drained, found on gently sloping to steep slopes (0 to 25 percent), and have a loam or silt loam surface layer and a clayey subsoil. In the Basin most of the Groseclose and Poplimento soils are found in areas with two to seven percent slopes that are most suited for cultivated crops and pasture. These soils on the broad, gently sloping ridges are suited to cultivated crops especially corn, small grains, alfalfa, and grasses and legumes for hay. Steeper areas with these soils are suited to pasture.

Natural fertility is low in the Groseclose soil and medium in the Poplimento soil while both soils have acidity limitations, application of lime and fertilizer can increase crop yields. The erosion hazard is severe in steep areas. Potential for timber production is present and areas with these soils are easily managed for woodlands.

However, settlement of areas with Groseclose and Poplimento soils is limited by the clayey subsoil, slow soil permeability, low strength, high shrink-swell potential, slope, and depth to bedrock.

4.1.6 Infrastructure

Public water is available throughout the Basin, but sanitary sewer exist only in an area close to the US 460 Bypass. The capacity of the Town's sewer system is limited, and only few new connections can be accommodated without the construction of a new sewer system in the Tom's Creek Basin. Construction of a sewer system to serve developments in the Basin was a condition for the 1973 annexation of the Basin by the Town from Montgomery County.

Most of the parcels in the Basin have very good road accessibility. The design capacity of Tom's Creek, Meadowbrook, Shadow Lake, and Glade Roads are currently adequate for the existing traffic demands and meet user safety requirements. Future development of the Basin will necessitate improvements for these roads including two
Figure 4.7: Karst Features & Woodlands
Source: Geography Dept. (Karst) & USGS 1:24000 Topo. Maps (woodlands)
lanes, bike lanes, and a sidewalk, and an interchange at the intersection of US 460 Bypass and Tom’s Creek Road.

4.2 Tom’s Creeks Basin: Vision for 2046

A vision for the Basin’s future development has been proposed by the residents of the Basin and Town Planning staff after an extended series of discussions and meetings and a survey of the citizens regarding their perceptions on various Basin related development issues. This vision serves as a guiding element for developing land use policies and plans that aid in managing the growth and development in the Tom’s Creek Basin. The salient features of this vision were:

- To develop the Tom’s Creek Basin as a rural residential area where the natural and agricultural character of the Basin is preserved while achieving a creative residential site design. To preserve open space, protect natural resources such as water quality, tree cover, wildlife, and scenic vistas, and minimizing physical and visual disturbances residential clustering will be promoted.

- To develop a central greenway core surrounding the Tom’s Creek which will be largely public, undeveloped, and includes large pastures and natural vegetation. This central greenway will serve as a recreational, scenic, and natural resource zone that protects the water quality in the creek and underground aquifers and provides large area of open space and wildlife habitat. Further, greenway connections to the rest of the Basin and the George Washington-Jefferson National Forest will be developed by pedestrian and bicycle linkages as part of the larger Town greenway network.

- Sanitary sewer will be constructed in phases as new developments take place in the Basin. Where sanitary sewer service is unavailable developments should provide for the ultimate connection to the sanitary sewer when the system is available.

- To develop small scale neighborhood commercial uses catering to the needs of Basin residents without attracting significant additional traffic. The site design and scale of commercial structures are to be in harmony with the Basin’s rural character.
4.2.1 Proposed Zoning Districts and Design Standards

To implement the proposed vision for the Tom's Creek Basin, the Town Planning staff formulated new zoning districts and design standards, developed through a process of community participation and consensus building. The following proposed zoning districts and design standards are now under consideration by the Town for adoption (Resolution 11-C-95, 1995).

**Rural Residential.** This zoning is a type of conservation development district that incorporates mandatory open space preservation and small clustering of residential units on the remainder of the parcel. The development rights of the open space are automatically transferred to the developed portion of the parcel. Some salient features of this zoning district are:

- Developments herein should promote the conservation of agricultural and forest lands, natural resources, and unified open space area; creation of residential developments on a traditional rural scale; and flexibility and creativity in design of residential subdivisions with less suburban-style sprawl.

- The permitted uses are agricultural and forestry, residential, and civic uses (community recreation, open space, public parks and recreational areas, and minor utility services). Some other civic and commercial use types is allowed by obtaining special use permits from the Town.

- The maximum density development is one dwelling unit per acre, no minimum lot size restrictions, and the maximum floor area ratio is 0.25 for lot sizes 1/3 acre or less and 0.30 for lots greater than 1/3 acre. A minimum of fifty percent of the land must be preserved as permanent opens space when land is subdivided.

**Rural Residential-II.** This district is a type of planned development residential zoning that makes possible the preservation of additional agricultural, forest, or open space lands through a transfer of development rights. Rural Residential-II (RR-II) zoning is an option for landowners within the Tom's Creek Basin. Some salient features of this zoning district are:

- Permitted uses herein are those permitted by right or special use permit in the Rural
Residential District. Other use types which are determined to be appropriate and compatible with the proposed development and surrounding uses may be permitted when the developer applies for the Town’s approval of the development plan.

- The minimum district size is ten acres and the minimum open space is fifty percent of the gross area of the district.

- The maximum gross density is one dwelling unit per acre. However, maximum density can be increased to two units per acre through density bonuses that can be obtained by incorporating one or more features like additional open space, provision of private community recreation facilities, provision of open space for recreational uses with public access, dedication to Town of land within proposed greenways, dedication to Town of parkland, and by other means.

**Creek Valley Overlay District.** This zoning district promotes natural resource protection by identifying lands adjacent to the 100 year floodplain which play a critical role in water quality protection. These lands include steep slopes and highly erodible soils. Development is highly restricted in this district. Some salient features of this zoning district are:

- The Creek Valley District consists of: 1) Tom’s Creek and Tom’s Creek 100 year flood plain; 2) all areas 15% or greater slopes adjacent to the floodplain, or if no floodplain is present, 15% or greater slopes that begin within 50 feet of the creek channel; 3) all wetlands contiguous to the lands described in 1 and 2; and 4) all the land within a corridor of 50 feet plus four additional feet for each percent slope measured perpendicular to the stream bank.

- No residential uses are permitted. Only water dependent or passive recreation uses are permitted.

- Development density (one unit per acre) that is prohibited due to a parcel’s location within the Creek Valley District may be transferred to those portions of the same lot, or to other lots within the same planned development, which area is located outside the Creek Valley District.
4.3 Tom’s Creek Basin Land Suitability Analysis: Methodology

The soil type, hydrological features, and topography of the Basin were identified as the most critical factors for the land suitability analysis since environmental issues are considered to have the most important bearing on the Basin’s future development. Since, agricultural, residential, and conservation uses are the most predominant land uses in the Basin, currently and in the proposed plan, a land suitability analysis should consider those factors important to these uses.

Other data like parcel ownership status, development status of a parcel (whether developed or undeveloped), parcels having sanitary sewer, and other relevant data were either unavailable or could not be entered in digital form due to time constraints. Use of such data would have enabled in developing a more comprehensive land suitability analysis for the Tom’s Creek Basin.

Land suitability analysis for the Basin consisted of creating the following factor map overlays using the different analytical tools available in ARC/INFO:

- **Creek Valley Overlay district.** This composite map was created by the overlay of factor maps for floodplain, stream buffers, wetlands, and areas that had certain slopes and were within a specified distance of the floodplain and the stream buffer.

- **Agricultural use suitability.** A factor overlay map from the soils map was created showing three land suitability categories (good, fair, and poor) for agricultural use.

- **Residential use suitability.** Three factor maps for suitability for residences without basements, residences with basements, and septic tank absorption fields were created from the soils map. These factor maps displayed the three limitations categories (moderate, moderate to severe, and severe) for each of the three uses. A composite for overall residential suitability is generated by overlaying these three factor maps since the soil limitations for the three uses is very similar.

- **Commercial use suitability.** A factor overlay map from the soils map was created showing three land suitability categories (moderate, moderate to severe, and severe) for commercial use.
Finally, the four factor maps for the Creek Valley Overlay District, agricultural suitability, residential suitability, and commercial suitability are overlaid to create a final composite to identify land suitability and any potential land use conflicts for areas in the Basin. From the composite, the relative suitability for agriculture, residential, commercial, and conservation uses for an area was compared. The use for which the area was most favorably suited for amongst the four uses was assigned to that area. Areas were assigned to mixed use when such areas were well suited for more than one use.

This final composite was also overlaid with the existing zoning map to identify whether there is any compatibility between the existing zoning and the land suitability analysis. Further, the four factor maps and the final composite were overlaid on the current parcel map to identify the number parcels in the different suitability zones.

4.3.1 **Category determination for the Suitability Analysis.**

* Agriculture use suitability categories.* The good, fair, and poor suitability categories for agriculture use were determined by the soil capability class. The Soil survey of Montgomery County identifies eight classes designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The Duffield-Ernest, Frederick and Vertrees, Groseclose and Poplimento, and the Weaver soils found in areas with slopes between two to seven percent in the Tom's Creek Basin were in capability class II. Soils in capability class I were not found in the Basin.

Areas with soils in class II were determined to have good suitability, soils in class III with fair suitability, and those soils in class IV or lower capability class with poor suitability for agriculture use. “Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices, or both. Class III soils have severe limitations that reduce the choice of plants or that requires very careful management, or both. Class IV soils have very severe limitations that reduce the choice of plants or that requires very careful management, or both (Soil Survey of Montgomery County Virginia, 1985).”
Residential and commercial use suitability categories. Suitability categories for septic tank absorption fields, residences with or without basements, and commercial use were defined by the limitations imposed by soil type for these uses. Areas in the Basin were identified to have either moderate, moderate to severe, or moderate limitations for these uses.

Soil limitations were considered severe when special design, significant increases in construction costs, and possibly increased maintenance was required to overcome the limitations imposed by the unfavorable soil properties or site features. It was considered moderate when special planning, design, or maintenance was needed to overcome or minimize the limitations (Soil Survey of Montgomery County Virginia, 1985). The moderate to severe limitations category defines the suitability for those areas where a group of soils coexist, wherein one has severe limitations and the other has moderate limitations for that use.

4.3.2 Data Used for the Land Suitability Analysis

Most of the data used for this suitability analysis study had to be digitized since the analysis was at a large scale where detailed data was unavailable or had too many errors. Appropriate digital data was available from the Blacksburg Planning and Engineering Department but the data had too many errors and required considerable editing.

The sources of data used for digitizing purposes were available at different scales. Errors from digitizing also occurred. This required editing work to make the data usable for analysis. The errors in data were within reasonable limits for the analysis to generate fairly valid output. The different sources for the data used were:

- **Parcel Data.** Parcel map from the Blacksburg Planning and Engineering Department.
- **Existing Zoning.** Zoning Map from the Blacksburg Planning and Engineering Department.
- **Tom Creek’s Basin Boundary.** Parcel map from the Blacksburg Planning and Engineering Department. This boundary limits map was used for clipping functions in ARC/INFO.
• **Streams, Wetlands, and Forests.** 1:24,000 USGS topography maps for the Blacksburg quadrant were used.

• **Floodplain.** FEMA floodplain maps for the Tom’s Creek Basin was used.

• **Contour data for Slopes.** 1:24,000 USGS topography maps for the Blacksburg quadrant were used. Contours at 100 feet interval were digitized.

• **Soils map.** Soils map was available from a graduate student at this university who had previously digitized it. The soils map required attribute data entry of soil properties for the soil polygons.

• **Karsi map.** Karst map was available from the Geography Department at this university. This data had been acquired from Montgomery County public offices.
5 CASE STUDY OF LAND SUITABILITY ANALYSIS FOR TOM’S CREEK BASIN

Four suitability maps were created for agricultural, residential, commercial, and conservation uses. Finally, a composite based on the overlay of the four suitability maps was created to identify land suitability and any potential land use conflicts for areas in the Basin. From the composite, the relative suitability for agriculture, residential, commercial, and conservation uses for an area was compared. The use for which the area was most favorably suited for amongst the four uses was assigned to that area. Areas were assigned to mixed use when such areas were well suited for more than one use.

The analytical functions used in ARC/INFO to perform this suitability analysis were primarily a number of overlay functions, buffering, dissolve, eliminate, and reselect operations, and database manipulation functions to create suitability categories and relationships between the different suitability maps and data layers. No weights were assigned to any categories or factors for developing the individual suitability and composite maps. The findings from this land suitability analysis are discussed below.

5.1 Soil Suitability for Agriculture Use

In the Basin approximately sixty three percent of the area is well suited for agriculture uses such as growing corn, small grains, alfalfa, and pasture while eleven percent of the Basin area is fairly suited, and the remaining twenty six percent is poorly suited for agriculture uses. The areas with fair and poor suitability for agriculture uses are located towards the western and northern corporate limits of the Town, where steep slopes are predominant (Figure 5.1).

Approximately eighty six percent (532 parcels) of all parcels in the Basin have some land well suited to agriculture. However, seventy percent (375 parcels) of these parcels that are less than two acres contain some land representing almost nine percent of the entire land area well suited for agriculture uses. Most of these smaller parcels are currently in residential use. The larger tracts of land well suited for agriculture uses are
Figure 5.1: Soil Suitability for Agricultural Use

Source: Soil Survey of Montgomery County, VA
found in parcels that are hundred acres or more in size. The area distribution of the suitability categories for agriculture uses by parcel size are shown in Table 5.1.

Table 5.1: Area distribution of suitability categories for agriculture (All area figures in acres)

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Areas with Poor Suitability</th>
<th>Areas with Fair Suitability</th>
<th>Areas with Good Suitability</th>
<th># of parcels with Good Suitability</th>
<th>Total area of parcels with Good Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>10.123</td>
<td>2.881</td>
<td>140.847 (5.46%)</td>
<td>304 (57.14%)</td>
<td>143.920</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>31.544</td>
<td>20.669</td>
<td>82.238 (3.19%)</td>
<td>71 (13.35%)</td>
<td>105.181</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>172.120</td>
<td>81.725</td>
<td>344.645 (13.36%)</td>
<td>94 (17.67%)</td>
<td>455.263</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>217.431</td>
<td>97.885</td>
<td>390.842 (15.15%)</td>
<td>33 (6.20%)</td>
<td>496.772</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>370.089</td>
<td>163.475</td>
<td>841.797 (32.63%)</td>
<td>27 (5.08%)</td>
<td>1174.222</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>291.633</td>
<td>70.367</td>
<td>766.801 (29.72%)</td>
<td>6 (1.13%)</td>
<td>917.076</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1080.435</strong></td>
<td><strong>437.018</strong></td>
<td><strong>2579.686</strong></td>
<td><strong>532</strong></td>
<td><strong>3292.434</strong></td>
</tr>
</tbody>
</table>

Source: Soil suitability map for agricultural use

5.2 Soil Suitability for Residential Use

Land suitability analysis findings for septic tank absorption fields, residences with or without basements, and overall residential use are discussed below. The overall residential use map is a composite of soil limitations maps for septic tank absorption fields and residences with or without basements. The composite identifies areas most suitable for specific types of residential development.

5.2.1 Septic Tank absorption fields

Soil properties impose severe limitations on septic tank absorption fields in approximately seventy eight percent of the Basin area. Only three percent of the Basin area has moderate limitations and the remaining nineteen percent of the area has moderate to severe limitations (Figure 5.2). Areas with moderate and moderate to severe limitations are found primarily in parcels adjacent to Meadowbrook Drive and Tom’s Creek Road.

Approximately seven percent (49 parcels) of all parcels in the Basin have some land with moderate limitations for septic tank absorption fields. From these parcels, thirty three parcels that are two acres or more in size contain some land representing almost ninety four percent of the total land area with moderate limitations. Parcels 10 < > 25
Figure 5.2: Soil Limitations for Septic Tank Absorption Fields
Source: Soil Survey of Montgomery County, VA
acres contain forty five percent of all land in the Basin that have moderate to severe limitations for septic tank absorption fields. The area distribution of the limitation categories for septic tank absorption fields by parcel size are shown in Table 5.2.

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Areas with severe limitations</th>
<th>Areas with moderate to severe limitations</th>
<th>Areas with moderate limitations</th>
<th># of parcels with moderate limitations</th>
<th>Total parcel area with moderate limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>127.409</td>
<td>25.795</td>
<td>0.648 (0.51%)</td>
<td>5 (10.20%)</td>
<td>2.379</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>109.465</td>
<td>17.841</td>
<td>7.145 (5.66%)</td>
<td>11 (22.45%)</td>
<td>15.412</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>446.173</td>
<td>116.701</td>
<td>35.616 (28.22%)</td>
<td>16 (32.65%)</td>
<td>89.420</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>965.358</td>
<td>382.400</td>
<td>27.603 (21.87%)</td>
<td>11 (22.45%)</td>
<td>173.301</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>527.754</td>
<td>135.113</td>
<td>43.291 (34.30%)</td>
<td>3 (6.12%)</td>
<td>160.913</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>940.885</td>
<td>175.997</td>
<td>11.918 (9.44%)</td>
<td>3 (6.12%)</td>
<td>530.940</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3117.057</strong></td>
<td><strong>853.857</strong></td>
<td><strong>126.224</strong></td>
<td><strong>49</strong></td>
<td><strong>972.365</strong></td>
</tr>
</tbody>
</table>

Source: Soils limitation map for septic tank absorption fields

5.2.2 Residences without basements

Soil properties impose moderate limitations on approximately twenty two percent of the Basin area and three percent of the area with moderate to severe limitations for building residences without basements (Figure 5.3). Most of the Basin has severe limitations for residential development without basements. Areas with moderate limitations are found primarily in parcels adjacent to Meadowbrook Drive and Tom’s Creek Road.

Approximately forty percent (245 parcels) of all parcels in the Basin have some land with moderate limitations for residences without basements. From these parcels, almost forty eight percent (118 parcels) of the parcels that are two acres or more in size contain some land representing approximately ninety four percent of the land area with moderate limitations. The remaining 127 parcels that are less than two acres in size mostly contain half of the land in the parcel with moderate limitations. This high percentage of parcel land with moderate limitations is suitable for building residences without basements. The area distribution of the limitation categories for residences without basements by parcel size are shown in Table 5.3.
Figure 5.3: Soil Limitations for Residences without Basements
Source: Soil Survey of Montgomery County, VA
Table 5.3: Area distribution of soil limitation categories for residences without basements
(All area figures in acres)

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Areas with severe limitations</th>
<th>Areas with moderate to severe limitations</th>
<th>Areas with moderate limitations</th>
<th># of parcels with moderate limitations</th>
<th>Total parcel area with moderate limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>127,408</td>
<td>0.000</td>
<td>26,443 (2.96%)</td>
<td>98 (40.00%)</td>
<td>52,235</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>109,442</td>
<td>0.024</td>
<td>24,986 (2.79%)</td>
<td>29 (11.84%)</td>
<td>40,642</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>442,454</td>
<td>15.331</td>
<td>140,704 (15.74%)</td>
<td>60 (24.49%)</td>
<td>327,964</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>527,754</td>
<td>14.098</td>
<td>164,306 (18.38%)</td>
<td>26 (10.61%)</td>
<td>411,392</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>955,856</td>
<td>68.148</td>
<td>351,357 (39.30%)</td>
<td>26 (10.61%)</td>
<td>1,099,616</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>932,459</td>
<td>10.120</td>
<td>186,222 (20.83%)</td>
<td>6 (2.45%)</td>
<td>1,016,581</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,095,487</strong></td>
<td><strong>107,617</strong></td>
<td><strong>894,034</strong></td>
<td><strong>245</strong></td>
<td><strong>2,948,550</strong></td>
</tr>
</tbody>
</table>

Source: Soils limitation map for residences without basement

5.2.3 Residences with basements

Area of the Basin with moderate limitations for residences with basements is comparatively less than the area with moderate limitations for residences without basements. In the Basin approximately nine percent of the area has moderate limitations and fifteen percent has moderate to severe limitations. Areas with moderate limitations for residences with basement are found primarily in parcels adjacent to Meadowbrook Drive (Figure 5.4).

In the basin seventy seven parcels contain some land with moderate limitations for building residences with basements. Approximately thirty three percent of land with moderate limitations are found in five parcels that are 25 <> 100 acres. This parcel size category also contains forty seven percent of all land with moderate to severe limitations. The area distribution of the limitation categories by parcel size are shown in Table 5.4.

Table 5.4: Area distribution of soil limitation categories for residences with basement
(All area figures in acres)

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Areas with severe limitations</th>
<th>Areas with moderate to severe limitations</th>
<th>Areas with moderate limitations</th>
<th># of parcels with moderate limitations</th>
<th>Total parcel area with moderate limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>127,408</td>
<td>23.751</td>
<td>2.692 (0.75%)</td>
<td>9 (11.69%)</td>
<td>5,376</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>109,466</td>
<td>7.112</td>
<td>17,874 (4.99%)</td>
<td>19 (24.68%)</td>
<td>26,185</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>442,175</td>
<td>74.500</td>
<td>77,815 (21.74%)</td>
<td>28 (36.36%)</td>
<td>154,359</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>527,754</td>
<td>83.663</td>
<td>94,741 (26.47%)</td>
<td>13 (16.88%)</td>
<td>203,389</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>965,267</td>
<td>290.335</td>
<td>119,760 (33.45%)</td>
<td>5 (6.49%)</td>
<td>241,298</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>940,885</td>
<td>142.830</td>
<td>45,085 (12.59%)</td>
<td>3 (3.90%)</td>
<td>530,941</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,117,057</strong></td>
<td><strong>622.099</strong></td>
<td><strong>357,982</strong></td>
<td><strong>77</strong></td>
<td><strong>1,161,548</strong></td>
</tr>
</tbody>
</table>

Source: Soils limitation map for residences with basement

45
Scale 1" = 3418'

Figure 5.4: Soil Limitations for Residences with Basements
Source: Soil Survey of Montgomery County, VA
5.2.4 Soil suitability for Overall Residential use

Residential use suitability in the Basin is a composite developed by an overlay of soil limitations maps for septic tank absorption fields, residences without basements, and residences with basements. These three maps are overlaid to determine land use suitability for residential use in the Basin because the soil limitations for these uses are very similar. The composite identifies areas most suitable for specific types of residential development. The composite identified areas with one of the six categories of suitability for residential use based on the soil limitations for the three uses as shown in Table 5.5.

Table 5.5: Suitability categories for the composite residential use map

<table>
<thead>
<tr>
<th>Class</th>
<th>Limitations for residences without basement</th>
<th>Limitations for residences with basement</th>
<th>Limitations for septic tank absorption fields</th>
<th>Total (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 6</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate</td>
<td>126.221 (3.08%)</td>
</tr>
<tr>
<td>Class 5</td>
<td>moderate</td>
<td>moderate</td>
<td>moderate to severe</td>
<td>231.749 (5.66%)</td>
</tr>
<tr>
<td>Class 4</td>
<td>moderate</td>
<td>moderate to severe</td>
<td>moderate to severe</td>
<td>536.054 (13.08%)</td>
</tr>
<tr>
<td>Class 3</td>
<td>moderate to severe</td>
<td>moderate to severe</td>
<td>moderate to severe</td>
<td>86.65 (2.10%)</td>
</tr>
<tr>
<td>Class 2</td>
<td>moderate to severe</td>
<td>severe</td>
<td>severe</td>
<td>9.386 (0.23%)</td>
</tr>
<tr>
<td>Class 1</td>
<td>severe</td>
<td>severe</td>
<td>severe</td>
<td>3107.54 (75.85%)</td>
</tr>
</tbody>
</table>

Source: Soil suitability map for residential use

Areas with Class 6 suitability, relatively most suitable for residential use, are found primarily in parcels adjacent to Meadowbrook Drive (Figure 5.5). Areas with Class 5 and 4 suitability, the other two suitable categories for residential use, are adjacent to areas with Class 6 suitability for residential use. Land in Class 6 suitability is found in forty nine parcels, Class 5 suitability in forty eight parcels, and Class 4 suitability in 178 parcels. Land in these three suitability categories represent approximately twenty two percent of the total acreage in the Basin.

Parcels that are 25 < 100 acres contain the largest areas for all residential use suitability classes except for class 6 suitability. The area distribution of the residential suitability categories by parcel size are shown in Table 5.6.
Figure 5.5: Soil Suitability for Residential Use
Source: Soil Survey of Montgomery County, VA
<table>
<thead>
<tr>
<th>Class</th>
<th>Total Area</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LT 1 acres</td>
<td>1 - 2 acres</td>
<td>2 - 10 acres</td>
<td>10 - 25 acres</td>
<td>25 - 100 acres</td>
<td>GE 100 acres</td>
</tr>
<tr>
<td>Class 6</td>
<td>Total area</td>
<td>0.648</td>
<td>7.146</td>
<td>35.615</td>
<td>43.291</td>
<td>27.603</td>
</tr>
<tr>
<td></td>
<td>% area</td>
<td>0.51%</td>
<td>5.66%</td>
<td>28.22%</td>
<td>34.30%</td>
<td>21.87%</td>
</tr>
<tr>
<td></td>
<td># of parcels</td>
<td>5</td>
<td>11</td>
<td>16</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Total parcel area</td>
<td>2.379</td>
<td>15.412</td>
<td>89.420</td>
<td>173.301</td>
<td>160.913</td>
</tr>
<tr>
<td>Class 5</td>
<td>Total area</td>
<td>2.044</td>
<td>10.729</td>
<td>42.202</td>
<td>51.451</td>
<td>92.156</td>
</tr>
<tr>
<td></td>
<td>% area</td>
<td>0.88%</td>
<td>4.63%</td>
<td>18.21%</td>
<td>22.20%</td>
<td>39.77%</td>
</tr>
<tr>
<td></td>
<td># of parcels</td>
<td>5</td>
<td>11</td>
<td>18</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total parcel area</td>
<td>3.940</td>
<td>15.011</td>
<td>100.342</td>
<td>144.425</td>
<td>175.648</td>
</tr>
<tr>
<td>Class 4</td>
<td>Total area</td>
<td>23.752</td>
<td>7.112</td>
<td>62.886</td>
<td>69.566</td>
<td>231.600</td>
</tr>
<tr>
<td></td>
<td>% area</td>
<td>4.43%</td>
<td>1.33%</td>
<td>11.73%</td>
<td>12.98%</td>
<td>43.20%</td>
</tr>
<tr>
<td></td>
<td># of parcels</td>
<td>89</td>
<td>11</td>
<td>36</td>
<td>15</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Total parcel area</td>
<td>46.979</td>
<td>15.966</td>
<td>200.369</td>
<td>238.190</td>
<td>923.968</td>
</tr>
<tr>
<td>Class 3</td>
<td>Total area</td>
<td>11.613</td>
<td>14.098</td>
<td>58.646</td>
<td>1.693</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% area</td>
<td>13.50%</td>
<td>16.38%</td>
<td>68.15%</td>
<td>1.97%</td>
<td></td>
</tr>
<tr>
<td></td>
<td># of parcels</td>
<td>7</td>
<td>4</td>
<td>9</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total parcel area</td>
<td>55.448</td>
<td>74.125</td>
<td>446.644</td>
<td>171.135</td>
<td></td>
</tr>
<tr>
<td>Class 2</td>
<td>Total area</td>
<td>9.386</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% area</td>
<td>100.00%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td># of parcels</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total parcel area</td>
<td>127.250</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Soil suitability map for residential use

### 5.3 Soil Suitability for Commercial Use

Approximately eighty five percent the area in the Basin has severe limitations for commercial use while the remaining area has moderate to severe limitations. Large areas with moderate to severe limitations for commercial use are found primarily in a number of parcels adjacent to Tom's Creek Road and Meadowbrook Drive (Figure 5.6).

In the Basin 184 parcels contain some land with moderate to severe limitations for commercial use. However, eighty four parcels that are two or more acres in size contain some land representing ninety five percent of all the area in this suitability category. Parcels that are 25 < 100 acres contain the largest areas with moderate to severe
Scale 1" = 3418'

Figure 5.6: Soil Limitations for Commercial Use
Source: Soil Survey of Montgomery County, VA

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limitations for commercial use. The area distribution of the limitation categories by parcel size are shown in Table 5.7.

**Table 5.7: Area distribution of soil limitation categories for commercial use**  
(All area figures in acres)

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th>Areas with severe limitations</th>
<th>Areas with moderate to severe limitations</th>
<th># of parcels with moderate to severe limitations</th>
<th>Total parcel area with moderate to severe limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>129.848</td>
<td>24.003 (3.86%)</td>
<td>89 (48.37%)</td>
<td>46.979</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>127.3340</td>
<td>7.112 (1.14%)</td>
<td>11 (5.98%)</td>
<td>15.966</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>523.9890</td>
<td>74.500 (11.98%)</td>
<td>39 (21.20%)</td>
<td>226.683</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>622.495</td>
<td>83.663 (13.45%)</td>
<td>17 (9.24%)</td>
<td>271.997</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>1086.118</td>
<td>289.243 (46.49%)</td>
<td>23 (12.50%)</td>
<td>987.948</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>985.971</td>
<td>142.830 (22.96%)</td>
<td>5 (2.72%)</td>
<td>804.856</td>
</tr>
<tr>
<td>Total</td>
<td>3475.070</td>
<td>622.098</td>
<td>184</td>
<td>2354.429</td>
</tr>
</tbody>
</table>

Source: Soils limitation map for commercial use

### 5.4 Creek Valley Overlay District

The Creek Valley Overlay District is a special conservation zone proposed for the Tom’s Creek Basin. This composite was created by the overlay of factor maps for floodplain, stream buffers, wetlands, and areas that had certain slopes and were within a specified distance of the floodplain and the stream buffer (Figure 5.7). The Creek Valley District representing approximately twenty two percent of the entire acreage in the Basin affects 240 parcels that occupy almost eighty eight percent of the Basin. The area distribution of the Creek Valley Overlay District in the affected parcels by parcel size is shown in Table 5.8.

**Table 5.8: Area distribution of the Creek Valley Overlay District in the affected parcels**  
(All Parcel Area in Acres)

<table>
<thead>
<tr>
<th>Parcel Size</th>
<th># of Parcels in Creek Valley</th>
<th>Total Area in Creek Valley</th>
<th>Total Area of Parcels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1 acre</td>
<td>53 (22.08%)</td>
<td>15.84 (1.76%)</td>
<td>26.83</td>
</tr>
<tr>
<td>1 - 2 acres</td>
<td>30 (12.50%)</td>
<td>23.45 (2.61%)</td>
<td>45.05</td>
</tr>
<tr>
<td>2 - 10 acres</td>
<td>77 (32.08%)</td>
<td>152.70 (17.01%)</td>
<td>405.81</td>
</tr>
<tr>
<td>10 - 25 acres</td>
<td>42 (17.50%)</td>
<td>169.58 (18.89%)</td>
<td>640.74</td>
</tr>
<tr>
<td>25 - 100 acres</td>
<td>31 (12.92%)</td>
<td>268.32 (29.89%)</td>
<td>1340.85</td>
</tr>
<tr>
<td>100 acres or more</td>
<td>7 (2.92%)</td>
<td>267.79 (29.83%)</td>
<td>1128.80</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
<td>897.68</td>
<td>3588.08</td>
</tr>
</tbody>
</table>

Source: Creek Valley Overlay District and affected parcels map
Figure 5.7: Creek Valley Overlay District and affected parcels

Source: Hydrology, Slope, and Parcel Maps
5.5 Overall Land Suitability for different uses in the Basin

The four factor maps for agricultural suitability, residential suitability, commercial suitability, and Creek Valley Overlay District are overlaid to create a final composite to identify land suitability and any potential land use conflicts for areas in the Basin. No weights are assigned to any factor. From the composite, the relative suitability for agriculture, residential, commercial, and conservation uses for an area was compared. The use for which the area was most favorably suited for amongst the four uses was assigned to that area. The areas locations of the different suitability categories for each of the four land uses identified from the composite is discussed below.

5.5.1 Land Suitability for Agriculture use

Two categories of agricultural suitability were identified from the composite based on the suitability for agriculture, residential, commercial, and conservation uses as shown in Table 5.9.

<table>
<thead>
<tr>
<th>Agri. Suit. class</th>
<th>Suitability for agriculture use</th>
<th>Suitability for residential use</th>
<th>Limitations for commercial use</th>
<th>Area affected by Creek Valley Dist.</th>
<th>Total (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>good</td>
<td>Class 1</td>
<td>severe</td>
<td>No</td>
<td>1739.226 (97.3%)</td>
</tr>
<tr>
<td>12</td>
<td>fair</td>
<td>Class 1</td>
<td>severe</td>
<td>No</td>
<td>48,986 (2.7%)</td>
</tr>
</tbody>
</table>

Source: Suitability map for agricultural and mixed use

Areas with Class 11 agriculture suitability were identified as prime areas for agriculture use because these areas have soils with capability class II for agriculture use, severe limitations for residential or commercial use and are not affected by the Creek Valley Overlay District. In the Basin approximately forty two percent of the entire acreage is well suited for agriculture uses and has Class 11 agriculture suitability. A mere one percent of the entire acreage in the Basin is fairly suited for agriculture and has Class 12 agriculture suitability.

In the Basin 486 parcels contain some land that has Class 11 agriculture suitability. Most of the areas with Class 11 or 12 agriculture suitability are spatially distributed in the area between Meadowbrook Drive and US 460 Bypass (Figure 5.8). The agriculture use
Figure 5.8: Land Suitability for Agricultural & Mixed Uses
Source: Soil, hydrology, and topography maps
suitability categories by parcel sizes are shown in Table 5.10.

Table 5.10: Area distribution of suitability categories for agricultural use
(All area figures in acres)

<table>
<thead>
<tr>
<th></th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 11: Good Agricultural use Suitability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area</td>
<td>110.328</td>
<td>70.252</td>
<td>228.860</td>
<td>269.681</td>
<td>499.809</td>
<td>560.296</td>
</tr>
<tr>
<td>% area</td>
<td>6.34%</td>
<td>4.04%</td>
<td>13.16%</td>
<td>15.51%</td>
<td>28.74%</td>
<td>32.22%</td>
</tr>
<tr>
<td># of parcels</td>
<td>281</td>
<td>60</td>
<td>82</td>
<td>32</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>133.143</td>
<td>87.870</td>
<td>391.098</td>
<td>480.460</td>
<td>1094.106</td>
<td>917.076</td>
</tr>
</tbody>
</table>

| **Class 12: Fair Agricultural use Suitability** |            |             |              |               |                |              |
| Total area       | 2.619      | 3.369       | 1.979        | 32.681        | 8.338          |
| % area           | 5.35%      | 6.88%       | 4.04%        | 66.71%        | 17.02%         |
| # of parcels     | 5          | 4           | 3            | 6             | 4              |
| Total parcel area| 6.722      | 15.602      | 41.270       | 274.322       | 648.696        |

Source: Suitability map for agricultural and mixed use

5.5.2 Land Suitability for Mixed use

Two suitability categories of mixed use were identified from the composite based on the suitability for agriculture, residential, commercial, and conservation uses as shown in Table 5.11.

Table 5.11: Suitability categories for mixed use

<table>
<thead>
<tr>
<th>Mixed Suit. Class</th>
<th>Suitability for agriculture use</th>
<th>Suitability for residential use</th>
<th>Limitations for commercial use</th>
<th>Area affected by Creek Valley Dist.</th>
<th>Total (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>good</td>
<td>Class 4</td>
<td>moderate to severe</td>
<td>No</td>
<td>476.368 (87.53%)</td>
</tr>
<tr>
<td>42</td>
<td>fair</td>
<td>Class 3</td>
<td>moderate to severe</td>
<td>No</td>
<td>67.835 (12.47%)</td>
</tr>
</tbody>
</table>

Source: Suitability map for agricultural and mixed use

Areas with Class 41 mixed use suitability are prime areas where both agricultural uses and residential development without basements can be encouraged. Such areas have soils with capability class II for agriculture use, moderate limitations for residences without basements, and moderate to severe limitations for septic tank absorption field. In the Basin no areas were identified that were solely suitable for commercial uses. Areas with Class 41 or 42 mixed use suitability can be designed for commercial uses by incorporating special design features to overcome the moderate to severe limitations imposed by the soil properties.
Approximately twelve percent of the entire acreage in the Basin is in Class 41 mixed use suitability. The other category represents a mere two percent. In the Basin 176 parcels contain some land with Class 41 mixed use suitability. Most of the areas with either suitability category of mixed use are spatially distributed in the area between Meadowbrook Drive and US 460 Bypass (Figure 5.8). However, large tracts of area with Class 41 mixed use suitability is found in the area between Tom’s Creek Road, Meadowbrook Drive, Shadow Lake Road, and US 460 Bypass. This is a prime area where future residential development could be allowed with some agricultural uses in the Basin. The mixed use suitability categories by parcel sizes are shown in Table 5.12.

Table 5.12: Area distribution of suitability categories for mixed use
(All area figures in acres)

<table>
<thead>
<tr>
<th>Class</th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>21.658</td>
<td>7.007</td>
<td>51.763</td>
<td>55.062</td>
<td>208.811</td>
<td>132.067</td>
</tr>
<tr>
<td>% area</td>
<td>4.54%</td>
<td>1.47%</td>
<td>10.87%</td>
<td>11.56%</td>
<td>43.83%</td>
<td>27.72%</td>
</tr>
<tr>
<td># of parcels</td>
<td>88</td>
<td>11</td>
<td>35</td>
<td>15</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>46,172</td>
<td>15,966</td>
<td>196,313</td>
<td>238,190</td>
<td>923,968</td>
<td>804,856</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
</tr>
<tr>
<td>% area</td>
</tr>
<tr>
<td># of parcels</td>
</tr>
<tr>
<td>Total parcel area</td>
</tr>
</tbody>
</table>

Source: Suitability map for agricultural and mixed use

5.5.3 Land Suitability for Residential use

Three suitability categories of residential use were identified from the composite based on the suitability for agriculture, residential, commercial, and conservation uses as shown in Table 5.13.

Table 5.13: Suitability categories for residential use

<table>
<thead>
<tr>
<th>Res. Suit. Class</th>
<th>Suitability for agriculture use</th>
<th>Suitability for residential use</th>
<th>Limitations for commercial use</th>
<th>Area affected by Creek Valley Dist.</th>
<th>Total (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>fair</td>
<td>Class 6</td>
<td>severe</td>
<td>No</td>
<td>99,015 (38.90%)</td>
</tr>
<tr>
<td>22</td>
<td>fair</td>
<td>Class 5</td>
<td>severe</td>
<td>No</td>
<td>149,717 (58.82%)</td>
</tr>
<tr>
<td>23</td>
<td>poor</td>
<td>Class 2</td>
<td>severe</td>
<td>No</td>
<td>5,805 (2.28%)</td>
</tr>
</tbody>
</table>

Source: Suitability map for residential use
Areas with Class 21 residential use suitability are prime area for residential development with or without basements in the Basin. For such areas the soil capability class is III and limitations for residences with or without basements and septic tank absorption fields is moderate. Areas with Class 22 residential use suitability are the other prime areas for residential development with or without basements though soil limitations for septic tank absorption fields is moderate to severe. Areas with Class 23 residential suitability are not well suited for residential development or any other use. Such areas have moderate to severe limitations for residences without basements severe limitations for residences with basements and septic tank absorption fields.

Areas with Class 21 and 22 residential use suitability are found primarily in parcels adjacent to Meadowbrook Drive (Figure 5.9). Such parcels containing some land in Class 21 or 22 are prime sites for residential development with or without basements in the Basin and are mostly two acres or more in size. Areas with Class 21 residential use suitability represent around two percent of the entire acreage in the Basin, areas with Class 22 represent almost four percent, and areas with Class 23 represent a mere fraction.

The residential use suitability categories by parcel sizes are shown in Table 5.14.

### Table 5.14: Area distribution of suitability categories for residential use

(All area figures in acres)

<table>
<thead>
<tr>
<th>Class 6 residential and fair agriculture use suitability</th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
<td>0.416</td>
<td>6.181</td>
<td>24.983</td>
<td>35.275</td>
<td>26.109</td>
<td>6.051</td>
</tr>
<tr>
<td>% area</td>
<td>0.42%</td>
<td>6.24%</td>
<td>25.23%</td>
<td>35.63%</td>
<td>26.37%</td>
<td>6.11%</td>
</tr>
<tr>
<td># of parcels</td>
<td>4</td>
<td>10</td>
<td>16</td>
<td>11</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>1.827</td>
<td>13.489</td>
<td>89.420</td>
<td>173.301</td>
<td>160.913</td>
<td>530.941</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class 5 residential and fair agriculture use suitability</th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
<td>0.852</td>
<td>8.797</td>
<td>21.056</td>
<td>37.672</td>
<td>65.129</td>
<td>16.211</td>
</tr>
<tr>
<td>% area</td>
<td>0.57%</td>
<td>5.88%</td>
<td>14.06%</td>
<td>25.16%</td>
<td>43.50%</td>
<td>10.83%</td>
</tr>
<tr>
<td># of parcels</td>
<td>2</td>
<td>11</td>
<td>17</td>
<td>9</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>1.644</td>
<td>15.011</td>
<td>90.973</td>
<td>144.425</td>
<td>175.648</td>
<td>211.725</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class 2 residential use suitability</th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
<td>5.805</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% area</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of parcels</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total parcel area</td>
<td>127.250</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Suitability map for residential use
Scale 1" = 3418'

Figure 5.9: Land Suitability for Residential Use
Source: Soil, hydrology, and topography maps
5.5.4 Land Suitability for Conservation

Areas affected by the Creek Valley district or had poor suitability for agriculture, residential, and commercial uses were identified as areas suitable for conservation purposes from the composite. Some areas had good mixed use or residential use potential but were affected by the Creek Valley district. Such areas had either steep slopes or were within a certain distance from streams or floodplain. These areas were not eliminated from consideration from the soil suitability maps for such uses because of some generalization in the soils data. The different conservation suitability categories is shown in Table 5.15.

Table 5.15: Suitability categories for conservation

<table>
<thead>
<tr>
<th>Cons. Suit. class</th>
<th>Suitability for agriculture use</th>
<th>Suitability for residential use</th>
<th>Limitations for commercial use</th>
<th>Area affected by Creek Valley Dist.</th>
<th>Total (in acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>poor</td>
<td>Class 1</td>
<td>severe</td>
<td>No</td>
<td>596.092 (39.95%)</td>
</tr>
<tr>
<td>31</td>
<td>poor/fair</td>
<td>Class 1</td>
<td>severe</td>
<td>Yes</td>
<td>489.485 (32.81%)</td>
</tr>
<tr>
<td>33</td>
<td>good</td>
<td>Class 1</td>
<td>severe</td>
<td>Yes</td>
<td>220.290 (14.77%)</td>
</tr>
<tr>
<td>35</td>
<td>fair</td>
<td>Class 6/Class 5</td>
<td>severe</td>
<td>Yes</td>
<td>109.011 (7.31%)</td>
</tr>
<tr>
<td>37</td>
<td>good</td>
<td>Class 4/Class 3</td>
<td>moderate to severe</td>
<td>Yes</td>
<td>77.043 (5.16%)</td>
</tr>
</tbody>
</table>

Source: Suitability map for conservation use

Areas with poor suitability for agriculture, residential, and commercial uses and unaffected by the Creek Valley Overlay District representing approximately fifteen percent of the entire acreage in the Basin were identified as suitable for conservation purposes. Such areas are found in many parcels adjacent to the Town northern and western corporate limits (Figure 5.10). In the Basin 169 parcels have some land with Class 32 conservation use suitability and 136 parcels with Class 31. The conservation suitability categories by parcel sizes are shown in Table 5.16.

Table 5.16: Area distribution of suitability categories for conservation

<table>
<thead>
<tr>
<th>Class 32</th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total area</td>
<td>4,629</td>
<td>16.114</td>
<td>97.656</td>
<td>125.488</td>
<td>223.989</td>
<td>128.216</td>
</tr>
<tr>
<td>% area</td>
<td>0.78%</td>
<td>2.70%</td>
<td>16.38%</td>
<td>21.05%</td>
<td>37.58%</td>
<td>21.51%</td>
</tr>
<tr>
<td># of parcels</td>
<td>23</td>
<td>25</td>
<td>57</td>
<td>31</td>
<td>26</td>
<td>7</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>11,984</td>
<td>39,956</td>
<td>300,726</td>
<td>481,239</td>
<td>1,073,710</td>
<td>1,128,801</td>
</tr>
</tbody>
</table>

Table continued next page
Figure 5.10: Land Suitability for Conservation Use
Source: Soil, hydrology, and topography maps
<table>
<thead>
<tr>
<th></th>
<th>LT 1 acres</th>
<th>1 - 2 acres</th>
<th>2 - 10 acres</th>
<th>10 - 25 acres</th>
<th>25 - 100 acres</th>
<th>GE 100 acres</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 31</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total area</td>
<td>5.682</td>
<td>15.189</td>
<td>61.933</td>
<td>83.404</td>
<td>151.338</td>
<td>171.939</td>
</tr>
<tr>
<td>% area</td>
<td>1.16%</td>
<td>3.10%</td>
<td>12.65%</td>
<td>i7.04%</td>
<td>30.92%</td>
<td>35.13%</td>
</tr>
<tr>
<td># of parcels</td>
<td>17</td>
<td>20</td>
<td>46</td>
<td>27</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>Total parcel area</td>
<td>9.783</td>
<td>31.127</td>
<td>244.015</td>
<td>406.933</td>
<td>951.671</td>
<td>615.379</td>
</tr>
</tbody>
</table>

|                |            |             |              |               |                |              |
| **Class 33**   |            |             |              |               |                |              |
| Total area     | 6.711      | 4.875       | 45.083       | 45.010        | 54.934         | 63.677       |
| % area         | 3.05%      | 2.21%       | 20.47%       | 20.43%        | 24.94%         | 28.91%       |
| # of parcels   | 30         | 16          | 44           | 25            | 25             | 6            |
| Total parcel area | 14.05 | 24.401      | 218.384      | 386.476       | 1114.211       | 917.076      |

|                |            |             |              |               |                |              |
| **Class 35**   |            |             |              |               |                |              |
| Total area     | 1.424      | 2.898       | 31.777       | 21.561        | 28.525         | 22.826       |
| % area         | 1.31%      | 2.66%       | 29.15%       | 19.78%        | 26.17%         | 20.94%       |
| # of parcels   | 6          | 7           | 24           | 13            | 4              | 2            |
| Total parcel area | 3.776 | 10.753      | 137.434      | 203.389       | 175.648        | 382.860      |

|                |            |             |              |               |                |              |
| **Class 37**   |            |             |              |               |                |              |
| Total area     | 2.028      | 0.103       | 12.689       | 19.378        | 33.499         | 9.346        |
| % area         | 2.63%      | 0.13%       | 16.47%       | 25.15%        | 43.48%         | 12.13%       |
| # of parcels   | 13         | 4           | 15           | 12            | 13             | 4            |
| Total parcel area | 7.310 | 5.573       | 104.311      | 197.545       | 604.984        | 684.557      |

Source: Suitability map for conservation use

5.6 **Land Suitability Compatibility with the existing zoning**

The land suitability composite map was overlaid with the existing zoning map to identify areas of land suitability compatible with the existing zoning. Agriculture, residential, mixed, and conservation uses identified from the land suitability analysis were compatible with the existing area zoned for agriculture uses (Figure 5.11) where low density residential uses are also allowed. Areas currently zoned for agriculture use are either vacant, in low intensity agriculture use, or in some low density residential use. Some areas with mixed use suitability were compatible with the area zoned for residential or university uses.

The incompatibility is in areas that are currently zoned for residential or university uses but are most suitable for agricultural use as identified by the land suitability analysis (shown in white in Figure 5.11). Most of the parcels in the area currently zoned residential are connected to the Town sewer. It seems that the current zoning had been developed without taking into consideration the soil properties, a crucial factor in
Figure 5.11: Land Suitability & Existing Zoning Compatibility
Source: Soil, hydrology, topography, and zoning maps
determining where developments should be encouraged in the environmentally sensitive Tom’s Creek Basin. Further, it seems that there was a lack of comprehensiveness in the earlier land use plans to direct the Basin’s development. This view is reinforced by the current development status in the Basin where residential development has primarily occurred along the existing streets.

It has been only the last two years that a conscious effort has been initiated to develop a land use policy compatible to the environmental concerns of the Basin. The replacement of the existing zoning districts by the new proposed zoning districts of Rural Residential, Rural Residential II, and Creek Valley Overlay Districts seem to be in the right direction.
6 CONCLUSION

6.1 Land Suitability Analysis

Land Suitability analysis is often criticized for the number of value judgments or assumptions required when determining what factors are most critical for each land use, what relative values to assign to subfactors, and how to determine relative importance of the different factors. However, by incorporating more professional and public input in the process of assigning values to broaden the basis for judgments and refraining from aggregating information too far can make suitability analysis a useful technique in identifying the location and area of zones suitable for a particular use. Further, incorporating GIS in the suitability analysis process will aid in developing more comprehensive land suitability analysis because it allows developing a number of land suitability iterations based on different assumptions.

However, land suitability analysis by itself cannot be used to develop a land use plan for any area. Information generated from land suitability analysis can be used in conducting other land developability analyses like carrying capacity, committed land, and market forecast analyses. Information from land suitability and other analyses can then be used by the Town planners and community leaders in developing a land use plan for the Tom’s Creek Basin that conforms to their vision of future development in the Basin.

The land suitability analysis for the Tom’s Creek Basin identifies 42.45% of the Basin area well suited for agriculture uses, 5.91% for residential uses, 13.29% for mixed uses, and 36.41% of the acreage that need to be conserved for environmental purposes (Figure 6.1). Prime areas for residential development were identified to be contained primarily in a number of parcels along Meadowbrook Drive. The suitability analysis also identifies large tracts of area well suited for mixed uses in the area between Tom’s Creek Road, Meadowbrook Drive, Shadow Lake Road, and US 460 Bypass. Thus, future residential and some minor commercial uses in the Basin should be encouraged to locate in these areas. These areas well suited for residential and mixed uses have very good road accessibility and most importantly are adjacent to the already developed residential
Figure 6.1: Land Suitability for Different Uses

Source: Soil, hydrology, and topography maps
area on Glade Road near US 460. The close proximity of areas with development potential and already developed areas in the Basin can aid in the development of infrastructure facilities like sanitary sewer for the Basin and a core containing clustered residential development surrounded by areas of open space and greenery. This will aid in developing the Tom’s Creek Basin as a rural residential area where the natural and agricultural character of the Basin is preserved.

Further, most of the areas identified suitable for residential and mixed uses are found in parcels that are ten acres or more in size. Land owners of such parcels can obtain transferable development rights by incorporating certain features in the proposed development plans for that area as per the new proposed Rural Residential II District. This will aid in residential clustering and preservation of open space and environmentally sensitive lands. Further, the Town could encourage consolidation of parcels to enable in developing an environmentally sensitive development since, areas of suitability do not follow any parcel demarcations.

The findings of this land suitability analysis would be more comprehensive if data on parcel’s current land use, ownership, and availability of sewer and water facilities were incorporated in the study. ARC/INFC was found to be very versatile for conducting this analysis, but it did require technical competency and time to be able to use the software’s functionality.

6.2 Applicability of GIS in Land Use Planning

This study reveals the importance of availability of data in the right format for doing any analysis using GIS. Database development and management is the most time consuming part of any GIS. GIS is very well suited for analysis purposes both at the large and small scales when data is readily available. However, if considerable time and costs are required for data collection, the cost effectiveness of GIS for small areas becomes questionable. The criteria for the applicability and success of GIS in land use planning depends on defining the scope of GIS, gaining and maintaining political support, and to
develop and implement a plan for setting up the system (acquiring the appropriate hardware, software, and technical personnel), developing and maintaining databases, and performing analysis.

The costs of a GIS are - hardware and software, GIS personnel and staff training, system and data maintenance, and database development. The benefits from a GIS can be described in terms of efficiency (time and labor savings), effectiveness (enhanced decision making and development of new products and services), and intangible benefits if any (improved public image, improved employee pride and job satisfaction, increased job professionalism and confusion reduction). Initially the costs are more than the benefits but with time as the system starts functioning at its designed operational level benefits outweigh the costs.
7 BIBLIOGRAPHY

Carstensen, Lawrence W. 1995 Course Handbook for Introduction to Geographic Information Systems. V.P.I. & S. U., Blacksburg, VA


Steinitz, C., Parker, P., and Jordan, L. September 1976 “Hand Drawn Overlays: Their History and Prospective Uses.” Landscape Architecture

Town of Blacksburg 1995 Resolution 11-C-95. Blacksburg, VA


Zoning Ordinance Rewrite Committee, Town of Blacksburg 1994 Tom’s Creek Survey Results. Blacksburg, VA