Section 2: The Plan

Virtually all the forest was destroyed in starting this west Knox County subdivision. Now it highly eroded and no houses were developed.

Guiding Principles, Objectives and Policies

The following points are the overarching themes that are presented in the remaining portions of the plan. Each of the principles, associated objectives and policies are reiterated in greater detail in the subsequent sections.

Conservation and restoration of forested ridges should be a component of environmental and economic sustainability in Knoxville and Knox County.

- In order to avoid water quality and quantity issues, including erosion and flooding, maintain the majority of steep forested slopes.
- To avoid further negative impacts to regional air quality, conserve and reforest steep slopes and ridgetops.
- Maintain a combination of private and public open spaces, where forests are kept largely intact, to foster wildlife and plant habitat protection.
- Recognizing that open space systems can enhance neighborhood and community property values, continue to set aside hillside woodlands in private development and create additional ridgetop natural areas.
- Limit development intensity and forest clearing in relation to steeper slopes and ridgetops; foster higher intensity development on flatter areas below ridges.

Conservation of McAnnally and other ridges near House Mountain could be part of regional open space system.

The health and safety of Knoxville and Knox County residents should be protected by avoiding high intensity hillside development.

- Guide development to areas where there is adequate water pressure for fire protection services.
- Revise standards for hillside road and driveway grades to better ensure emergency service access.
- Avoid development on slopes that are characterized by soils that have a high potential for landslides.
- Ensure that the early planning stage of hillside development includes a review of water service requirements, so that adjustments to density, height of building or other design elements can be considered to minimize the impacts of water facilities on the landscape.

Ridge conservation should be part of an open space system that reduces sprawl, maintains scenic resources and creates greenbelts around our communities.

- Maintain the Rural Area as identified in the Growth Policy Plan, conserving this predominant portion of our forested ridges, and direct development to the city of Knoxville, its Urban Growth Boundary and the county's Planned Growth Area.
- Limit building heights on hillsides and on ridgetops whereby housing and other uses blend with forest cover and natural slopes.
- Link ridge corridors as part of an open space system, building upon such corridors as the Urban Wilderness Trail.
- Continue to foster the work of the Legacy Parks Foundation and other land trusts in establishing ridge-oriented open space systems.
- Offer incentives to conserve hillsides and ridgetops, including increased intensities of land use on more level portions of a parcel.

Hillside and Ridgetop Protection Area

Knoxville-Knox County's General Plan and sector plans have identified steep slope protection areas since the 1990s. The significant use of those maps has been: (1) to depict areas that are appropriate for less intense uses, particularly residential uses, and (2) to enable the planning commission, city council and county commission to have a process to consider rezoning requests for hillside areas on a consistent basis. This process has been used to create "planned zoning districts," such as planned residential, so that an appropriate density can be determined and environmental constraints can be identified at the time of rezoning. Planned zoning districts also require site plan review so that a development and conservation plan, which depicts housing sites, roads and open spaces, can be established to conserve sensitive forested hillside areas.

The Hillside and Ridgetop Protection Plan map (see page 32) is proposed for much of the same purposes with the addition that flatter areas on the tops of ridges are included in the map. This is made possible on a systematic basis by advances in geographic information system (GIS) mapping that can identify those flat areas above a steep slope, including "ridgetops." This is significant because one of the overall objectives in creating the task force and this plan was to address ridgetop protection, including appropriate density, siting of structures, clearing and development standards.

The new Hillside and Ridgetop Protection Area is proposed to conserve natural terrain, water resources and scenic qualities associated with the ridges, while allowing development under certain circumstances. The map shows that there are diverse shapes to our ridges. Some have exceedingly steep hillsides, while others are lopsided, having a steep side and gently sloping side. These characteristics relate to underlying geological formations (see Background, pages 7 - 8). However, there is a common set of general development principles that can be used to conserve natural terrain:

- The steeper the slope, the lesser the amount of housing density and development intensity.
- The steeper the slope, the lesser the amount of land disturbance and a greater amount of conservation.
- The tops of ridges define the "crown" of Knox County's natural beauty and are worthy of conservation.

The plan maps and the policies are significant tools in minimizing negative impacts of construction on steep hillsides, including excessive deforestation, soil erosion, water quality degradation, landslides and loss of natural beauty.

Characteristics of the Hillside and Ridgetop Protection Area

The Hillside and Ridgetop Protection Area, also known as the Hillside Area, is characterized by slopes that are 15 percent and greater and at least five acres in size and flatter areas on ridges, including their summits. Within this area, most hillsides have a 15 to 40 percent slope while approximately 10 percent of the slopes are between 40 to 50 percent.

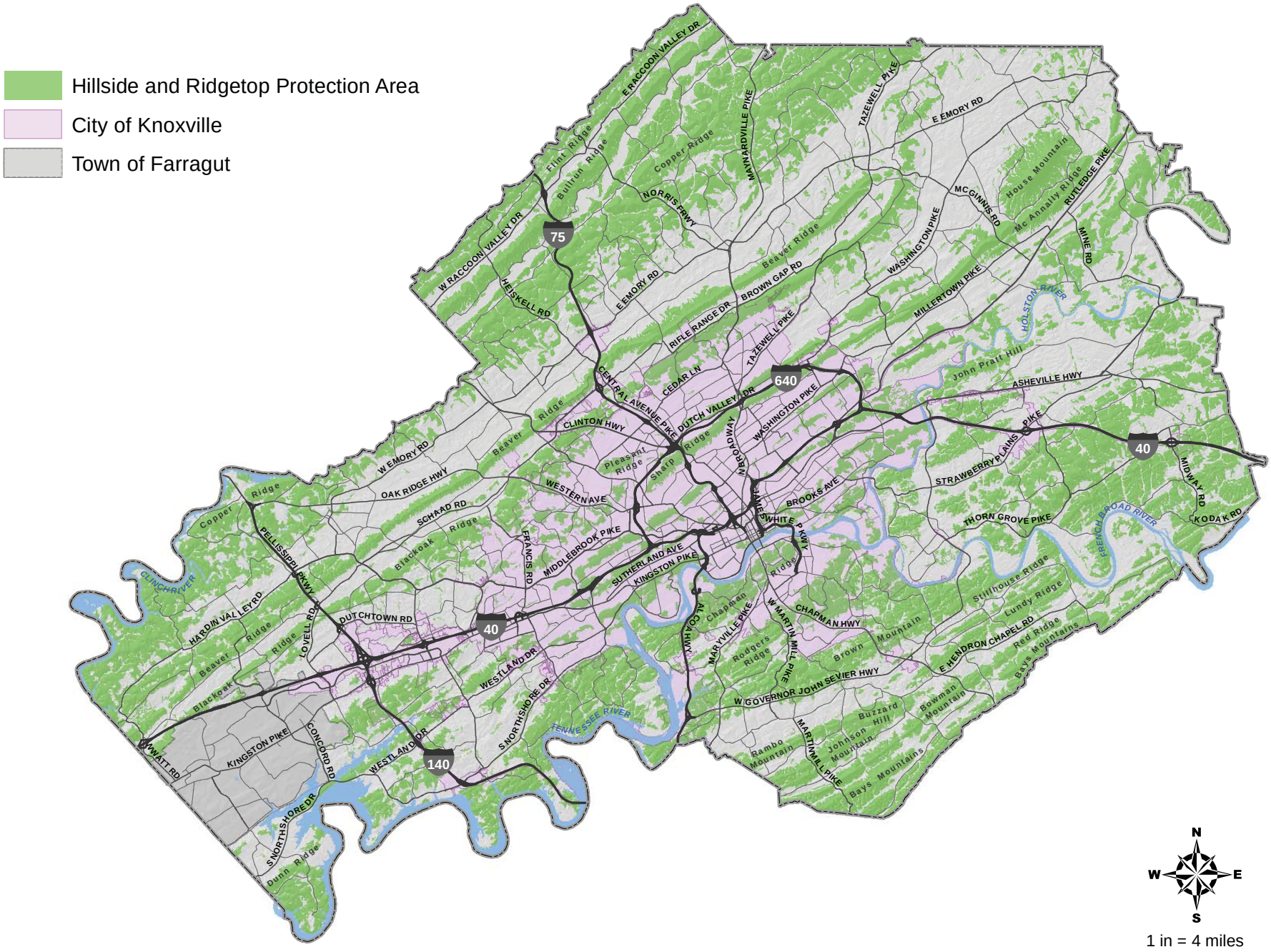
As slopes increase, the stability of soils generally decreases, thus the likelihood of soil failure is greater on steeper slopes, especially where more unstable soils are found (see Map 4: Soil Slippage Potential, page 12).

The Hillside and Ridgetop Protection Area also contains the vast majority of Knox County's forested resources, especially in the Rural Area (see Map 5: Knoxville, Knox County, and Farragut Growth Plan, page 18). Since these areas are mostly undisturbed, ridges are significant wildlife corridors. Species richness, as demonstrated through the work of the Tennessee Department of Wildlife and Fisheries, is also greater on ridges (see pages 4 and 5).

Table 2: Proposed Hillside and Ridgetop Protection Area Acreage by Slope

Percent Slope	*Acres*	*Percent of County*
0 - 15	38,024.38	29.00%
15 - 25	43,424.14	33.12%
25 - 40	33,033.52	25.20%
40 - 50	9,559.43	7.29%
50 or more	7,066.04	5.39%
Total	131,107.51	100%

Map 7: Hillside and Ridgetop Protection Plan



Zoning and Development Policies

Zoning is the foundation for land use control in Knoxville and Knox County. Over the last two decades, MPC, the city council and county commission have made rezoning decisions based on the capability of land to sustain certain intensities of development, recognizing that steep slope and flooding conditions pose limitations. The zoning codes contain limitations on the height of building, which is 35 feet in the zoning districts that are currently within the Hillside and Ridgetop Protection Area. No changes are recommended to the building height limitation on steep slopes and ridgetops.

The Growth Policy Plan, General Plan and sector plans contain policies regarding recommended residential densities relative to the degree of slope. The following represents a refinement of those policies recognizing that there are significant geologic hazards and engineering constraints to development on the steepest slopes.

An example of two dwelling units per acre in the 15 to 25 percent slope group

LOW DENSITY AND RURAL RESIDENTIAL USES

Base Density

For the purposes of rezoning cases and other decisions in implementing this plan, the following densities are recommended in calculating the overall allowable density for those portions of a parcel that are within the Hillside and Ridgetop Protection Area. The areas of the Growth Policy Plan referenced below are presented on page 18:

Table 3: Residential Density in Relation to Slope within the Hillside and Ridgetop Protection Area
(Recommended Basis for Rezonings and Subdivision Design)

Percent Slope	*Low Density Residential in City,Urban Growth Boundary and Planned Growth Area*	*Percent Clearing Calculation for Overall Purposes*
0 - 15	Knox County: Maximum = 5 du/1 acre City of Knoxville: Maximum = 6 du/1 acre	100
15 - 25	Maximum = 2 du/acre	50
25 - 40	Maximum = 1 du/2 acres	15
40 - 50	Maximum = 1 du/4 acres	10
50 or more	No Development*	None
Ridgetops**	Maximum = 1 du/1 acre	15***

* The effect of this prohibition on parcels in Knox County is minimal as only one parcel has more than 80 percent of its area on slopes in excess of 50 percent; namely, a 10 acre parcel on Porterfield Gap Road that has 97 percent of its area on slopes over 50 percent. There are several very small, vacant lots on Sharp's Ridge above Lonsdale, many of which have been chronically tax delinquent, and vacant mobile home lots on Beaver Ridge that have a majority of their area on slopes that are over 50 percent.

** Ridgetops are generally the more level areas on the highest elevations of a ridge. Because the shapes of Knox County ridges are so varied (see pages 8 - 9), the ridgetop area should be determined on a case-by-case basis with rezoning and related development proposals.

*** Also see the ridgetop development policies, pages 38 and 45.

Density Bonus Provision

The density on the site may be raised in relation to the conservation of the steeper slopes and ridgetops that are part of a parcel. In cases relative to the Hillside and Ridgetop Protection Area, the planning commission may approve a density bonus of up to10 percent of the total units allowed in the base density when a conservation easement is placed on an undisturbed steep hillside or ridgetop portion of a parcel. An additional bonus density of 10 percent of that allowed by the base density may be approved when public access, such as a trail easement, is provided within the conservation easement. This bonus provision should be made available within a planned residential development and in a conservation subdivision.

An example of clustered housing on a modest slope in Black Mountain, North Carolina. This approach enabled the conservation of steep hillsides nearby. Note the small front yards and use of earth tone colors, chosen to help the houses blend with the natural terrain.

Density/Intensity Outside the Hillside Protection Area

The land below the Hillside and Ridgetop Protection Area, which contains more than 200,000 acres or about 60 percent of the county, would be suitable for those uses proposed by the General Plan and individual sector plans, and that are consistent with the Growth Policy Plan. As such, density and intensity would be regulated by those particular plans.

Some hillsides are very steep like the north face of Copper Ridge, which has slopes in excess of 50 percent. Very low density residential uses and minimal forest clearing are recommended on such slopes.

Clearing and Grading Provision

Hillside and ridgetop development necessitates careful consideration of the forest cover on various types of slopes. Loss of that cover may lead to erosion, water quality and geotechnical problems. The natural beauty of a ridge is also lost with wholesale destruction of hillsides. The clearing limits for rezoning cases, and subdivision and site plan review processes are shown in Table 3. In reviewing rezoning requests, concept and site plans, it may be necessary to note the steepest slopes of a parcel for conservation purposes. Clearing and grading should not be permitted until a development or clearing and grading plan has been approved.

This represents a good local example where clearing was limited around a ridgetop house, providing views for the owner and maintenance of the surrounding forest.

Pre-existing Vacant and New Lots

After a lot has been created, most purchasers will try to save trees as they build a house. Their goals are rational: shade, beauty and maintaining property value; numerous studies have shown that a wooded setting around a house adds 10 to 20 percent to the value of the lot.[1] In the Hillside and Ridgetop Protection Area, such conservation is particularly warranted so that neighboring property owners will not be adversely affected by greater runoff and loss of natural beauty. In the case of pre-existing vacant lots that are zoned for low density residential purposes, uses that are allowed under the current zoning should be permitted. The percentages of tree clearing, such as those for the slope groups in Table 3, should be used to avoid total lot clearing. Additionally, reduced building setbacks are recommended to avoid clearing and grading to minimize construction costs and the extent of cut and fill slopes (see page 37).

When new lots are created in a hillside subdivision, several options should be considered to conserve forested areas: (1) establishing clearing limitations on lots as part of the subdivision plat (this could be realized by a deed restriction); (2) setting aside a conservation easement on ridgetops and the steepest, forested portions of a lot; or (3) creating an administrative review process through building and planning officials to allow hillside home development and streamline the approval process.

Recommended Zoning

Planned residential zoning (PR, RP-1) is recommended for low density when parcels are in or partially within Hillside and Ridgetop Protection Areas.

MEDIUM DENSITY RESIDENTIAL AND OFFICE USES

Density and Use Intensity

The following provisions are recommended for decisions regarding medium density residential and office rezoning and site plan approvals that are within or partially within the Hillside and Ridgetop Protection Area. A parcel must be depicted on a sector plan for medium density or office uses, thus having reasonable locational characteristics in relation to adequate transportation and utility infrastructure.

When high density apartment or condominium uses are appropriate, the development should be constructed at the toe of a ridge.

- On slopes less than 15 percent, allow residential densities in the city up to 24 dwellings per acre and 12 dwellings per acre in the county, and office uses, when those areas are not on the top of a ridge.
- Allow consideration of medium density residential and office uses on slopes of 15 to 25 percent with certain provisions to reduce the amount of site disturbance: (1) smaller setbacks should be considered to avoid slope cuts, and (2) these uses should only be considered when the building footprint does not exceed 5,000 square feet per one acre when the slope is closer to 15 percent and graduating to one 5,000 square foot building footprint per two acres when the slope is closer to 25 percent. All new proposals for medium density and office uses should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission. Conservation measures and other incentives may be used to protect as much of the building site as possible (a summary of incentives is presented in Appendix H).

Clearing and Grading Provision

There are various techniques to avoid excessive clearing, including locations of medium density and office buildings on more level portions of a site (see above) and alternative parking layouts (see page 39). These provisions are outlined for medium density residential and office uses in the protection area to avoid various problems, including erosion and water quality degradation.

- On slopes of less than 15 percent within the protection area, site clearing and grading should be determined via site plan review, based on the size of more level area and its relation to other slope groups (for example, a quarter acre site within a large area of steep slopes (25 percent or more) would not be a good site for apartment development).
- In areas of 15 to 25 percent slopes, clearing should not exceed 50 percent of the area in that slope group (unless the Metropolitan Planning Commission approves a a development plan or creates a special district).
- On slopes greater than 25 percent, no clearing or grading should be permitted for medium density residential and office projects.
- Slopes that are created via grading (cut and fill slopes) and are adjacent to undisturbed slopes in the Hillside and Ridgetop Protection Area should be reforested. The Hillside Reforestation method is recommended (see page 41).

Recommended Zoning

Planned residential zoning (PR, RP-1) is recommended for medium density when a parcel is in or partially within the Hillside and Ridgetop Protection Area. A zone that requires site plan review is recommended for office development in the Hillside and Ridgetop Protection Area. A straightforward solution to accomplish this review is to amend the office park zoning districts to require use-on-review in the Hillside and Ridgetop Protection Area.

COMMERCIAL, INDUSTRIAL AND BORROW PIT USES

Use Restrictions

Commercial uses require attributes of reasonable location and terrain, particularly moderately level sites, and very good transportation and utility infrastructure.

- Commercial development should be allowed on land below the Hillside and Ridgetop Protection Area, when a parcel overlaps the protection area as long as the development proposal is consistent with the Growth Policy Plan and applicable elements of the Knoxville-Knox County General Plan.
- For commercial projects that extend into 15 to 25 percent slopes, slope restoration and reforestation of cut-and-fill areas should be accomplished to minimize the long term impact to water quality and lessen forest canopy loss in the hillside and ridgetop protection area.
- Industrial development is not recommended on hillsides that exceed 15 percent; this criteria has been used in various MPC industrial and business park site identification studies, such as those of 2002 and 2005.
- Borrow pit uses may only be allowed on slopes under 15 percent and should be restored via the Hillside Reforestation method (see page 43).

Recommended Zoning

Planned commercial zoning districts (PC, PC-1) must be used for commercial projects when parcels are in or partially within the Hillside and Ridgetop Protection Areas.

PLAN AMENDMENTS AND SPECIAL DISTRICTS FOR OFFICE AND COMMERCIAL USES

Other new office and commercial development may be considered in the Hillside and Ridgetop Protection Area under special circumstances. The following criteria should be considered in evaluating potential projects:

1. The area should be designated in the sector land use plan as office or commercial.
2. In some circumstances, a plan amendment will be necessary. Among the significant criteria that should be considered in making an amendment are:
   a. The type of ridge or hillside (see pages 7 and 8; narrow knife-edge ridges are generally not appropriate);
   b. The site's proximity to highways, freeways and transit;
   c. Traffic carrying capacity for those roads and streets providing access to the site; and
   d. The site's location in relation to the City, its Urban Growth Boundary, and the County's Planned Growth Area, especially areas that are particularly suitable as employment centers such as major highway intersections and freeway interchange areas.
3. In creating development plans for such sites, the design team should:
   a. Identify and conserve slopes over 25 percent;
   b. Use structured parking (preferably underground), especially for buildings taller than three stories, to reduce the area devoted to required off-street parking;
   c. Identify the measures to restore mature vegetation and forests that will be cleared due to construction; and
   d. Consider measures such as bio-infiltration, lower impact road design, reduced setbacks and other means available as incentives (see Appendix H).

All new proposals should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission.

OTHER CONSIDERATIONS

Retaining walls may be needed in various types of land development. Examples include providing a road without ripping out a large swath of sloping terrain in a residential development or fortifying a slope in more intensive development, avoiding cuts into steeper, natural hillsides. Determination of retaining wall height and safety measures (for example, fencing to avoid a person's fall) are subject to engineering staff review. Trees that would compromise the strength of walls should not be approved without engineering staff review.

The Effect of the Hillside Policies

During the course of public input, some individuals observed that they felt that hillside areas are the only places left for future development. Staff analyzed the implications of the policies and has found that there is an array of opportunities to accommodate new development, both within and outside hillsides areas. This is summarized below and more fully explained in Appendix C.

Development Guidelines

MAXIMUM BUILDING HEIGHT

With few exceptions, such as near downtown and some office districts, the maximum building height of Knoxville's and Knox County's zoning regulations is 35 feet. This allows a three-story building. It is recommended that the maximum building height in the Hillside and Ridgetop Protection Area be 35 feet for all uses, as measured from the average natural grade of the proposed building footprint to the roofline (if a flat roof is used) or to the midpoint of the height of a pitched roof.

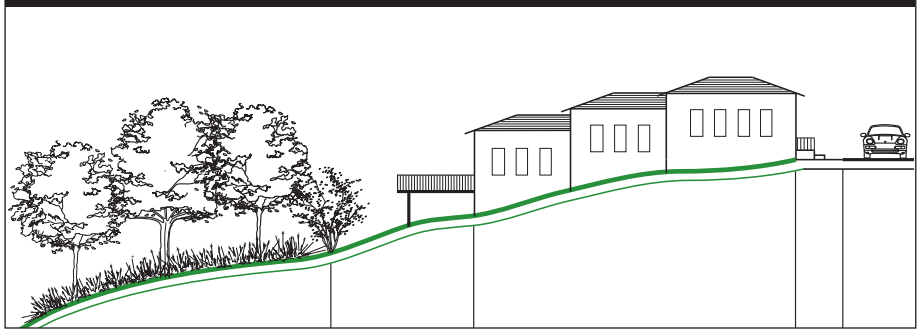
Water utilities, including tanks or towers, play a role in determining the acceptable height of buildings. Utility districts should be involved in the planning process to ascertain water pressure and related utility implications relative to height.

Existing zoning codes limit building heights to 35 feet. Hillside-oriented houses such as these are examples of structures that would meet the recommended 35 foot maximum height standard.

LOW AND RURAL RESIDENTIAL DENSITY DEVELOPMENT

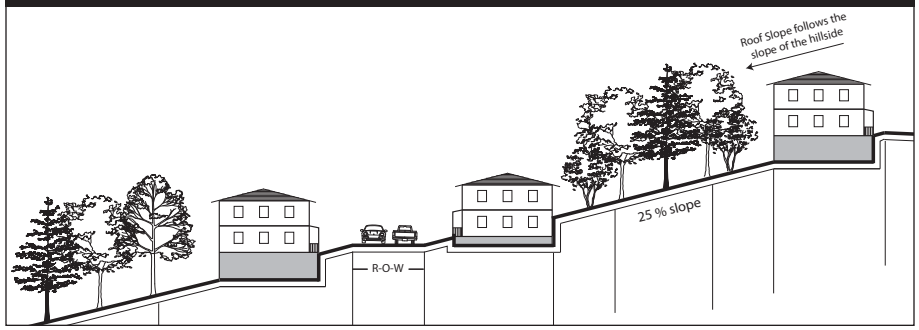
Detached and attached dwellings constitute the majority of uses that would be developed in the Hillside and Ridgetop Protection Area. The following design recommendations help achieve the goal of low impact development.

Figure 1: Example of Terrain Adaptive Architecture



- Terrain adaptive architecture is recommended. Structures should be built into the natural slope of the land to minimize cut and fill; pad grading (for example, preparation for a concrete building slab) should be avoided.
- Street pavement width should be minimized, and in some circumstances it may be reduced to 20 feet; in no case should it exceed 26 feet. Right-of-way width should not exceed 40 feet for 20 foot wide roads.
- Front yard setbacks may be reduced to limit overall site disturbance under some circumstances, such as when there is a fairly level space near the road and the back of the lot falls steeply downhill. These smaller setbacks may be approved via use-on-review or in exceptional cases of pre-existing lots, when a hardship is demonstrated.
- Rooflines should generally be designed to have a pitch that follows the natural slope; however, portions of the valley-facing facade can be accented by gables. Roofing material colors should be of earth tones (grays, greens, tans, and browns).

Figure 2: Example of Reduced Right-of-Way, Setbacks, and Adaptive Rooflines



- Lot orientation should be with the natural grade of the land. This will generally be a lateral orientation with a road running along the contours of a hillside. Additional lot width may be needed to accommodate driveway access.
- Residential building materials should be comprised of fire resistant material such as stone, brick or wood siding over a masonry foundation (see Firewise safety recommendations, page 48). Exterior material colors should be of earth tones such as grays, greens, tans, browns and natural wood.
- Tree preservation should be encouraged particularly on the rear of lots and near ridgetops to screen homes; at least 85 percent of trees within 100 feet of a ridgetop should be conserved.
- Homes should be clustered on more level land areas of the site, while areas with slopes 25 percent greater and ridgetops should be left undisturbed or developed at a very low density.
- Parking guidelines to minimize site disturbance include the following:

  For detached dwellings:

  On-street parking may be considered to meet off-street parking requirements on steep hillside sites, including bulb-outs with parking stalls running parallel to a road.

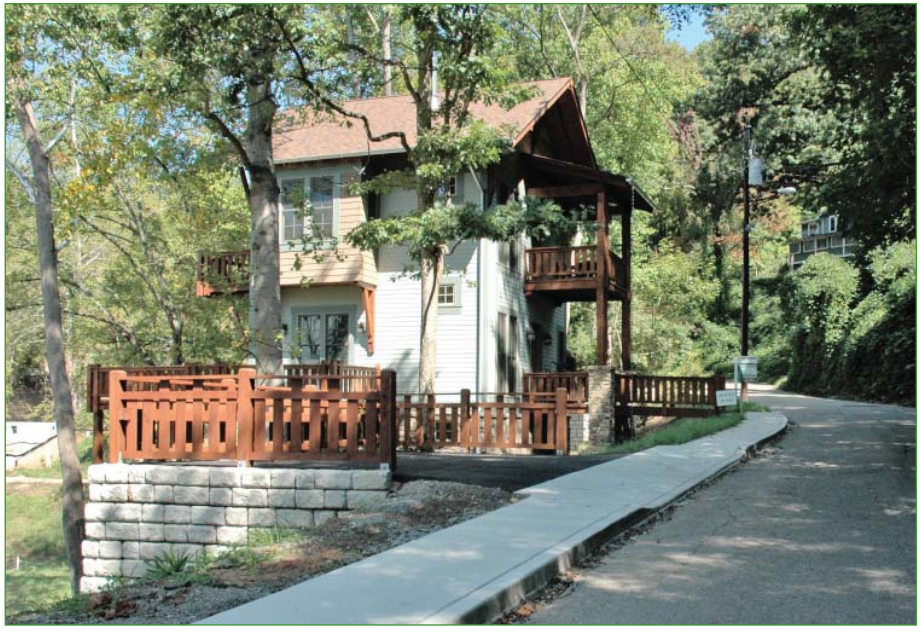
  Off-street parking options include:
  "Tucked-under garages" constructed within a house, minimize clearing and grading. Several designs are possible in placing a garage under a house: when the house is uphill and close to the right-of-way, a "tucked-under garage" can be a good solution; when access can be provided to the side of house a basement garage is another good solution.

  Parking pads near the right-of-way also offer a solution, especially on small lots, as long as sight distances are adequate where the pad meets the road.

  For attached dwellings, such as condominiums and duplexes, which are best sited on more level portions of a site, the following options are recommended:

  On-street parking may be considered, using bulb-outs with parking stalls running parallel to a road.

  Off-street parking under a structure is to be encouraged on hilly locations to reduce tree canopy removal.



This parking pad is an acceptable means to provide off-street parking in Asheville's low density hillside district to avoid the clearing that a conventional driveway would require.

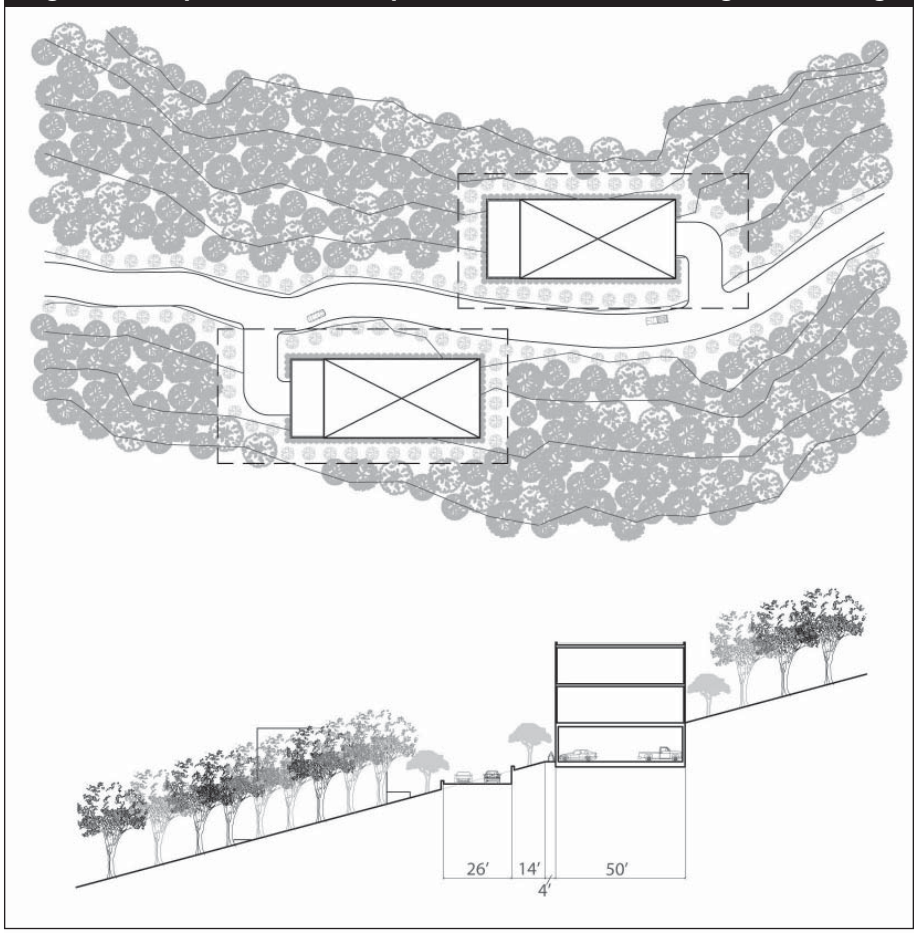
A local example of a "tucked under garage"

MEDIUM DENSITY RESIDENTIAL AND OFFICE DEVELOPMENT

Portions of the Hillside and Ridgetop Protection Area are characterized by moderate to steep slopes which present challenges for development in regard to public safety and environmental concerns. Under some circumstances, limited medium density housing or office development may be appropriate in area where transportation systems are very good and provisions for housing near jobs have been found to be a prudent land use policy (such as in the Tennessee Technology Corridor). In order to provide proper development guidance for such areas, the following recommendations should be considered in creating site plans:

- To reduce the amount of hillside site disturbance, development should be focused in more level areas below or on the less steep parts of the Hillside and Ridgetop Protection Area.
- Allow consideration of medium density residential and office uses on slopes of 15 to 25 percent with certain provisions to reduce the amount of site disturbance: (1) smaller setbacks should be considered to avoid slope cuts, and (2) these uses should only be considered when the building footprint does not exceed 5,000 square feet per one acre when the slope is closer to 15 percent and graduating to one 5,000 square foot building footprint per two acres when the slope is closer to 25 percent. All new proposals for medium density and office uses should be subject to the approval of a use on review and site plan by the Metropolitan Planning Commission. Conservation measures and other incentives may be used to protect as much of the building site as possible (a summary of incentives is presented in Appendix H).
- The maximum allowable height of a building should not exceed 35 feet, measured from the average natural grade of the building site.
- The criteria for the conservation of Hillside and Ridgetop Protection Areas focuses on the prevention of erosion and the preservation of trees and scenic views. As such, new development, including non-residential buildings, parking areas, artificial berms, and detention/retention ponds, should not be permitted on slopes in excess of 25 percent.
- Road and access should be accommodated with low-impact design, including narrower pavements and rights-of-way (these are further discussed on page 38).
- Under building parking structures, or terraced parking, should be used to preserve hillside and ridgetop protection areas.
- Shared parking and on-street parallel parking bays should be used where possible to minimize land disturbance, minimize impervious surface coverage, and preserve natural beauty.
- Maximum allowed parking for medium density and office density should be further examined to limit surface parking impacts; the suggested standards for office development is that the maximum parking should not exceed 2 spaces per 1,000 square feet of gross floor area.

Figure 3: Example of Office Development on a Hillside with Underground Parking



COMMERCIAL AND INDUSTRIAL DEVELOPMENT

As noted previously, new commercial and industrial rezonings should not be permitted in the Hillside and Ridgetop Protection Area. However, pre-existing commercially zoned vacant property and new development on that land or on land adjoining the protection area should be considered in view of the following:

- Incentives should be explored to foster development totally outside of the Hillside and Ridgetop Protection Area. These should include consideration of a reduction in off-street parking, retail parking, shared parking, decreased setbacks and taller buildings on the level land.

In this mixed-use and commercial development the impact to the hilly terrain was limited by reducing the setbacks of the restaurant and condominiums (top) *and the wooded setting behind the commercial space and housing units was also saved* (bottom).

SUBDIVISION REGULATIONS

Development within the Hillside and Ridgetop Protection Area requires alternative design standards in order to protect public safety and environmentally sensitive areas. The current Minimum Subdivision Regulations address hillside development in a limited manner that is not consistently implemented. The Hillside and Ridgetop Task Force recommended that the current regulations be modified to foster safe and effective development with minimum land disturbance.

Infrastructure improvements for development, such as roads and utilities, contribute a significant amount to the total land disturbance of a site. Roads, for instance, in residential neighborhoods are typically 26 feet wide to accommodate on-street parking on both sides of the street while allowing for one continuous, uninterrupted travel lane. In the Hillside and Ridgetop Protection Area, it is anticipated that the intensity of development will be less than in other areas so more narrow streets (20 foot widths) can be acceptable as long as vehicles are not parked on streets. For fire protection needs, when a turn-around is required on a dead end street, roadways should meet all minimum design requirements of the city and county fire officials.

In level areas, underground utilities are typically located to the sides of roads because it is easier to maintain road surfaces when utility repairs are needed. Conventional, “flat land” subdivisions generally have 50 foot wide rights-of-way. However, when road widths are reduced and utilities are located under pavement, the right-of-way width can be reduced and still provide adequate space for utilities. This provides a secondary benefit of reducing the space between the street and the front property line, and reduces the need to clear and grade on steep slopes.

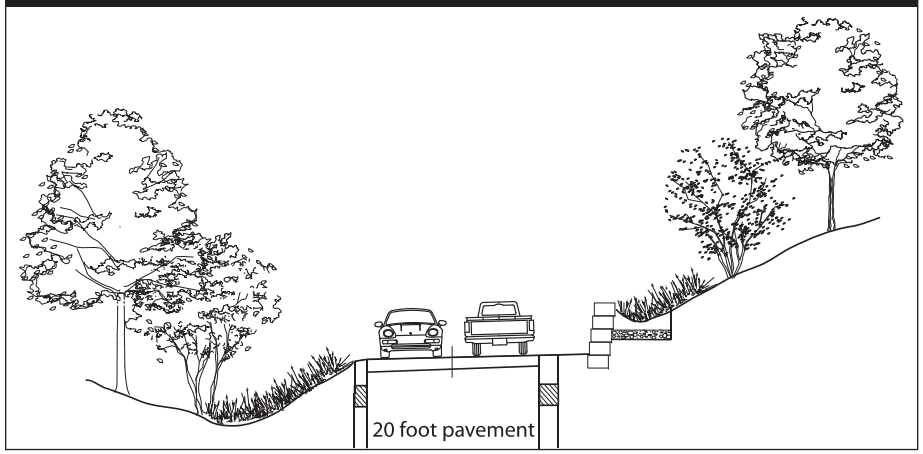
In the Hillside and Ridgetop Protection Area, it is proposed that utilities be placed under road surfaces when possible to reduce the amount of clearing and grading on extremely steep side slopes.[2] This is likely to be accomplished on a case-by-case basis because: (1) there are so many utility districts in Knox County, which operate independently and have different policies for utility placement, and (2) the city and county engineering departments may adopt different management practices for utility locations relative to road pavement.

Roadway Standards

In view of the input of the city and county engineering and public safety officials, the following hillside standards are recommended:

- Rights-of-Way = 40 feet
- Pavement Width = 20 feet (curb-to-curb; or edge-to-edge if stormwater drainage is provided by swales)
- Maximum Road Grade = City of Knoxville - 12 percent; Knox County - 15 percent
- Maximum Driveway Grade = 15 percent for both the city and county
- Turn-Arounds = In regard to turning radii, including hammerhead and cul-de-sac design, both the city and county follow the *American Association of State Highway and Transportation Officials* standards, and these are adequate for emergency vehicles. City fire officials follow *National Fire Protection Association 1141* standards. In general for a cul-de-sac, these standards require a right-of-way radius of 50 feet and a paved radius of 40 feet.

Figure 4: Example of Proposed Width for Hillside Road (20 Foot Pavement within a 40 Foot Right-of-way)



Setback and Lot Size Recommendations

The placement of structures on hillsides is very important when trying to limit the amount of disturbance. In order to provide the most flexibility, setbacks should be able to be reduced be to allow structures in the most appropriate location without encroaching into necessary setbacks for fire protection (some approaches are outlined on page 50). The hillside provisions of the subdivision regulations should be revised to offer greater flexibility in setbacks and larger lot size dimensions that are in keeping with this plan (that is, larger minimum-sized lots than the current 20,000 square feet on slopes that exceed 25 percent).

Proposed Conservation Subdivision Program

Conservation subdivisions are characterized by common open space, compact lots, less road pavement and, sometimes, clustered housing. The purpose of a conservation subdivision is to protect such resources as ridges and farmland while allowing the same housing density under zoning and subdivision regulations. A greater density, called a density bonus, may be offered to encourage conservation in residential development planning.

Open Space Program

The conservation subdivision open space requirement is to protect environmentally sensitive lands. It may also be used to provide recreation opportunities, including a density bonus when public access is provided. The open space requirements are based on the underlying zoning classification and will generally range from 40 to 60 percent of the parcel. The open space is required to be protected from development through a conservation easement.

Primary and Secondary Open Space Areas

The open space land should be determined by several factors; some are primary, others are secondary. Primary conservation areas should be included as open spaces because of environmental values and sensitivity to development, including slopes in excess of 25 percent and the floodplains along stream corridors. Secondary conservation areas are features that should be protected but are not as high a priority, such as forested 15 to 25 percent slopes and farmland.

Density Determination

Residential density will not be less than that allowed under conventional residential zone districts (such as the city's and county's low density residential zoning) or through the rezoning provisions of Planned Residential zoning. Essentially, the minimum lot size of the zone district is divided into the parcel size to determine the density that would be permitted without conservation provisions. Some cities and counties ask for a preliminary plan (sometimes referred to as a "yield plan"), showing the residential lot layout to determine the number of lots that could be created under convention zoning and subdivision codes. Thereafter, the designer can use the flexibility of the conservation subdivision provisions, including reduced lot size and narrower streets, to create a layout that sets aside the open spaces. Fire protection and water supply must also be considered, including the height of water tanks or towers in the area.

Density Bonus Provision

As noted in the zoning policy section (page 34), density may be increased in relation to the conservation of hillside and ridgetops up to 20 percent above the base zone density by setting aside conservation easements on steep forested slopes.

Open Space Management

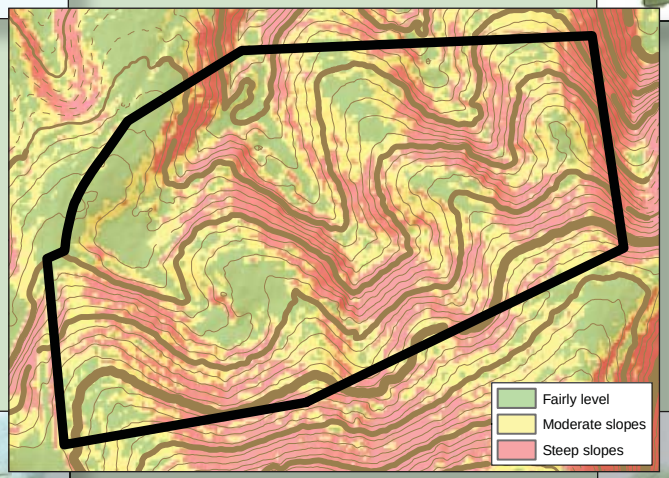
The management and permanent protection of open space is required to protect the resource from destruction or unscrupulous development. Restrictive mechanisms, including deed restrictions, conservation easements and transfer of ownership to a conservation organization or government, are typical approaches. The management of open space should be handled by the entity that has ownership, such as a neighborhood organization, conservation organization or city or county park department.

Applicable Zoning Districts

The conservation subdivision option should be available within most residential zoning districts. The potential hillside zoning overlay district and the county's agricultural zoning district are best suited to protect hillside and ridge resources; a density bonus should be considered to foster conservation. Pre-existing zoning, such as the Low Density Residential (RA) Zone, should also be considered when a developer desires to save such a resource as a hillside by reducing lot size and potentially clustered housing.

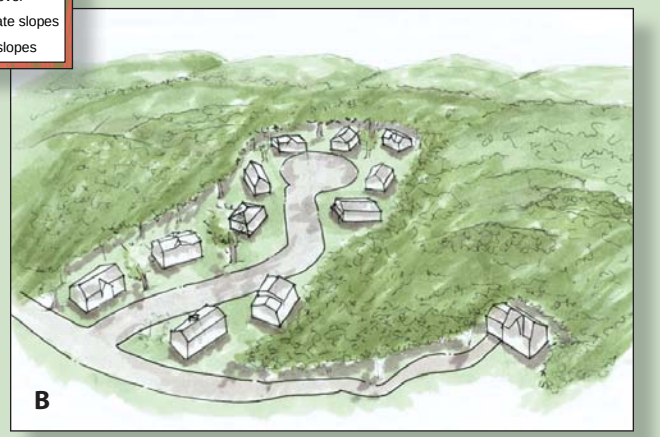
Figure 5: Hypothetical Hillside Development Example

EXISTING SITE TOPOGRAPHY:
Heavily forested, widely varied terrain



Scenario A:
CONVENTIONAL SUBDIVISION
The developer examined the topographic constraints of the site and originally proposed a plan for six large lots.

Scenario B:
CONSERVATION SUBDIVISION
Because the zoning allowed ten units on the site, the developer considered a conservation subdivision layout with clusterd housing, that would allow a 20 percent density bonus for preserving the surrounding hillside with a conservation easement.



REFORESTATION

Background

Hillside reforestation is a healing process when trees are planted on sites that were cleared and graded. Reforestation can also be a natural phenomenon when land is cleared for timber or development. An overview of the city's tree planting standards is presented on page 21. The county has no replanting provisions. Both local governments require soil stabilization, such as planting grass. That, however, does not re-establish a forest, and its associated benefits of habitat, beauty and greater water quality protection.

Clearing and grading on steep topography results in extreme landscape and hydrological changes. Some of the scars on Knox County's hillsides are so severe that the devastation cannot be easily remedied. As a result of extensive grading, soils are heavily compacted, limiting infiltration and increasing velocities of runoff. This places increased demands on stormwater infrastructure and limits the recharge of groundwater.

Knox County's existing forests are generally over a hundred years old. When lost, two generations of children will grow up during the 50 to 70 years that it will take a tree to reach maturity. Consequently, the emphasis in the Hillside and Ridgetop Protection Area should be to conserve trees for the benefit of current and future generations. This practice of good stewardship was recommended by citizens in creating this plan.

A Better Grading and Reforestation Practice

In view of the foregoing concerns, task force staff consulted with forestry professionals to identify better practices for slope stabilization and reforestation.[3] The most promising method is that of the Appalachian Regional Reforestation Initiative (ARRI), which a developed a six step process for grading and reforestation that should be added to the city's and county's engineering and stormwater best practices manuals. The practice is summarized below and is described in detail in Appendix D.

Description of the Recommended Practice

This is an approach to grading and tree planting where hillside forest cover is lost due to construction. It has been demonstrated to be an effective means to avoid soil compaction and difficulties in sustaining tree growth that is associated with conventional grading. The method, which relies on reuse of organic matter, top soil and rock, fosters significant stormwater infiltration and woodland regeneration. It has been tested in the Appalachian region by scientists from the University of Kentucky and Virginia Tech, and is now the standard practice in surface mine restoration. The steps include:

1. Topsoil and rock material from disturbed areas are saved on site at the beginning of a project to create a medium that is suitable for good tree growth and water infiltration.
2. Natural landforms should be mimicked in creating cut-and-fill areas. The majority of the backfill should be placed and compacted using standard engineering practices.
3. The final surface should be prepared by loosely distributing and lightly grading the topsoil and rock mixture, avoiding compaction of the upper few feet. That surface layer, which will form the forest's soil, should be a few feet deep.
4. For immediate erosion control, groundcover should be planted that is slow growing and tolerant of many soil conditions, such as red top and perennial rye grasses or legumes such as birdsfoot trefoil and white clover.
5. A combination of native trees should be selected that will grow rapidly, creating habitat and soil stability. These include oaks, black cherry, redbud and sugar maple; also see Appendix E).
6. The selected species should be planted as seedlings in the dormancy of winter.

This will be the typical appearance after grading -- loosely distributed rock and organic material.

The results of tree growth are significant as can be seen after three years.

Recommended Actions

The following steps are recommended in improving reforestation practices:

- The city and county should adopt the foregoing reclamation process as a slope restoration alternative in their best management practice manuals.
- Because this practice would be a new addition to the city's and county's engineering best management documents, a "test case" should be pursued, potentially offering an incentive (such as a grant) to create a benchmark for the costs and benefits of the method. Several "pilot" steps should be considered: (1) voluntary compliance by a developer to use the method with new construction; (2) use of the technique as a road or public facility project; or (3) a demonstration project in healing a previously cut slope.
- Another alternative method may be forthcoming. A student housing development will likely be created west of Edington Road in the next few years. As part of site plan approval several forested slopes were to be conserved; however, some cut slopes were approved with the understanding that they would be planted with native trees, using a method that has been tested in Athens-Clark County, Georgia. If successful on this Vestal-area site, that method may also be appropriate to adopt as a best management practice.

Cost Advantages

There are two potential cost benefits with the ARRI method: (1) less time than conventional soil compaction methods (that is, continually running a dozer back and forth to compact and smooth a slope); and (2) less stormwater runoff (water penetrates the rougher surface, with its rocks and un-compacted soils and organic debris) to reduce velocity of runoff and encourage infiltration, avoiding sedimentation, large detention basins and other infrastructure costs.

GRADING AND CLEARING

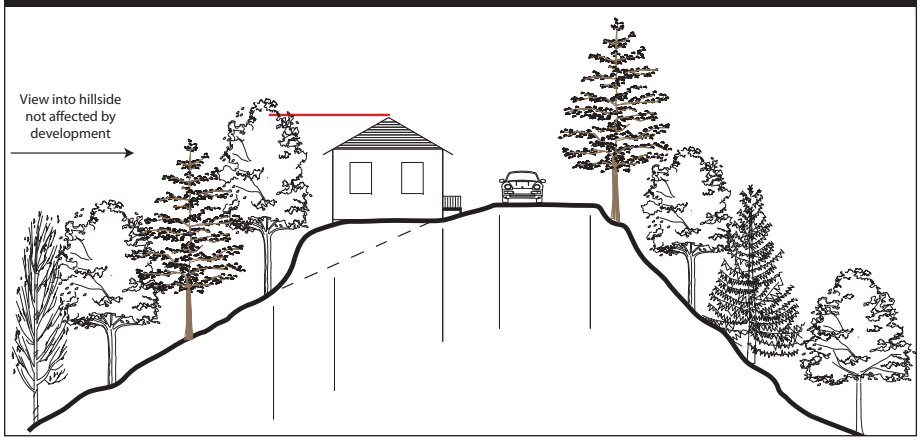
More attention to hillside grading and clearing will realize several goals of this plan: water resource and habitat protection along with public safety objectives such as keeping slopes intact, particularly those with unstable soils. Some land disturbing activities are currently regulated under stormwater permitting processes. Grading, especially as it relates to drainage and water quality, has been the principal concern requiring permitting. In the city, the permit is called a Site Development Permit; in the county, it is called a Grading Permit. Both permits require a plan showing the extent of the grading dimensions and how soil erosion and sedimentation will be mitigated. However, neither permit considers the removal of trees and other vegetation as part of the development plan review processes.

As of 2010, issuance of a grading permit in Knox County or a site development permit in the City of Knoxville require that a surety bond, cashier's check or letter of credit be provided to cover the performance bond costs for construction and grading. These relate to road construction, erosion prevention, sediment control and water quality buffers. The recent economic recession has contributed to several unfinished projects on steep slopes where a letter of credit was accepted as the means to address proper restoration and construction. However, several unfinished, eroding sites have resulted as the result of bankruptcies with no actual funds at local governments' disposal to see the project is properly completed. These sites continue to leach sediment into neighboring properties and water bodies. The restoration costs to local governments on these sites could result in hundreds of thousands to millions of dollars to return the land to a state that does not impact surrounding properties and waters.

The local governments have realized that there are shortcomings to the current bonding systems, especially letters of credit (largely worthless following a bankruptcy). Therefore, efforts to address this situation by the local governments are highly recommended.

Instead of working potential house sites into the hillside topography, the developer chose to clear the entire ridge, ultimately resulting in erosion problems. No lots have been developed.

Figure 6: Example of Preserving Tree Ridgeline with Residential Development



Land Disturbance Defined

Any activity that results in a change in existing soil, topography or vegetation, including development, clearing, grading and filling, is land disturbance. Under the proposed program, some clearing activities are not to be affected, including agricultural, and utility and emergency work to protect life, property and levels of public services.

Permitting for Land Disturbance

The following would be elements of a land disturbance permitting program:

General Requirements

When applying for building and development permits for property that is in the Hillside and Ridgetop Protection Area, applicants would depict grading and clearing areas with the amount of disturbance limited by the standards on page 31. This should apply to new subdivisions and pre-existing vacant lots. The total disturbance allowance can be used on any portion of the property within the Hillside and Ridgetop Protection Area, except on slopes over a 50 percent grade and on ridgetops. In those areas, total clearing should be limited so that the tree line on ridges remains undisturbed to the greatest extent practicable.

Disturbance Area Delineation

Hillside disturbance areas should be depicted on a site plan and marked in the field so that they can be verified by inspectors, and so that construction crews will know the limits of their operations. The disturbance limits should be marked with barrier fencing or other markings so that forest resources are not destroyed.

Geotechnical Analysis on Potential Landslide Areas

A geotechnical analysis is a review of the surface and subsurface characteristics of soils to determine the properties that are relevant to a project and any associated risks. Soils that are on steep slopes generally have a high slip potential when either the soils down slope or the soils in the hazard area are disturbed. In the Hillside and Ridgetop Area, geotechnical analysis should be required on slopes that are 40 percent or greater, or have soils that are considered to have a high slip potential, before any land disturbing activities can commence.

Reforestation and Landscaping

This is the process of re-establishing trees and ground cover within an area that has been disturbed. For small disturbance areas, like in and around parking areas and around buildings, a landscaping plan should be provided for planting native trees that will grow to provide shade, reduce runoff and improve the aesthetic appearance of the development. For large reforestation needs, such as extensive cut slopes, the Hillside Reforestation method depicted on pages 43-44 is an alternative that has merit and should be considered.

Ridgetops

A ridgetop is generally an area of 0 to 15 percent slopes at the pinnacle of a hillside. These areas will be delineated when a development plan is submitted for review (see the development guidelines, page 37). Tree line conservation is necessary in this area because of their prominence on a community's landscape; guidelines are provided on page 38. In some cases, new trees should be planted. A list of appropriate species is presented in Appendix E.

TIMBER CUTTING AND LOGGING

Forest clearing and grading for development purposes is a vastly different practice than growing and cutting timber as an agricultural endeavor. Under state law, zoning cannot limit agricultural practices, which include tree harvesting for lumber or other commodities. Two Tennessee zoning-related statutes are Title 13, Chapter 7, Section

114 (regarding county zoning powers), and Title 6, Chapter 54, Section 54 (regarding a city's zoning powers) cover this limitation. Statute 6-54-126 is illustrative:

"For any land that is used for agricultural purposes as of May 10, 1998, a municipality may not use its zoning power to interfere in any way with the use of such land for agricultural purposes as long as the land is used for agricultural purposes."

Additionally, under the Tennessee Right-to-Farm Act (Tennessee Statute 43-26-103), farmers are protected from nuisance suits when a farm operation is carried out in conformity with generally accepted agricultural practices.

Conserving and growing trees that will ultimately be used for lumber or related uses are agricultural purposes. Timber-producing practices can be regulated, however, by standards that assure that cutting and logging are carried out in a manner: (1) to conserve soil resources; (2) to foster forest regeneration follow timbering; and (3) to reduce impacts to public roads and adjacent properties.

Knoxville already has a development code, which is not part of the zoning ordinance, to provide guidance for timbering operations. The code limits the amount of clearing in a five year period and requires a site plan to depict the forest area that is to be cut. Owners of single family house lots are exempted from the ordinance. Knox County does not have a tree protection and timber production ordinance.
In urban and suburban areas, timbering can impact neighborhoods because of noise from machinery, issues with trucks entering highways, damage to roads, clean-up costs (when management is poor) and potential property value losses. In view of these concerns, both the city and county should adopt code changes to better regulate timber production and logging operations. The codes should address the following:

- Forest regeneration using the best management practices recognized by the state of Tennessee;
- Preparation of a timber cutting and future forest management plan reviewed by a professional forester;
- A time frame after cutting and logging to allow forest to grow. (In other words timbering should not be a precursor to development, merely for the purpose of cutting trees without an intent to further produce trees as agricultural products. This can be cross-referenced in subdivision regulations.);
- Exemptions from the tree cutting provisions for house lots of a certain size (such as under two acres) and for such emergency situations as ice and wind storms;
- A provision for protection of specimen trees (that is, trees of outstanding size that are determined by the forester who prepares the management plan to be noteworthy to this region).

Administration

ZONING AND PLANS REVIEW

Planned Zone Districts

When a zoning change is requested, such as agricultural to residential, planned residential zoning should be recommended by MPC staff and adopted by the legislative bodies. That has been the practice in following General Plan policies for a decade now and should be continued. Planned residential zoning requires site plan review, providing the opportunity to more fully consider the most appropriate natural locations for housing, open space conservation and infrastructure. Consequently, this type of zoning is a most appropriate means to balance private and public benefits.

Zoning Overlays and Plans Review for Permitting

In addition to policies related to rezoning decisions, an amendment to zoning or land development codes is recommended to address (1) consideration of a hillside and ridgetop overlay district, or (2) standardized review of parcel development via the building permit process. Overlay districts are used in many cities and counties, including Brentwood, Tennessee; Fayetteville, Arkansas; and Huntsville, Alabama. Standardized review is a procedure that has proved to be worthwhile in Asheville. One or the other method could be an effective way to address consistency in all hillside development approvals, including cost-saving measures, such as reduced setbacks, narrower roads, forest conservation and density. The proposed program for each alternative is outlined below.

Hillside Overlay Zoning District

An overlay district does not change the permitted residential uses of the "underlying" zone; however, it would establish additional review of housing density and location of development areas. An overlay would establish guidelines for new construction and a review process to assure that development and conservation are in better balance. The geographical basis for the overlay would be the Hillside and Ridgetop Protection Area. Zoning overlays have been used for years to assure that certain design standards are addressed. City or county officials are familiar with historic, downtown design and technology corridor overlay districts. Because an overlay district can be easily depicted on the zoning map, property owners, developers and development services staffs can readily see the overlay in relation to the underlying zone. The Knoxville Utilities Board sees an advantage in having an overlay as a "trigger" to assure that water supply and fire protection are always considered in initial stages of development planning.

Standard Review Under Building Permit Processes

Asheville has mastered this system, which is tied to their geographic information system and their building permit process. Essentially, an extension of the method to Knoxville and Knox County would work under the following scenario. Standards are

adopted for intensity of use, clearing and road widths to reduce development impacts in relation to degrees of hillside slopes. When a property owner decides to develop a large parcel or a single pre-existing lot, staff could use Knox County's Geographic Information System to identify whether or not the parcel is in or out of the Hillside and Ridgetop Protection Area. If the parcel is in the protection area, then standards must be met in preparing development plans, including the density and clearing standards that are identified on page 33. If a pre-existing vacant lot is found to be in the Hillside and Ridgetop Protection Area, density would not be regulated; however, the clearing standards (page 35), smaller setback standards (page 37), and parking alternatives (page 38) should apply for the benefit of the house builder.

Special Hillside Development Zoning Code

Some places, including Knoxville, have begun to create form-based zoning codes that address design issues, such as consistency in building location along a street, height, landscaping and road features. While these kinds of codes are typically used in urban settings such as South Waterfront, it is conceivable to create a special form-type code that would address hillside development issues, include provisions to create low profile architecture, small footprint buildings, house-like structures, and low impact roads. Variations in topography may prove to make this approach difficult and a more generalized approach using guidelines with site plan review may be more practical to administer.

Residential Uses in the Agricultural Zone

An amendment should be considered to the county's agricultural (A) zoning district to provide opportunities for hillside and ridgetop development review. Currently, one house can be built on a minimum one-acre in this zoning district. Under the current county agricultural zoning, tree conservation is not addressed on the residential lots. The agricultural zoning district should be amended to require use-on-review in permitting lots in the Hillside and Ridgetop Protection Area, using the following standards:

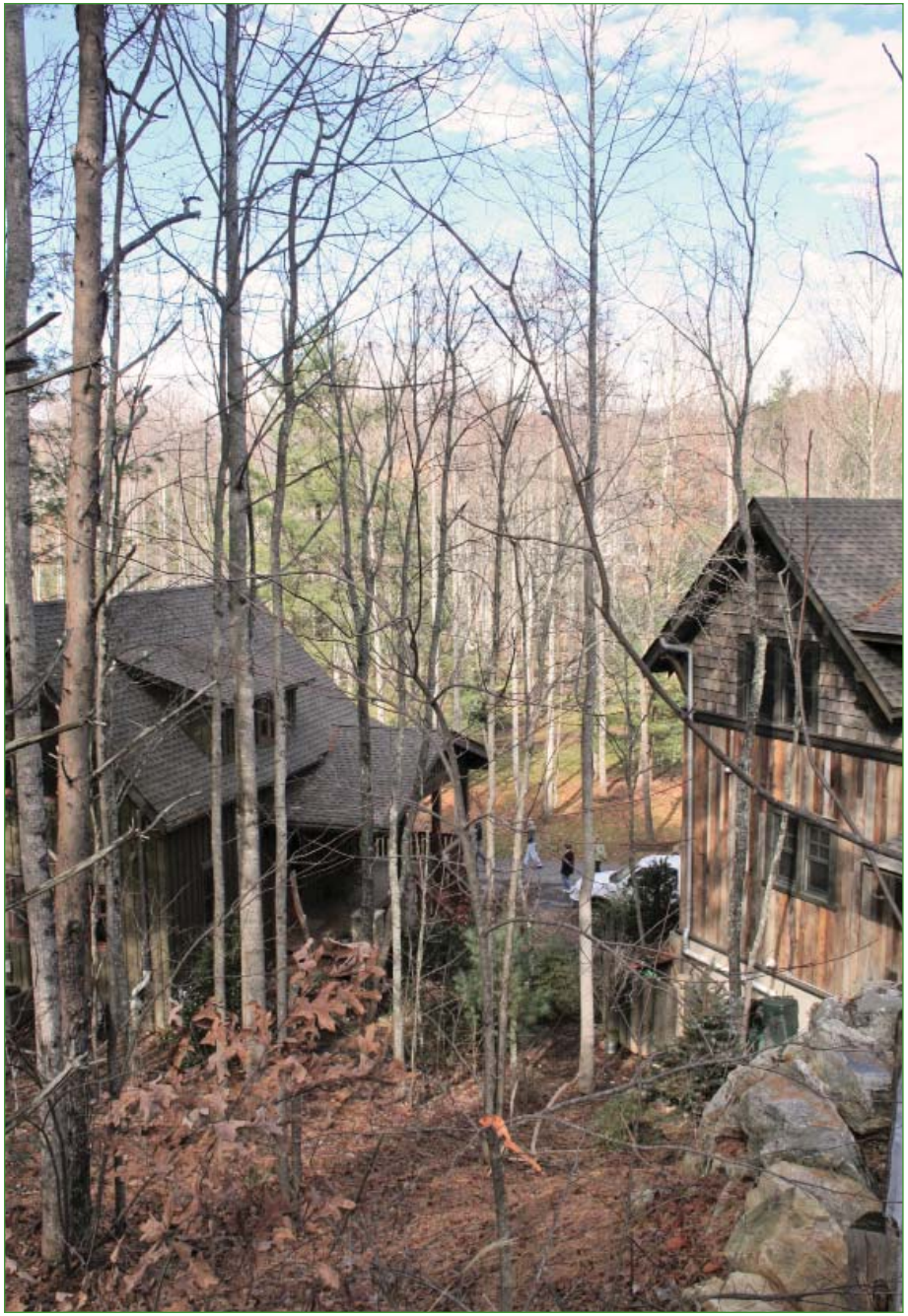
Table 4: Proposed Minimum Lot Size, Density and Clearing on Hillsides in the County's Agricultural-Zoned Areas

Percent Slope	*Minimum Lot Size**	*Density*	*Maximum Clearing*
15 - 25	1 acre	1 du/acre	50%
25 - 40	2 acres	1 du/2 acres	15%
40 - 50	4 acres	1 du/4 acres	10%
50+**	No Development	None	None
Ridgetop and within 100 feet of ridgetop***	1 acre	1 du/acre	15%

*All minimum lot sizes must meet septic tank drain field requirements of Knox County Health Department; occasionally a larger size area may be required. Under state law a drain field may not be created on a slope greater than 50%

**Only one parcel in the county is almost totally characterized by slopes over 50%.

***Also refer to the ridgetop development guidelines, pages 37 and 45.



In this mountain community, houses were clustered in relatively close proximity on gently sloping sites (foreground) to converse steep forested hillsides (background).

Very large lot development, like the house on this north Knox County ridge, would conform to the recommended rural hillside standards.

Additionally, the proposed road width subdivision standards would apply in these areas, reducing development cost. Consideration should also be given to flexibility in setbacks. This would better assure slope protection and more effective fire protection.

Finally, the agricultural zone should be amended to allow clustered houses on agricultural-zoned property within or partly within the Hillside and Ridgetop Protection Area. This would allow attached and detached dwelling units on portions of a site in the Hillside and Ridgetop Protection Area that are below or part of 15 to 25 percent hillside slopes. In such cases, similar standards as those of the low density residential proposals should be used as long as septic or community-based wastewater systems can meet state and local engineering and health standards. The provision for these new rural lot size standards may become more necessary because community-based wastewater systems could provide the means for a developer to consider one acre lots on very steep slopes (greater than 25 percent), knowing that a septic drain field would not have to be placed on an individual parcel. Clearing and road construction on slopes greater than 40 percent is not advisable.

Staff Review and Inspections

Conventionally, the city and county engineering, public works and code administration staffs review road design, building structure, grading and stormwater plans. The city's Public Service Department personnel are responsible for timber clearing plans and replanting plans when clearing is approved for site development. The county has no similar review. When site plans are approved under use-on-review, city and county staffs do not inspect planting plans and MPC staff is not equipped to carry out field inspections. Consequently, there are short-comings in what is currently required by code or via plan approval.

Stormwater inspections offer a promising means to address some of these shortcomings in the future, especially in setting tree clearing limits because those inspectors are already visiting sites to examine stream buffers, site fencing and other management practices. Use of geographic information systems (including global position systems) may be instrumental in making field inspections easier. Still, city and county staffs have concerns regarding the means by which to carry out plan reviews and inspections. While Knoxville has the horticulturist position listed in its tree protection code, that position has not been funded for over 15 years.

Recommendation

The Task Force recommends that a greater level of review and inspection be carried out to assure that the principles of this plan be realized. This could include several options:

1. Additional city and county engineering and code staff or reallocation of existing staff to see that clearing limits are created in plans and on-site.

2. Funding a city forester and a county forester position are alternatives to improve the current system and administer a hillside and ridgetop protection program. Responsibilities would include: reviewing clearing and development limitations relative to codes (including hillside plan review); working with engineering and planning staff to assure

that road standards are being followed; reforestation plan review (checking that correct species and techniques are followed); and overseeing field inspections to assure that conservation and planting programs are implemented. As an alternative to two positions, a metropolitan forester position could be considered by funding and housing that position as part of the Metropolitan Planning Commission's activities.
3. Another alternative is to have the design professional (engineer or landscape architect) identify protection areas on site plans and certify that they have been marked and conserved on-site.

REVIEW OF SUBDIVISION PROPOSALS, LAND DISTURBANCE ACTIVITIES AND TIMBER REMOVAL OPERATIONS

Several changes are recommended to subdivision and related development codes. In order to reduce erosion, land disturbance and safety risks, alternatives should be created for hillside subdivisions whereby setbacks, lot size and road widths can be reduced to to conserve steeper slopes. A conservation subdivision provision (see example in Appendix F) should also be adopted. Land disturbance codes should be augmented to protect hillside forests. When forested slopes are cleared, the impact on water quality and flooding are significant because of poor percolation and runoff velocities that make erosion worse. Currently, the Knox County Stormwater Regulations call for a 50-foot undisturbed buffer. When slopes are as much as 25, 40 or 50 percent, as on many hillsides, wider buffers should be considered. As noted in the background section (pages 21-22), there are several shortcomings in land disturbance processes, particularly in tree clearing, that should be addressed for an effective ridge protection. Subdivision review, development permit, and stormwater review processes are appropriate for implementing the plan's conservation and development objectives. In summary, a wider stream buffer should be established when the Hillside and Ridgetop Protection Area is near a stream or river.

In the summer of 2010, the U.S. Department of Environmental Protection and, in turn, the Tennessee Department of Environmental Conservation, revised the requirements of the National Pollution Discharge Elimination System (NPDES) to better control runoff and water pollutants in all regions of the country. In Knox County, the new requirements will result in slightly wider stream buffer standards and limitations on land disturbance in relation to development phasing. The County Engineering Department is working with a committee to consider revisions to stormwater regulations that will place the county in compliance with the new NPDES standards. Stream buffering and erosion control are to be addressed in those revisions.

The county should also adopt a code to address reforestation of areas where trees are cut for timber production, which is an agricultural practice. The city and county should develop a review and approval process whereby a professional forester will approve timber clearing permits to address reforestation and the negative consequences of uncontrolled cutting and logging practices.

Bull Run Creek, like many streams in Knox County, is bordered by very steep slopes. The current required buffer would not protect the more expansive forested slope (see area of concern).

FIRE SUPPRESSION

When houses are constructed on steep hillsides and ridges, the danger of wildfires becomes more severe. Loss of hillside and ridgetop property is all too common during wild fires in this region, including nearby Sevier and Blount Counties. State and local fire officials recommend that homeowners take precautions to reduce potential fire disasters. These include the following proposed programs:

Fire Suppression Programs

Not all ridges are currently served with public water. Consequently, water lines and fire hydrants are not available. Private sources of water, such as wells, are the main alternative, especially in the rural, outlying portions of Knox County. While fire fighting services can be made available through the city of Knoxville, Rural Metro and community-based volunteer fire departments, the response time can be longer to reach hillside areas because of distance and access problems, resulting from steeper roads and driveways. While not required by existing building codes, private sprinkler systems are advisable to extinguish a house fire or, in severe cases, to "buy time" for a fire truck to arrive.[4] Property damage is far less with sprinkler systems because they are activated early on and less water is needed to extinguish a fire. In places that are not served by public water, home sprinkler systems can still be installed. Various manufacturers can provide the industry's standard (NFPA 13D system) with an attic or other storage tank. Such suppression can reduce insurance costs and is relatively inexpensive.

FireWise Program

Another fire preventive measure for hillside residential development is the "FireWise" program, which revolves around basic safety principles related to construction and landscape design. The greatest fire threat is the rapid uphill spread of fire, particularly under dry and windy conditions. Hillside houses in close proximity can be another problem. The "FireWise" program avoids such problems and contains several recommended measures:

House Construction

When choosing building materials, the primary goals are fuel and exposure reduction:

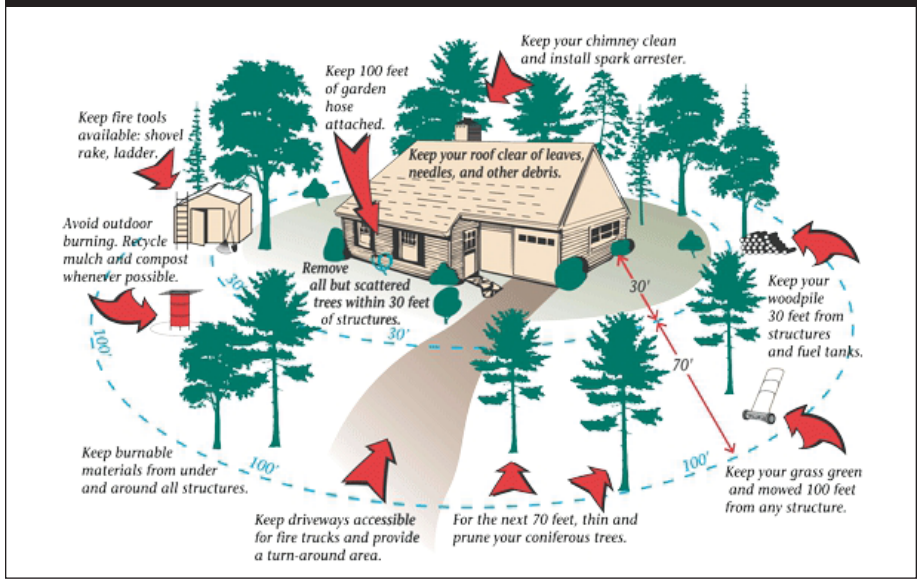
- ROOFS
  Fire resistant materials, such as most asphalt shingles, slate, clay tiles, metal, or cement, and concrete products should be used.
- WALLS
  Materials such as brick, stone, block, stucco and masonry are recommended. Though some materials will not burn, vinyl is not recommended as it can melt when exposed to high temperatures providing fire a direct path to interior walls. Wood siding above a masonry foundation is relatively fire resistant when it is not exposed to flammable vegetation, woodpiles and lattice.
- DECKS
  Wooden deck posts can serve as a ladder for fire to climb to the house. Masonry or other fire resistant materials are the recommended solution. Firewood and other flammables should not be stored under decks.
- CHIMNEY SPARK ARRESTORS
  Chimneys should have a spark arrestor installed to control flying embers.

Yard Landscaping and Tree Maintenance

The foremost objective is to maintain a "defensible space" around hillside houses. Trees, grasses and shrubs are the fuel for fires. Several prudent landscaping techniques can avoid wildfires that skip from plant to plant. This does not mean that clearing has to be widespread; however, certain measures can be used to limit the woody and grassy plants that can fuel a hillside fire.

- PLANT SELECTION
  All plants will burn if enough heat is generated in a fire. However, some species are better suited in resisting fire. Less flammable trees and plants include hardwoods, alders, hydrangea, crape myrtle and chokeberry. The flammable plants that should be avoided are closely spaced evergreens such as pines, cedars, junipers, hollies, spruces, firs and hemlocks. Other flammable trees and shrubs include magnolias, cypress, paper mulberry, rhododendron, laurel and azaleas. Grasses that go dormant can spread fire at ground level and should not be planted. Low growing shrubs should be chosen near houses to avoid situations where fire could reach siding and eaves.

Figure 7: FireWise "Defensibile Space" Fire Safety Principles



- TREE SPACING AND TRIMMING
  Closely-spaced trees and shrubs can result in the spread of fire. In general trees should not left to grow within 30 feet of a house. The crown of hardwood trees are not as great a fire threat as dense stands of evergreen trees. Evergreen trees should always have at least 20 feet between the tops. The lower limbs of closely spaced evergreens should be pruned to avoid having a fire climb into trees.
- PLANTING PATTERNS AND "HARDSCAPE"
  Planting trees and shrubs in widely separated spaces can reduce fire from spreading across a yard. Changes in the levels of a yard with stone or masonry retaining walls can also offer a firebreak. River rock and decorative gravel, especially around a house, is another effective fire prevention technique.

Recommendations

Two fire suppression methods are recommended:

- Residential fire sprinkler systems are highly recommended with new house development in the Hillside and Ridgetop Protection Area, particularly when no public water and hydrant facilities are available.
- Recommend that "FireWise" be a component of new hillside subdivisions, administered by a homeowners association to reduce the fire potential to individual houses and to protect neighboring properties in a collective manner. This can be accomplished through deed restrictions.

STRUCTURES ON HILLSIDES AND RIDGETOPS

Water towers and tanks are typically provided through a public utility, whose operations are defined under state law. Public utilities are not bound to comply with local zoning and related codes. Still, there are provisions which can be created for public review process in designing, locating and minimizing impacts of the facilities of public utility companies. These are outlined in this portion of the plan.

Communication towers, including cell phone, radio and television towers, are regulated through the Federal Communications Commission. While local governments and the Metropolitan Planning Commission have limited power to review and set design standards for cell phone towers, these tall structures are not subject to local prohibition.

A major emphasis of the task force's work has been on water supply facilities, including tanks, towers and the capacity of water lines to deliver fire protection and potable water services. Those issues are addressed below.

Water Tank, Tower and Supply

Public health and safety are foremost concerns in relation to water supply on slopes and hillsides, with fire protection and a sanitary source of water being key issues. Location and appearance of water towers and tanks are other concerns. All proposed water distribution systems must be created in accordance to the standards and approval by the appropriate utility jurisdiction and the Tennessee Department of Environment and Conservation.

Minimum General Requirements

The system must be designed, hydraulically analyzed, and installed to deliver required domestic water supplies, fire protection flows, and pressure requirements. Water quality standards must also be met.[5] The minimum water main size to provide water to fire hydrants should be verified with the appropriate utility jurisdiction and justified by hydraulic calculations with input from the appropriate fire protection agency. The system must be designed, stamped and submitted by a professional engineer licensed by the state of Tennessee.

Water Supply Implications

In view of the minimum general requirements, there are several implications for hillside development:

- SERVING SUBDIVISION LOTS WITH ADEQUATE DOMESTIC WATER SUPPLY AND FIRE PROTECTION
  Fire and health codes currently require that developments be served by adequate water line pressure and flow to support fire fighting purposes and to avoid contamination of drinking water, which can result when stagnant places could occur in the system. This is an issue because upper portions of subdivisions cannot always be served with adequate water pressure and flow. Additionally, to attain fire protection, hydrants have to be spaced at necessary intervals.[6] Certain high elevations in the county cannot be served by public water lines. Water pumps and booster stations are needed in such instances, especially with higher intensity land uses.

- SPRINKLER SYSTEMS WITHIN DWELLINGS AND OTHER BUILDINGS
  These systems are required for apartments and commercial structures Residential sprinkling systems cost about $1.50 per square foot; a cost that is occasionally a concern to a developer but is offset with better insurance rates because of safety benefits.

Proposed New Hillside Fire Protection Plans and Standards

Knoxville's and Knox County's fire officials and utility engineers agree on several principles that should be promoted in locating and designing water supply systems and creating development standards on hillsides. They are as follows:

- FUTURE WATER TANK AND TOWER LOCATIONS
  With such a large Rural Area (see map, page 18), there are limitations in serving the entire county with public water supplies. For economic reasons, not all ridgetop properties can be provided such public services (for example, private wells and sprinkler systems may be the only reasonable options). Still, there are certain points on some ridges that are advantageous locations for water tanks. The task force has worked with a few utility districts to identify such locations, but this needs to be further explored. To do so, the task force recommends that a consortium of all utility districts be formed to outline future potential locations of tanks and towers to serve developing urban and suburban areas. The Knoxville Utilities Board has already accomplished this analysis (see map, page 15).

  This process should be tied to the Urban Growth Boundary and Planned Growth Area of the Growth Policy Plan (see map, page 18) because those parts of Knox County are, by public policy, the places where growth is to be directed. This task can result in the creation of a county-wide, water supply sufficiency map that would identify where gravity-based water supply systems can and cannot be extended and, consequently, where the higher and lowest intensities of land development should be recommended. This will have implications for public policies relative to hillside protection and development, including land use and growth management plans.

  How such facilities are located is important not only for the reasons discussed above, but also to meet aesthetic concerns – maintaining the natural beauty of the region and reducing visual impacts on communities.

- SUBDIVISION ROAD AND DEVELOPMENT STANDARDS
  Several new code amendments are recommended to address excessive grades while providing access for fire fighting equipment, including minimum road width (20 feet within-the-pavement parking to be prohibited), maximum road grade (15 percent); maximum driveway grade (15 percent) and maximum building height (35 feet).

Designing and Locating Water Towers, Tanks and Reservoirs

Some utility districts and communities have developed basic principles to locate and design water supply facilities. Locally there are several good examples where principles, as those recommended below, have been applied. In north Knox County, Hallsdale-Powell Utility District has ground tanks on Copper Ridge. They are difficult to see because they are painted in earth tone colors and are set back from the ridge's crest. A similar design was used by West Knox Utility District to build its tank on Beaver Ridge above Schaad Road and the Knoxville Golf Course. The following principles are proposed to avoid the type of appearance of the now infamous south Knoxville water tower on the crest of Chapman Ridge.

- AVOID WATER TOWER LOCATIONS AT THE EDGE OF RIDGE CRESTS.
  A water tower near the edge of a prominent ridge would standout like a "sore thumb." As noted in the background report (see pages 7 - 8), there are several types of ridges in Knox County. The shape of a ridge is an important consideration when locating buildings and structures. "Knife-edged" ridges are prominent while "rounded" ridges, which are interspersed with hollows, are less so. When there are a series of rounded ridges, like those south of Chapman Ridge in south Knoxville, water towers could be sited on a knoll farther away from the first ridge line and not be conspicuous. In general, however, water towers are not an aesthetically pleasing solution in the proposed Hillside and Ridgetop Protection Area.
- BLEND WATER TANKS WITH THE NATURAL LANDSCAPE
  This is a far better aesthetic solution than building a water tower. The large-maturing, native trees of Knox County's oak-hickory forest grow to a height of 80 or more feet, offering natural camouflage for ground-mounted tanks. Water towers, such as that in south Knoxville, often exceed 150 feet. Tanks should always be the first possible solution to meet water supply needs.
- PAINT WATER TANKS IN EARTH-TONE COLORS.
  A common approach in some places is to paint water tanks and towers a "sky blue" color. That helps in the case of a water tower – we see this approach so often in various flat towns across America. However, when a tank is wedged into a hillside, an earth tone, like a shade of tan, should be used to provide camouflage.
- CONSERVE SURROUNDING TREES.
  Some clearing is necessary in erecting a tank. However, by keeping mature trees around the tank site, a natural screen is assured. Planting evergreens can supplement year-round screening of a water tank.

Water tanks, which rest on the ground and are surrounded by conserved woodlands, are an appropriate ridgetop utility design.

- CONSIDER DENSITY AND HEIGHT OF PLANNED DEVELOPMENT.
  In addition to the location of new development, density and height are significant in determining the type and location of the water supply facilities (tower or tank selection).

Public Review Proposals

The Knoxville Utilities Board has created a review process to more fully engage the public during the last year (this process is outlined on KUB's website). Such review opportunities should be extended to all community interests across Knox County. Public meeting options could include: (1) meetings, hosted by the utility district within potentially affected communities, or (2) a public hearing before the Metropolitan Planning Commission. Under State of Tennessee utility district statutes, districts are not obligated to abide by recommendations that are made by the planning commission or the local government. However, planning commission public meeting review could be the most transparent process and offers the means to consider a utility proposal in relation to the goals and policies of adopted community plans. Such a review process could be helpful, arriving at a more aesthetically pleasing project on hillside and ridges, especially in relation to the foregoing design principles (for example, location, color and tree conservation). Alternatively, rather than going through a change in state enabling legislation on planning commission duties, a memorandum of agreement among all utility districts to follow the foregoing design and location principles and a similar public review process could accomplish a similar purpose and be of overall public benefit.[7]

NATURAL AREAS AND RIDGE CONSERVATION CORRIDORS

Potential Conservation Programs

Knox County communities enjoy a naturally beautiful landscape, framed by forested ridges. Ridges define the edges of communities like Powell and Halls and are treasured by many residents. Ridge conservation corridors could be used to conserve natural settings for recreation including wildlife observation and walking trails. In one sense, these corridors could be part of a system of smaller Appalachian Trails. These conservation corridors are proposed to be part of a combination of public and privately-owned land and should be established through the following programs:

Hillside Conservation and Development Standards

Very low density residential development is already designated in most of the identified corridors and should be continued as one means to protect ridges (for example, one housing unit per two acres). Another option is clustered housing whereby incentives are provided to encourage developers to locate housing units on smaller lots at the toe of a slope or on more level terrain within a site (such increases in housing density could be made in exchange for a conservation easement).

Ridge Corridors and Trail Easement Acquisition

The work of the Legacy Parks Foundation is the model for this approach. Both private donations and public purchases should be considered. Tax advantages are available for donations and non-profit groups such as the foundation can assist in this option to create protected natural areas and walking trails.

Linkages between Ridge Conservation Corridors, and Natural and Wildlife Management Areas

Several proposals were outlined in the recently adopted Knoxville Knox County Park, Recreation and Greenway Plan. These include a proposed corridor along the top of McAnnally Ridge that would form a connection to House Mountain State Natural Area and a continuation of the Urban Wilderness and Historic Corridor. This corridor should be extended eastward to join the Civil War forts to Ijams Nature Center and William Hastie Park, and westward along Chapman Ridge.

Implementing Public and Quasi-Public Corridor Efforts

These options are available to implement and fund ridge corridor conservation efforts:

Legacy Parks Foundation

Legacy Parks Foundation is a public, tax-exempt organization founded in 2005 and is a part of the East Tennessee Foundation. Operated by an independent Board of Directors, it serves Knoxville and Knox County. Its mission is: “To enrich our quality of life by improving, preserving and growing parks, recreation and green space.” Financial support for the program comes from grants, private donations, corporate contributions, gifts of property, and bequests. Coordination with the Foundation is a necessity in creating the future park system and publicly accessible ridge corridors.

Located in Ijams Nature Center, this is the type of trail that could be created in many areas of Knoxville and Knox County.

Corporate Sponsors/Naming Rights

A potential funding source is to work with corporations and businesses that would like to provide land, materials, and other resources for the creation of natural areas, trails, greenways and ridge conservation areas. Several prominent local examples include Clayton Homes’ donation of a large open space on the Beaver Creek greenway, and the roles of the Pilot Corporation and Aslan Foundation in establishing the Urban Wilderness Corridor.

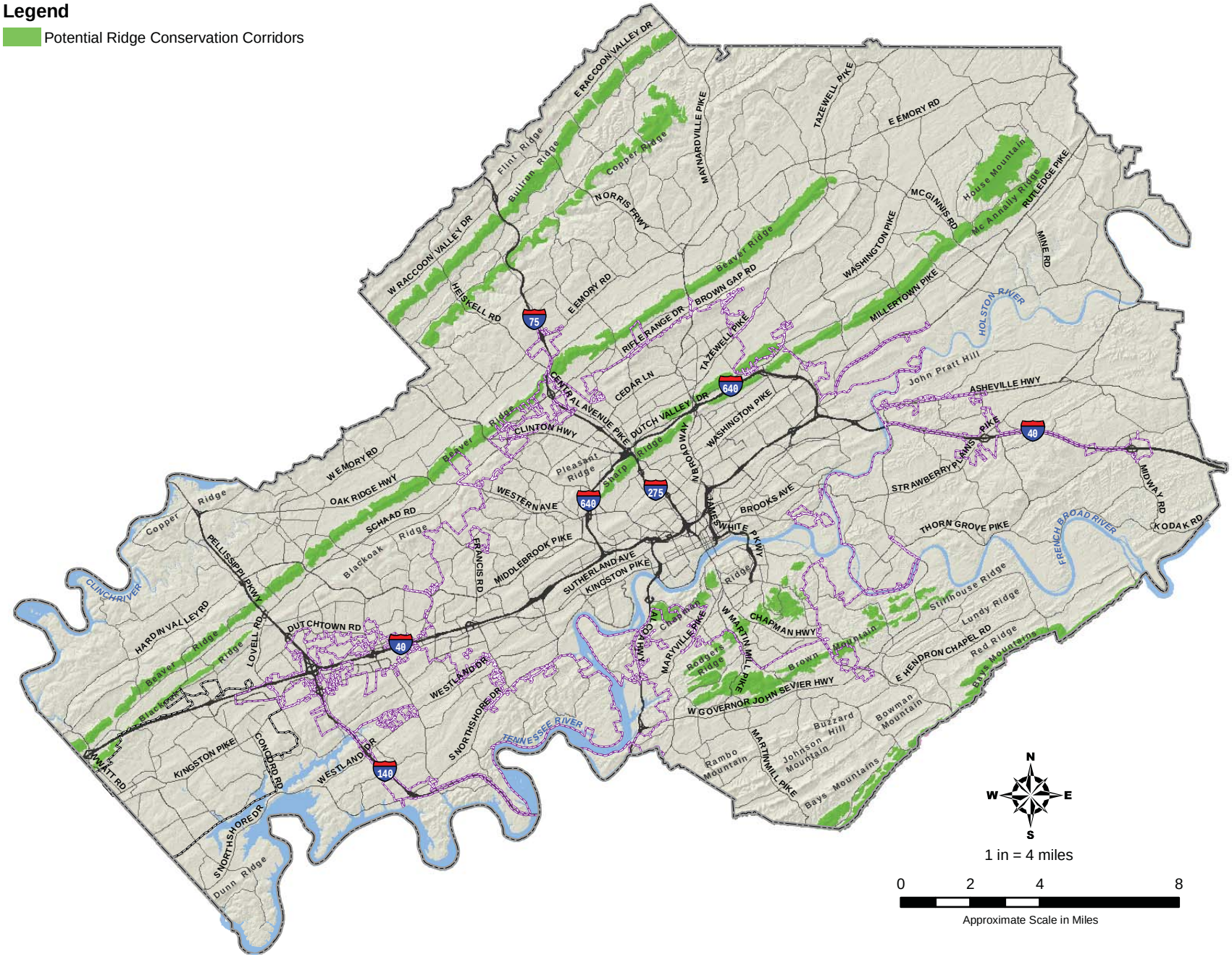
Real Estate Transfer Tax

The state currently uses a real estate transfer tax to acquire park land throughout Tennessee. Although this an extremely small portion of real estate transfer costs, the accumulative effect of thousands of transactions can be appreciable. It is recommended that Knoxville and Knox County officials work with state officials to amend the state law to direct a portion of the tax revenues, particularly those that collected in the county, for use in park and open space acquisition in Knox County.

Referenda for Open Space Funding

Provide opportunities through ballot measures or referenda that allow the public the opportunity to decide on creating new parks, greenways and open spaces. This should include bond issues and, potentially, the right for certain communities to establish their own park districts. A sales tax option is another consideration whereby a small portion of the sales tax is use for park and open space purchases. In Boulder, Colorado, for example, voters approved a local sales tax allocation of 0.4 percent in 1967 under which $116 million has been collected to establish 33,000 acres of greenways and foothill/mountain parks.

Map 8: Potential Ridge Conservation Corrridors



Endnotes

1 Menendez, Garry. "Saving Trees and Making Money in Residential Development," University of Tennessee Extension Service Bulletin #1766, 2005.

2 In Asheville's hillside areas, all utilities must be placed under a 20 foot-wide road to reduce cut slopes.

3 Victor Davis with the Office of Surface Mining and Dr. Jennifer Franklin with the University of Tennessee's Department of Forestry presented the restoration practices utilized for previously mined sites as part of the Appalachian Regional Reforestation Initiative to the task force, noting that these practices are also particularly well suited for disturbed soils related to development activities on hillsides.

4 This will usually require a storage tank in the attic or elsewhere on a property. Modern sprinkler systems have sensors related to fire location and limit the amount of water that is used to the room that has a fire.

5 The system may also have to be designed to include storage or pumping facilities, if necessary, to safely and reliably provide adequate domestic and fire flows and pressure at peak demands. For most water systems a satisfactory rule-of-thumb is to meet the needs of at least 24 hours of demand in elevated storage while maintaining required water quality standards.

6 The minimum standards for water lines (as of 2009) are 500 gallon per minute (gpm) flow and 20 pound per square inch flow; fire and utility officials are anticipating that a higher standard (1,000 gpm) is a better goal and may be forthcoming under state direction.

7 Utility districts have broad powers under state law and, generally, are not subject to city or county regulations. Under Tennessee Code Annotated, § 13-4-104, municipal planning commissions should be or can be reviewing public project plans by state or local agencies, including utilities. MPC is a regional planning commission, however, does not have such broad authority. Only state and state-funded projects are reviewed under the regional planning commission law and that review is by the Tennessee Department of Economic and Community Development, which may consider the work of the planning commission in its review. Consequently, consideration should be given to amending the state enabling statutes to allow regional planning commissions to have the same review authority pertaining to public project review as provided for municipal planning bodies. It would be advisable to have such review for areas within the city and in unincorporated areas. As such, the plans for the location and design of water towers and tanks could be reviewed in the course of an MPC meeting. As regards to areas outside the city of Knoxville, presently, there is no process for such referral for planning commission review in unincorporated areas. Again, a change in state law for referral of public projects within both city and county limits for regional planning commission review would assure that all interests can comment on locations and designs of facilities.