Harris Lake Drainage Basin Land Use Study

DRAFT

December 3, 2009

WAKE COUNTY
NORTH CAROLINA

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Harris Lake Drainage Basin Land Use Study

Wake County, North Carolina

DRAFT – November 2, 2009

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Harris Lake Drainage Basin Land Use Study

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Harris Lake Drainage Basin Land Use Study

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Harris Lake Drainage Basin Land Use Study

EXECUTIVE SUMMARY

At the completion of the Southwest Area Land Use Plan (SWALUP) update in July 2007, a key action item was to conduct a Harris Lake Drainage Basin Land Use Study. The purpose of the study was to more closely examine the area surrounding the Shearon Harris Nuclear Power Plant to determine a preferred development pattern for this fast developing area of Wake County.

The study, begun in the fall of 2007, involved a wide range of interested stakeholders including the towns of Apex, Holly Springs, and Fuquay-Varina, Progress Energy (who owns and operates the nuclear power plant), interested state agencies, and residents of the area.

Planning Framework

Growth in the Harris Lake Drainage Basin is representative of what is happening throughout the Triangle region of North Carolina – traditionally rural, agrarian areas are being rapidly transformed by unprecedented growth. Unlike other areas of Wake County, the Harris Lake study area is highly influenced by the presence of the Shearon Harris Nuclear Power Plant. The presence of the plant, however, seems to not have dampened the enormous development interest and pressure in southwest Wake County.

Town of Apex Fire Department

Four major issues shaped the framework for the study:

1. Interests of the three municipalities – Apex, Holly Springs, and Fuquay-Varina
2. Progress Energy property ownership - 43% of the study area
3. Shearon Harris Nuclear Power Plant and the associated 3 and 5 mile emergency planning zones (EPZs)
4. Quality and integrity of the natural environment

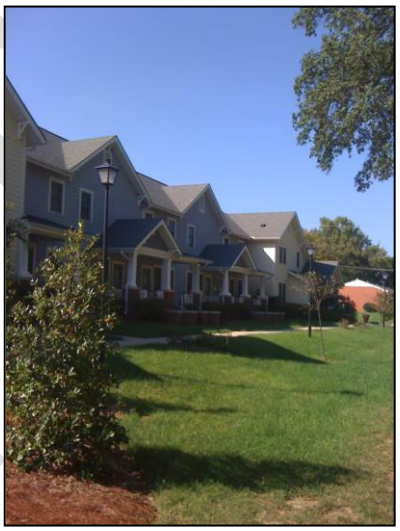
The Harris Lake area faces a challenging future, but one full of promise for an overall sustainable development pattern that incorporates preservation of the cultural and natural resources that are the foundation of this area's unique living environment. The preferred development scenario (proposed SWALUP amendment) is a consensus plan that represents a balance of the myriad interests of the general public, private property owners, Progress Energy, and local government entities that have a vested interest in growing the area while preserving the best and most unique elements of the area's rich heritage for the benefit of current and future citizens.

The goal of the study has been to accommodate sustainable growth by matching development types and intensities with existing and predictable future infrastructure patterns – public water and sewer and transportation facilities. These criteria generally resulted in locating employment

opportunities and mixed commercial / higher density residential uses in the upper reaches of the basin closest to existing municipalities and along existing US Highway 1 and near the planned I-540 corridor. Lower density residential and conservation areas are located in wedges radiating out along peninsulas created by Harris Lake and within the more transportation isolated southern portion of the study area.

Key stakeholder concerns at the beginning of the planning process included:

1. Providing for economic development opportunities that would allow residents to live and work within the area
2. Providing for a sustainable balance of jobs and housing
3. Conserving natural resources and rural lands
4. Addressing public safety and emergency management



New housing development in the Harris Lake Study Area

Throughout the study, the primary goal was to gather and address stakeholder concerns regarding future growth within the basin. The resulting consensus preferred development plan reflects as accurately as possible:

1. The reality of future municipal growth into the area
2. Future extension of public infrastructure to serve higher intensity growth areas
3. Conservation of environmental resources
4. Recognition of importance of existing rural communities and cultural/historic resources.

Past Planning Policy

In the past, Wake County's general planning policy for this area was to maintain very low density/intensity development within the 5-mile Emergency Planning Zone (EPZ) established by the Nuclear Regulatory Commission. This policy has significantly impacted growth plans for the towns of Apex and Holly Springs as both communities have within the past few years requested extensions of extraterritorial jurisdiction (ETJs) into the 5-mile area.

Following established policy, in November 2005, Wake County denied Holly Springs' request for an extraterritorial jurisdiction (ETJ) extension into the 5-mile EPZ in the southern portion of the drainage basin. The denial was based primarily on two concerns about the area – 1) the capacity of the transportation system to handle day-to-day as well as evacuation traffic, if ever necessary; and 2) public sewer capacity to serve the area. Ongoing discussions following the denial prompted the County's decision to go forward with a special study of the Harris Lake Drainage Basin.

The study uncovered that Nuclear Regulatory Commission (NRC) regulations do not control or set standards for land use around nuclear power plants. NRC regulations only address the necessity of having

emergency response plans in place. The NRC does not have standards for nor does it set minimum acceptable evacuation times. What case studies of other nuclear power plants revealed was that population densities around nuclear power plants vary widely and that local emergency management services are primarily concerned with maintaining an emergency response system that adequately addresses the need to safely evacuate if ever warranted.

The Planning Process

The land use planning process, begun in fall 2007, was in some regards blessed by the national and global economic downturn, which considerably slowed growth pressures within the study area. The slowdown in demand allowed leaders, staff, and citizens more time to devote to development of the plan. The planning process provided an opportunity for the stakeholders to assess where the study area is today, to identify growth challenges and opportunities, and to develop the tools to help manage a sustainable growth pattern.

Procedural principles for the study included:

1. Working cooperatively
2. Recognizing the uniqueness of the study area
3. Preserving rural character
4. Protecting environmental resources/open space and cultural/historic resources
5. Employing smart growth/low impact development standards
6. Encouraging compact mixed-use development
7. Minimizing infrastructure costs
8. Raising expectations for quality development
9. Providing for economic development

Preserving rural character is a key component of study recommendations.

The land use planning process was intended to:

- promote consensus and build broad support for a preferred development pattern
- provide the basis for continuous, cooperative, and
- coordinated County-municipal policies for development within the area

As development further encroaches into the Harris Lake Drainage Basin, the need for coordinated planning grows in importance and urgency. The preferred development plan, which will be reflected in the SWALUP amendment (the first among several study recommendations), will set the stage for accommodating additional growth while giving high priority to protecting and preserving the area's most valuable and unique natural resources. The fact that Progress Energy not only owns a large percentage of the study area, but has also agreed to support this concept, greatly improves the chances of success.

Harris Lake Drainage Basin Land Use Study

Description of the Study Area

The Harris Lake Drainage Basin Study Area, located in southwest Wake County, North Carolina, is about 20 miles southwest of the City of Raleigh and adjacent to the towns of Apex, Holly Springs, and Fuquay-Varina.

The complete Harris Lake drainage basin falls within Chatham, Harnett, and Wake Counties, but the study focused only on the portion of the drainage basin within Wake County. The Wake County portion of the basin covers 39,000 acres or approximately 61 square miles. Progress Energy owns almost 17,000 acres of land or approximately 43% of the study area. The majority of the study area is within the 5 mile Emergency Planning Zone (EPZ) of the Shearon Harris Nuclear Power Plant.

View of farm on Friendship Road.

The study area has remained largely rural with a history of large agricultural and forestry operations, many of which remain in operation today. The historic centers of population in the area, the towns of Apex, Holly Springs, and Fuquay Varina, are located at the upper reaches of the basin. With continuing rapid population growth in Wake County, these three municipalities have annexed and extended planning jurisdictions and utilities into the basin. This rapid expansion of urban type services nearer to the Shearon Harris Plant has raised concerns about future development within the area.

Natural Resource Areas

Much of the Harris Lake Drainage Basin closest to the Shearon Harris Nuclear Power Plant remains undeveloped and as such hosts some of the most environmentally valuable, pristine areas remaining in Wake County. Most of this protection is due to the large acreage purchased by Progress Energy in the 1970s and 1980s as part of the nuclear power plant project.

The area includes Harris Lake, an old growth longleaf pine forest, and gamelands managed by the North Carolina Wildlife Resources Commission. The lakes and undeveloped forests provide an outstanding habitat for many rare wildlife and plant species, including the bald eagle. The SWALUP established the goal of preserving these environmental assets as the “green infrastructure” that attracts innovative businesses and workers. Progress Energy’s participation and support of this primary goal has been instrumental in producing strong consensus for preferred development pattern for the basin.

Study Products

Case Studies

The planning process began with four case studies of development around nuclear power plants along the east coast of the US. The four nuclear power plants chosen for review were Calvert Cliffs Nuclear Power Plant in Calvert County, Maryland; McQuire Power Station in

Mecklenburg County, NC; Limerick Generating Station in Montgomery County, Pennsylvania; and Indian Point Energy Center in Westchester County, New York (just west of New York City).

The purpose of the studies was to review how other jurisdictions were managing growth around power plants to discern if there were specific lessons to be learned regarding land use and growth controls. Each case study examined population densities, growth patterns, environmental constraints, and evacuation management.

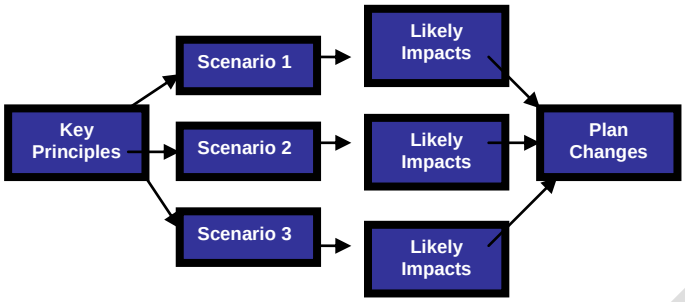
The surprising result of the case studies was there were no accepted or preferred models for directing land use growth and development around nuclear power facilities. The charge to local communities from the Nuclear Regulatory Commission is not to specifically control or direct growth, but to prepare for and put in place evacuation methods that adequately accommodate and expedite evacuation if the need should arise.

Harris Lake Profile
The case studies portion of the planning process also included developing a profile for the Harris Lake Drainage Basin. The profile examined the recently completed SWALUP update and past growth management policies for the area, environmental resources, property ownership, and transportation, water and sewer infrastructure.

Land Use Scenarios
After studying and analyzing key components of the natural and man-made systems within the Harris Lake Drainage Basin, potential growth scenarios were developed for stakeholder review. The goal of the scenario exercise was to present three separate but generally sequential growth scenarios representing increasing intensity of development.

All three scenarios also considered infrastructure costs - roads, water, and wastewater. Year 2035 travel demands were used to forecast transportation improvements to support growth within the area. Funding and actual construction of the road widening recommendations was a concern for stakeholders as transportation improvements often significantly lag growth. Each scenario was also assessed in terms of relative emergency evacuation/clearance times.

Land Development Scenario Activity



Scenario 1
Scenario 1 was conceived as the lowest-impact, lowest intensity development scenario with the least demand for infrastructure improvements and the highest level of protection for natural resources. Scenario 1 discouraged the need to extend public water and sewer any further into the drainage basin. Later in the planning process, the stakeholders decided to use the current SWALUP plan for the basin as Scenario 1. Scenario 1 then served as the benchmark for comparison with Scenarios 2 and 3.

Scenario 2
Scenario 2 envisioned more growth and development within the basin, but there was still restraint in the designation of low to moderate residential growth areas. This medium density / medium impact development scenario recognized the need for more public water and sewer infrastructure and the importance of providing better transportation routing both within the area and into and out of the area.

Scenarios 3 and 3A
Scenario 3 envisioned the highest sustainable levels of growth and development while recognizing that higher density/intensity of growth should be confined to specific areas in the upper reaches of the drainage basin. Scenarios 3/3A required the highest investment in transportation system improvements and the extension of public water and sewer to serve the designated development pattern.

Table 1: Demographics by Scenario ((assumes full build out)				
	Scenario I	Scenario 2	Scenario 3	Scenario 3A
Dwelling Units	11,420	12,530	27,000	12,647
Population	28,500	31,300	67,500	31,620
Employment	15,000	23,500	37,000	51,353

Scenario Summary
Scenarios 2 and 3/3A provided more industrial / office space for employment opportunities, but also required the highest investment in roads and utilities. Residential build-out population projections were similar in all three scenarios, but with higher density housing in Scenarios 2 and 3/3A. The scenarios also varied in the preferred locations for residential growth. Scenario 3/3A provided for the most intense development along the US Highway 1 corridor with a compact mix of retail, commercial, and industrial uses.

Table 2: Summary of Scenario Projections

Element	Scenario 1	Scenario 2	Scenario 3
Residences	11,420	12,530	12,647
Population	28,500	31,300	31,620
Employment	15,000	23,500	51,353
Road Improvements	$176m	$212m	$290
Public Water	$7m	$11m	$12m
Public Sewer	$5m	$9m	$12m
Evacuation / Clearance Times	3.6 hours	4.1 hours	4.6 hours

STUDY RECOMMENDATIONS

The study has six recommendations:

A. Amendment of the Southwest Area Land Use Plan (SWALUP)

The first recommendation is to amend the existing SWALUP to meet the planning principles identified by the Harris Lake Drainage Basin Study stakeholders. The recommended SWALUP changes would more closely align proposed land uses, especially in areas close to municipalities, with the land uses shown on adopted municipal land use plans for the area.

Proposed SWALUP revisions are intended to provide a more accurate picture of what is likely to occur in the future. Plan changes would allow for municipal development in certain areas within the 5-mile Emergency Planning Zone.

Recommended changes also propose to designate a large area (1,490 acres) along US Highway 1 as a business park. This revision is intended to encourage future job creation in an area that takes the best advantage of existing roadways and utilities.

Another proposed change is to designate the majority of Progress Energy's land within the study area (14,470 acres) as a Utility / Environmental Stewardship district. This change is intended to allow the company to use and lease the property as needed so long as the potential impacts to the natural environment are carefully considered.

B. Ongoing Cooperation

Future success is dependent on consensus and cooperation among the four local governments with jurisdiction within the Harris Lake area. Continued cooperation is necessary to ensure adherence to plan goals and successful implementation of plan objectives.

The exact framework for continuing cooperation can be determined by the affected governments, but at a minimum, the four units of government should commit at the highest levels to support and follow plan principles. Continuous planning / coordination can only be achieved through a structured process that brings interested parties – local governments and other interested agencies – together on a regular basis to discuss progress and how to address issues that will arise as the area continues to develop.

C. Interlocal Agreement

Following adoption of the Harris Lake Drainage Basin Study and amendment of the SWALUP, the four local governments should immediately begin to develop an interlocal agreement committing each entity to supporting and implementing study principles. Interested public and non-profit agencies should be invited to participate or comment on the particulars of the interlocal agreement, especially concerning transportation improvements and protection of environmental and historic/cultural resources.

At a minimum, an interlocal agreement should consider:

- Designation of Short Range and Long Range Urban Services Areas.
- Joint consideration of any future modifications to land use plans within the area.
- Extension of municipal public water and sewer services into the area.
- Commitment to adhere to environmental stewardship, conservation development[1], and sustainability/low impact design[2] standards that build upon the general principles / guidelines of the Study.

D. Municipal Services – Public Water and Sewer

The provision of public water and sewer typically steers where and when higher intensity development will occur. The SWALUP land use designations that are recommended in this study reflect current land use planning policies of the three municipalities within the area – Apex, Holly Springs, and Fuquay-Varina. If the municipalities choose to extend public utilities into other areas within the Harris Lake Basin this would impact the land use patterns recommended by the study.

Municipal services should only be extended into areas that have been identified as appropriate for development that requires public water and sewer to support the desired land development pattern. The costs for extending municipal water and sewer (Table 3) should primarily be borne by the land developer, not by the general public.

Table 3: Needs and Costs by Scenario (estimated cost in millions 2008/09 dollars)

Infrastructure Item	Scenario 1	Scenario 2	Scenarios 3	Scenario 3A
Road widening	$176.0	$211.4	$289.4	$289.4
Water infrastructure	$ 7.1	$ 11.0	$ 14.2	$ 14.2
Sewer Infrastructure	$ 4.6	$ 9.3	$ 13.4	$ 11.8
Total Infrastructure	$187.7	$231.7	$317.0	$315.4

E. Transportation / Traffic

Conduct a joint study among the four local governments and NCDOT / CAMPO to evaluate the impact of full build-out of the preferred land use development scenario (SWALUP amendment), not only in terms of daily traffic but for emergency / evacuation planning purposes. Study should consider:

- Timing of planned future public road improvements including completion of I-540/Western Wake Expressway to NC 55 Bypass in Holly Springs; Friendship Road interchange on US Highway 1 and Harris Plant/Bonsal temporary / permanent interchange on US Highway 1.
- Impacts/benefits of Harris Plant/Bonsal interchange as a permanent rather than temporary interchange (evaluated as part of Harris Plant expansion permitting process).
- Upgrade of bridge replacements associated with higher lake level as part of Harris Lake expansion permitting process to accommodate projected future traffic volumes (or at a minimum to design and construct so that future bridge widening can be accomplished at lower public cost).

Undeveloped roadside view within the study area.

- Setting goals for developer participation in the improvement of the transportation system network including how to prioritize developer contributions, including directing state and possibly local funding to ensure priority installation of improvements along most heavily traveled routes.
- Developing and seeking sponsorship of special enabling legislation that would allow local governments to assess transportation impact fees to ensure adequate road capacity for daily traffic and for more timely area evacuation if the need should ever arise. Special enabling legislation can be argued because of the unique nature of allowing development to encroach around the Harris Plant and the risk inherent in doing so unless evacuation routes are evaluated and expanded concurrently with new development.

F. Preservation of Natural and Historic/Cultural Resources

Throughout the Harris Lake Drainage Basin Study planning process, stakeholders were keenly aware of the natural and historic / cultural resources that are unique to this essentially undeveloped area of the fast urbanizing Wake County / Research Triangle area. Preservation of these precious resources should remain a top implementation priority as future development occurs within the area. Local jurisdictions that have land use control will determine the fate of these resources.

Scenic vista along Friendship Road.

Protection efforts should address:

- Appropriate balance of protection of significant natural and historic/cultural resources with the desired land development pattern.
- Preservation of the rural character and historic value of the New Hill Historic District and surrounds through development and adoption of land use development standards appropriate for the area.
- Preservation of scenic byway vistas along New Hill/Holleman – Olive Chapel/New Hill Road recognizing that vistas can be preserved to the greatest extent possible while accommodating future traffic volumes if development standards are adopted and enforced by the local jurisdictions having land use regulation authority along the corridor.
- Preference for conservation development and low impact development (LID) techniques for development within the Harris Lake Drainage Basin.
- Preservation of the Progress Energy-owned green buffer at the 260’ contour level to protect the new 240’ lake level required to accommodate Harris Plant expansion.
- Ongoing protection of Progress Energy-owned properties for utility uses and environmental stewardship.

Endnotes

[1] A conventional subdivision (residential or non-residential) subdivides land for lots and secondarily incorporates natural features. A conservation subdivision first identifies natural features to be conserved (streams, wetlands, wildlife corridors, historic sites, etc.) then locates building lots into the remaining areas of the property that are more appropriate for development. Conservation subdivision lots are typically smaller due to set asides for open space / conservation. Conservation subdivisions preserve more land in a natural state, disturb less land area and require fewer linear feet of roads and utility lines.

[2] Low impact development standards require a comprehensive land planning / engineering design approach with the goal of preserving water quality in urban and developing watersheds.

I. INTRODUCTION

Vision Statement

"Wake County will be a great place to live, work, learn and play. It will be a place where people are self-sufficient, enrich their lives, respect the environment, appreciate their heritage, participate in government, and plan for a better tomorrow." (Wake County Vision Statement)

"Wake County will be an outstanding community of urban and rural areas, where the demand for quality and affordable growth is met, economic development and opportunity is enhanced, environmental quality and cultural heritage are maintained, and all of these objectives are balanced with protecting the property rights of landowners."
(Vision Statement, Wake County Land Use Plan.)

A. Planning Framework, Process and Stakeholders

Unlike other areas of Wake County, the Harris Lake study area is highly influenced by the presence of the Shearon Harris Nuclear Power Plant. The presence of the plant, however, seems to not have dampened the enormous development interest and pressure in southwest Wake County.

Historic home within the New Hill Community.

The goal of the study has been to accommodate sustainable growth by matching development types and intensities with existing and predictable future infrastructure patterns – public water and sewer and transportation facilities. These criteria generally resulted in locating employment opportunities and mixed commercial / higher density residential uses in the upper reaches of the basin closest to existing municipalities and along existing US Highway 1 and near the planned I-540 corridor. Lower density residential and conservation areas are located in wedges radiating out along peninsulas created by Harris Lake and within the more transportation isolated southern portion of the study area.

The stakeholder group was created using a list of key stakeholders which included representatives of the three affected municipalities, the adjacent counties, Progress Energy, environmental management groups and emergency management agencies. Area residents were also asked to participate with residents who participated in the SWALUP planning process specifically invited.

Stakeholders included:

1. Residents of the area
2. Planning directors of the three municipalities – Apex, Holly Springs, and Fuquay-Varina

3. Progress Energy
4. NC Department of Transportation (NCDOT)
5. Capital Area Metropolitan Planning Organization (CAMPO)
6. NC Wildlife Resources Commission
7. Chatham County
8. Harnett County
9. Lee County
10. Wake County Commissioner
11. Wake County departments – emergency management, economic development, environmental services, community services

All stakeholders were sent project updates and meeting notifications once they joined the group. Stakeholders met seven times over the course of the study.

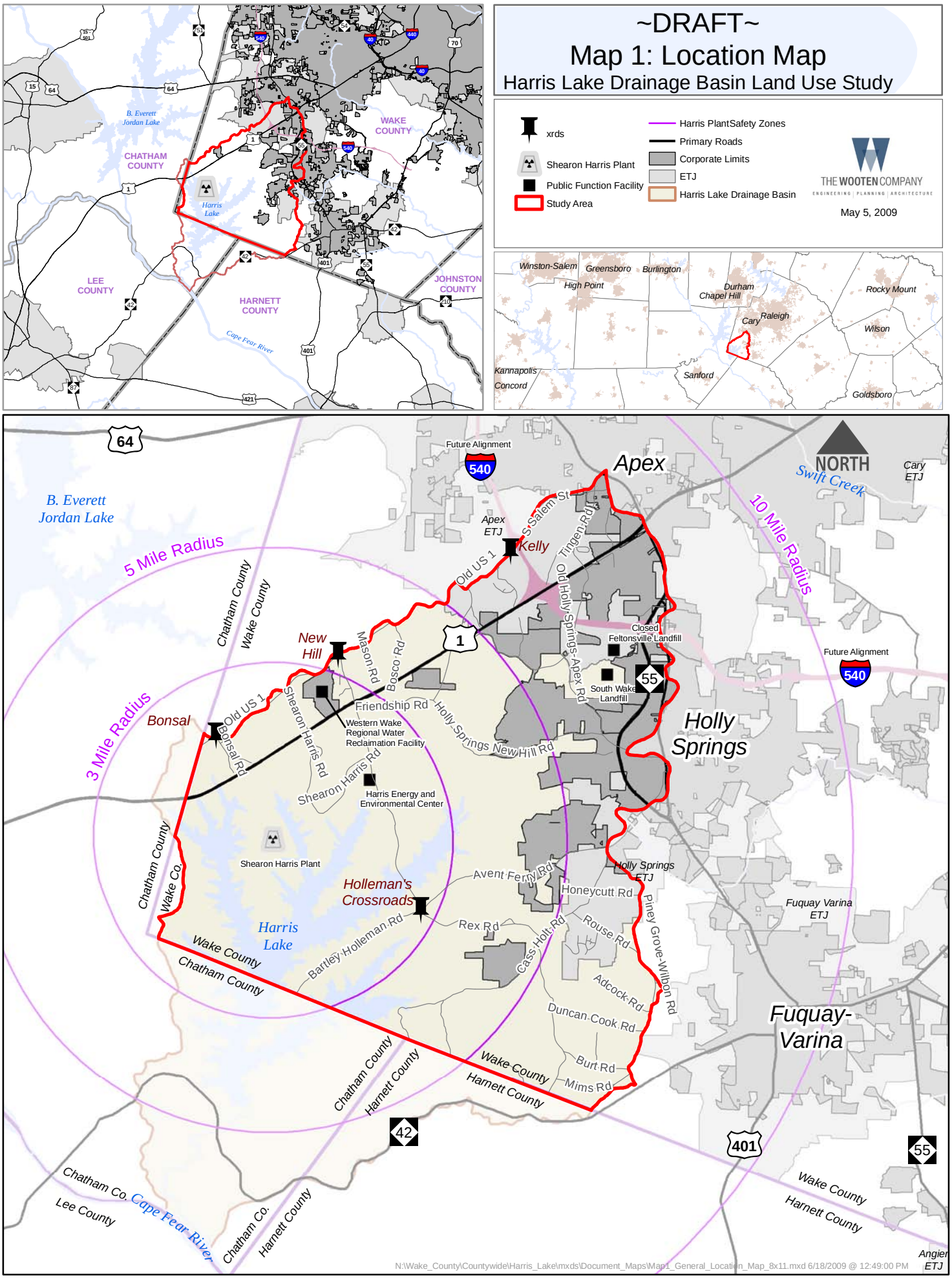
The study began with a review of the Wake County Profile and the four case studies of similar areas surrounding nuclear power plants along the East Coast (Appendix C). After studying and analyzing key components of the natural and man-made systems within the Harris Lake Drainage Basin, potential growth scenarios were developed for stakeholder review. The stakeholders also reviewed and provided feedback on each section of the draft document as presented.

The preferred development scenario (proposed SWALUP amendment) is a consensus plan from the stakeholders. Final study recommendations represent a balance of the myriad interests of the general public, private property owners, Progress Energy, and local government entities that have a vested interest in the area. While opinions on the total amount of development desirable for the area varied, all the stakeholders agreed in principle that the best and most unique elements of the area's rich heritage should be protected for the benefit of current and future citizens.

B. Purpose of Plan & Study Area

The Harris Lake Drainage Basin Land Use Study was undertaken as part of Wake County's continuing efforts to achieve the standards of the Wake County Vision Statement and to address specific concerns for this area that were expressed during development of the Southwest Area Land Use Plan. The Study provides insight and information on the land use program for the Harris Lake Drainage Basin within the overall economic, cultural, and environmental context within Wake County.

Harris Lake is located about 20 miles southwest of the City of Raleigh, just southwest of the Town of Apex, west of the Town of Holly Springs, and northwest of the Town of Fuquay-Varina (see Map 1 – Study Area). The complete Harris Lake Drainage Basin includes portions of Wake, Chatham, and Harnett Counties, but this study focuses only on that portion of the drainage basin within Wake County. The portion of the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Map 1: Location Map
Harris Lake Drainage Basin Land Use Study
xrds
Shearon Harris Plant
Public Function Facility
Study Area
Harris PlantSafety Zones
Primary Roads
Corporate Limits
ETJ
Harris Lake Drainage Basin
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B. Everett Jordan Lake
CHATHAM COUNTY
WAKE COUNTY
LEE COUNTY
HARNETT COUNTY
JOHNSTON COUNTY
Harris Lake
Cape Fear River
Winston-Salem
Greensboro
Burlington
High Point
Durham
Chapel Hill
Cary
Raleigh
Rocky Mount
Wilson
Kannapolis
Concord
Sanford
Goldsboro
64
Future Alignment
540
Apex
NORTH
Swift Creek
Cary ETJ
B. Everett Jordan Lake
5 Mile Radius
10 Mile Radius
3 Mile Radius
Chatham County
Wake County
Apex ETJ
S Salem St
Kelly
Old US 1
Tingen Rd
Old Holly Springs-Apex Rd
New Hill
Mason Rd
Bosco Rd
1
Closed Feltonsville Landfill
South Wake Landfill
55
Future Alignment
540
Bonsal
Old US 1
Bonsal Rd
Shearon Harris Rd
Friendship Rd
Holly Springs New Hill Rd
Western Wake Regional Water Reclamation Facility
Shearon Harris
Harris Energy and Environmental Center
Holly Springs
Shearon Harris Plant
Holleman's Crossroads
Avent Ferry Rd
Honeycutt Rd
Holly Springs ETJ
Fuquay Varina ETJ
Harris Lake
Bartley Holleman Rd
Rex Rd
Cass Holt Rd
Rouse Rd
Piney Grove-Wilbon Rd
Adcock Rd
Duncan Cook Rd
Burt Rd
Mims Rd
Wake County
Chatham County
Harnett County
Fuquay-Varina
42
401
55
Chatham Co.
Cape Fear River
Lee County
Harnett County
Wake County
Angier ETJ
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Harris Lake Drainage Basin within Wake County encompasses 39,000 acres – approximately 61 square miles – of land area.

The Harris Lake Drainage Basin remains largely rural in character with scattered clusters of development and numerous actively farmed and timbered lands. The farms tend to be small family-owned operations involving the growing of tobacco and grains and the raising of livestock (horses, cattle, and goats). Land, which is harvested for timber, is typically located closer to Harris Lake and the power plant. In addition, there are at least two quarries located within the study area, one on Rex Road, and another on Buckhorn–Duncan Road in the southern portion of the drainage basin.

Late afternoon view of farm in Friendship Community.

Harris Lake Drainage Basin is a unique planning area that is highly influenced by the very large percentage of land owned by Progress Energy. The company acquired the land in the 1970s to support and buffer the then proposed Shearon Harris Nuclear Power Plant (see Map 2 – Property Ownership).

The existing road network in the Harris Lake Area was constructed to meet the needs of a rural area. Like many areas across Wake County, the road network has not been expanded at the same rate the new homes, commercial buildings, or industrial uses have been added or expanded.

Wake County Emergency Management, in cooperation with Progress Energy, the Nuclear Regulatory Commission (NRC), and the Federal Emergency Management Agency (FEMA) investigated and established evacuation routes in the area. The study found that existing routes are appropriate for evacuating current residents and businesses within the area.

Evacuation route signage.

Continued development in the area would increase the strain on the area road network, and could affect the capacity to safely evacuate if needed. The land development scenarios produced in the Harris Lake Study were examined to determine the impact on evacuation.

While there are a number of nuclear power plants within the United States (see Case Studies in Section II) that are located within densely populated urban areas, it is desirable that population growth within the Harris Lake Drainage Basin not exceed the capability of the transportation network to safely evacuate the area if needed. Detailed and deliberate planning is required to ensure continued vitality and appropriate levels of growth within the Harris Lake Drainage Basin.

In addition to concerns about growth beyond the area's capability of sustaining development, the Harris Lake Drainage Basin presents one of the last opportunities within Wake County to preserve the essential

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Map 2
Property Ownership

Harris Lake Drainage Basin Land Use Study

Crossroad Communities
Shearon Harris Plant
Public Function Facility
Study Area
Primary Roads
Roads
Corporate Limits
ETJ
Major Lakes

Wake County Parcels
Ownership
Government
Individuals
Progress Energy (16,815 acres)
Public and Institutional

May 5, 2009

0 2,400 4,800 9,600 Feet

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NORTH

3mi

5mi

elements of rural life. Progress Energy's purchase of thousand of acres around the nuclear power plant has had the unintended benefit of protecting valuable forest, wildlife habitat, gamelands, recreation lands, and water bodies from rural sprawl which has impacted so much of rural North Carolina (see Map 3 – Environmental Resources).

C. Planning Jurisdiction & Relationship to Other Plans

Beyond extraterritorial planning jurisdictions associated with municipalities throughout Wake County, the County has assigned to each municipality short and long range urban services area boundaries into which municipal services may be extended in the future. Areas designated as short or long range urban services areas are presently under the planning jurisdiction of Wake County, but are delineated to better coordinate planning activities between municipalities and the County. Within 10-20 years, urban services areas are planned to either be annexed into municipal town limits or included in municipal extraterritorial jurisdictions.

According to the Southwest Wake Area Land Use Plan (SWALUP), three primary objectives for the Urban Services Areas in the SWALUP are:

1. To protect water quality in the Jordan Lake reservoir,
2. To preserve significant open space and historic resources in the area, and
3. To allow only very low-density developments in the Harris Lake Watershed area.

View of stream from Friendship Road over crossing.

The majority of the Harris Lake Drainage Basin is the only area within Wake County that has not been designated as part of a specific municipality's growth area. Both the Town of Apex and the Town of Holly Springs currently include portions of the study area in their respective long range land use plans. The determination of if, when, and how the Harris Lake Drainage Basin could develop is directly related to municipal interest in the area.

Short-Range Urban Services Areas (SRUSAs) are locations in which it is anticipated that municipal services will be extended within 10 years. SRUSAs are areas where the County anticipates encouraging future growth to make efficient use of planned infrastructure improvements. Long-Range Urban Services Areas (LRUSAs) are locations in which it is anticipated that services will not be extended within the next 10 years.

The current SWALUP recognizes the area within a 1-mile radius of the Shearon Harris Plant as non-urban where municipal water and sewer are not planned. These areas are not anticipated to be developed due to their proximity to the plant or due to lack of direct access from US 1 and the rest of the County.

~DRAFT~
Map 3
Environmental Resources
Harris Lake Drainage Basin Land Use Study

May 5, 2009

Feet
0 2,400 4,800 9,600

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NORTH

- Shearon Harris Plant
- Public Function Facility
- Major Roads
- Railroads
- Study Area

Sub-watershed that supports state-listed mussels

- 03020201120010
- 03030004020010
- 03030004030010
- Wake County Designated Critical Watersheds

Water Supply Watersheds

- Critical
- Protected
- Piedmont Ecoregion
- Voluntary Agricultural Dist.
- Buffers of Shearon Harris
- Creeks and Streams
- Lakes and Ponds
- Significant Natural Heritage Areas
- 100 foot Stream Buffer
- Gamelands
- Gamelands Buffer
- NC Triangle Greenprint Sites

Olives Chapel Rd
Olive Chapel Rd
Tody Goodwin Rd
Tody Goodwin Rd
Richardson Rd
Haw River (Jordan Lake) WS-IV NSW
Haw River (Jordan Lake) WS-IV NSW
Future Alignment
540
Kelly Rd
Kelly
S Salem St
Tingen Rd
Tingen Rd
Schieffelin Rd
Lufkin Rd
Ragan Rd
Evans Rd
Holland Rd
Barker Rd
Poole Rd E
Poole Rd E
Chatham County
Wake County
New Hill Olive Chapel Rd
Fairfield Rd
Old Us 1 Hwy
Future Alignment
540
Us 1 Hwy
Woods Creek Rd
Closed Feltonsville Landfill
Horton Rd
New Hill
Mason Rd
1
Copperhead Rd
Friendship Rd
South Wake Landfill
55
Nc 55 Hwy
Western Wake Regional Water Reclamation Facility
Shearon Harris Rd
Friendship Rd
Kadir Womble Dr
Bonsal
Shearon Harris Longleaf Pine Forest
Old Us 1
Us 1 Hwy
Rush Rd
Us 1 Us 1
Shearon Harris Rd
Shearon Harris Rd
Harris Energy and Environmental Center
King Rd
Shearon Harris Plant
Shooting Ln
03030004020010
S Main St
County Park Dr
Hollemans Crossroads Slopes
Avent Ferry Rd
03020201120010
Honeycutt Rd
Holleman's Crossroads
Rex Rd
Rex Rd
Harris Lake
Bartley Holleman Rd
Buckhorn Duncan Rd
3mi
Cass Holt Rd
Jim Branch/buckhorn Creek Forests
Adcock Rd
Duncan Cook Rd
Christian Chapel Church Rd
Sweet Springs Rd
Wade Stephenson
5mi
Starchase Ln
Burt Rd
Hobby Rd
Auger Hole Rd
Rollins Mill Rd
Mims Rd
Nc 42 Hwy
Nc 42 Hwy
Nc 42
Nc 42
CHATHAM COUNTY
03030004030010

In January 2009, Wake County updated a countywide land use plan (see Map 4 - Wake County Land Classifications Map) showing existing municipalities and areas of anticipated growth throughout the County. Subsequent to the 1997 Plan, area land use plans were developed to provide more detail on how growth was expected to occur within different areas within the County.

The SWALUP, initially adopted in 1999, covers an area larger than the Harris Lake Drainage Basin. An updated version of the SWALUP, adopted in July 2007, includes more highly defined planning tools for guiding growth within southwest Wake County. The 2007 SWALUP also incorporates other County planning components (Transportation, Open Space, and Recreation Plans) and updates to the municipal comprehensive plans for the towns of Apex and Holly Springs. The Town of Fuquay-Varina is included in the Fuquay-Varina/Garner Area Land Use Plan. Since a portion of the Fuquay-Varina Urban Services Area is located in the Harris Lake Drainage Basin, the town cooperated in the development of the Harris Lake Drainage Basin Land Use Plan.

D. SWALUP Goals & Strategies

Goals and strategies adopted by Wake County in 2007 are referenced and excerpted below (see pages ES-5 through ES-7 of the SWALUP:

1. "… guide quality growth throughout the County in conjunction with affected local governments …"

2. "… encourage growth close to municipalities, to take advantage of existing and planned infrastructure …"

3. "… encourage the development of communities, which provide adequate land for anticipated demands, in a pattern that allows a mixture of uses."

4. ". . . encourage maintenance of open space, scenic aspects of natural areas, entrance ways to urban areas, and transition between urban areas."

5. "… encourage the conservation of historical sites, environmentally significant areas, and important natural and cultural resources."

6. "… allow owners of significant farmlands and forest lands the opportunity to maintain the productivity of their land."

7. "… ensure that the land use plan and transportation plan mutually support each other."

8. "… always protect the property rights of landowners."

Wake County and the Triangle region rank high on a variety of "Best Of" lists.

Map 4
General Landuse Classifications

Harris Lake
Drainage Basin
Land Use Study

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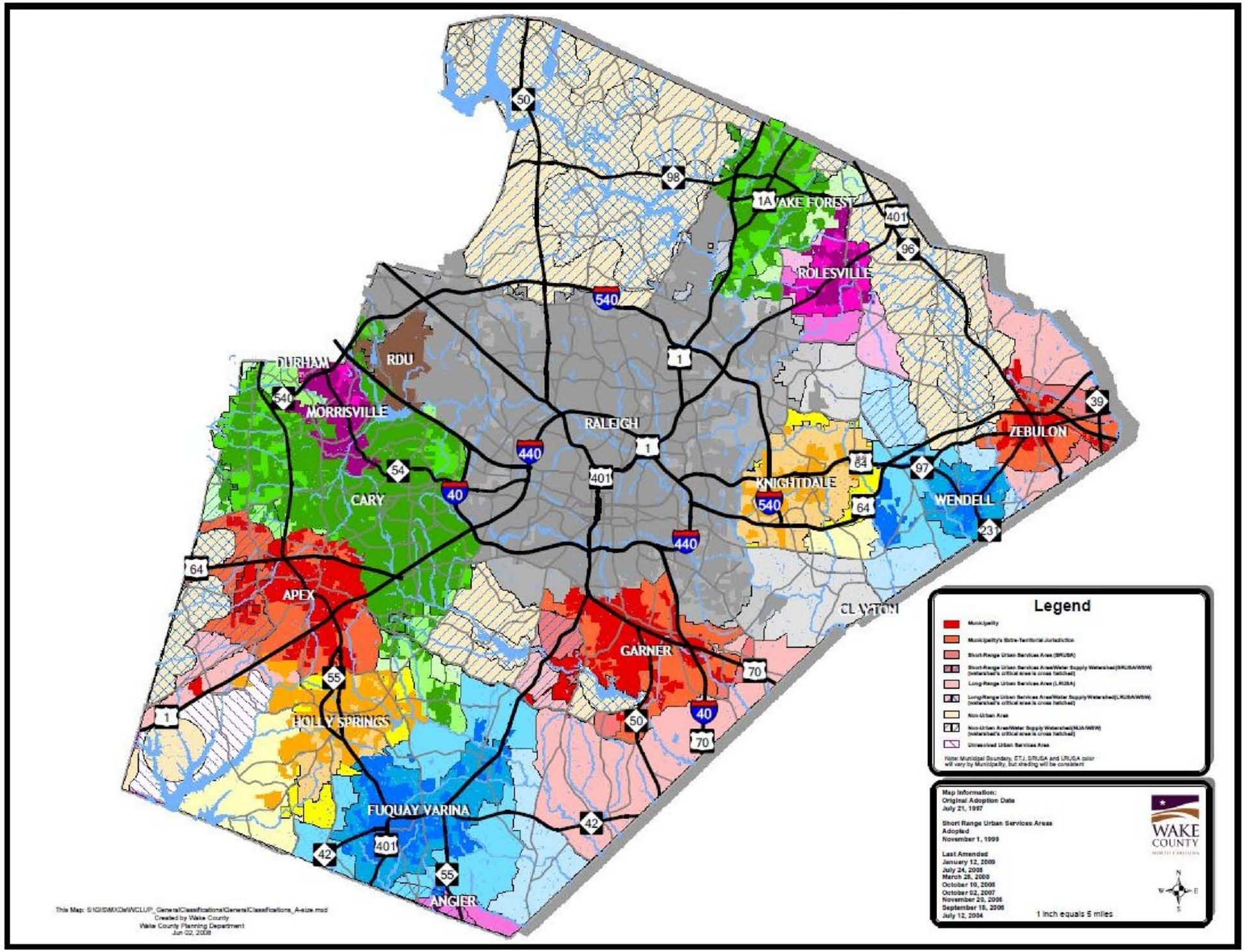


9. "… maintain the quality and develop the capacity of surface water resources …"

10. "… prevent contamination of and maintain the capacity of groundwater resources."

11. "… ensure that local governments provide adequate, properly located land for recreational and leisure opportunities."

General themes emerged from the Wake County Growth Management Strategy document finalized in 2005. These are referenced (see SWALUP page ES-6) are excerpted here for reference:

1. "… Strike a balance between intergovernmental cooperation and local control."

2. "Different circumstances call for different growth strategies …"

3. "… the County itself has a key role to play in preserving rural character, since most such lands lie outside municipal boundaries."

4. "… Need for compact, mixed-use development, in order to both minimize infrastructure costs and also protect open space."

5. "… Recognize the importance of a healthy economy in the region and that preserving an area's character and quality of life can contribute to local economic development."

E. Demographics & Growth Pattern

The Triangle region of North Carolina, of which Wake County is a part, has repeatedly been recognized as one of the best places to live and work in national magazines and surveys. With a high quality of life, the Triangle region continues to attract and be challenged by an ever-growing population.

In 2009, Wake County estimated a net influx of 95 residents per day. From 1970 to July 2008, a period of 38 years, the U.S. Census Bureau estimated that Wake County grew by more than 637,000 residents. Official future population projections show a comparable influx of new residents by 2030. Sustaining quality of life while accommodating growth remains a key planning concern for the communities within the Triangle.

F. Property Ownership & Current Use

Private property in the Harris Lake Drainage Basin is largely either residential. actively farmed or timbered forest lands. The SWALUP

identifies most of the developable land within the area as residential to be developed at a maximum of 3 dwellings per acre if water and sewer services are available.

The SWALUP recognizes that Progress Energy, as "the major landholder in this area", is a significant contributor to the character of the drainage basin and that the presence of the nuclear power plant influences current land uses. Progress Energy owns approximately 16,815 acres or 43% of the study area.

Progress Energy power line easement runs parallel to US Highway 1.

In addition to land associated with the power plant itself, Progress Energy owns surrounding acres, including Harris Lake, as a buffer to the facility. Many of these lands are in short-term protection and are managed by the NC Wildlife Resources Commission as game lands, used by NC State University for research, or are leased by Wake County for Harris Lake County Park.

Progress Energy representatives have indicated that at this time expansion of energy production, not property development, is the company's primary focus. The company has applied to the Nuclear Regulatory Commission for approval to build and operate two additional nuclear reactors and associated facilities.

The land surrounding Harris Lake was acquired to support the initial construction of the power facility in the 1980s. At that time, the company had intended to construct 4 reactors, but only one unit was built. Now the property is needed to support the expansion permit process and continued plant operations. As technology advances and the regulatory environment changes, the company has indicated it may also consider using land for other methods of energy production, e.g., wind or solar power.

Rural vista on a late fall afternoon.

Harris Lake was created in 1983 to provide cooling water for the Shearon Harris Nuclear Power Plant. The lake was created by damming Buckhorn Creek about two miles upstream from the confluence of Buckhorn Creek with the Cape Fear River. If Progress Energy is granted a license to construct two additional reactors at the plant, the Harris Lake water level will be raised 20' from 220' above sea level to 240' above sea level. The potential higher lake level was considered in development of all three land use scenarios.

Current Wake County zoning within the study area is primarily Residential 80, which requires minimum 80,000 square foot residential lots. The majority of the land within the study area consists of large wooded tracts owned by Progress Energy. Most privately-owned land within the area consists of tracts that are at least 10 acres or greater in size.

The great majority of the lower portion of the Harris Lake Drainage Basin remains rural. The area has a history of agricultural and forestry operations, many of which remain in operation today. Larger population centers within the basin – the towns of Apex, Holly Springs, and Fuquay Varina – are located in the upper reaches of the drainage basin; however, the three municipalities are rapidly expanding and extending public utilities and corporate limits further into the drainage basin.

There are numerous resource conservation opportunities within the study area.

Construction of the Interstate I-540 / Western Wake Parkway (as a toll highway) through the northern portion of the Harris Lake Drainage Basin will likely bring added development pressures to the area. Indeed, in summer 2009, the Town of Apex had just received and was reviewing a development proposal that could, at full build out, add 20,000 residents and create more than 30,000 jobs on land bounded by NC 55 and US 1 in the northern portion of the study area. Ongoing and increasing concerns about rapid population growth and the number of persons who may eventually inhabit the study area have prompted the need to develop a preferred growth scenario for the basin.

G. Natural Resources & Resource Management

The SWALUP identifies existing natural resources and numerous conservation opportunities within the Harris Lake Drainage Basin (reference Sections 7 and 9 of the SWALUP). The highest preservation priorities are NC Significant Natural Heritage Areas and areas within 150 feet of lands maintained by the NC Wildlife Resources Commission to provide a buffer to hunting, timbering, and prescribed burning activities.

The SWALUP also lists several secondary priorities for conservation including the entire Harris Lake Drainage Basin as an area that supports State listed endangered and threatened species of fish and mussels. The SWALUP recommends that efforts be made to minimize secondary and cumulative impacts of development to streams within the basin.

Harris Lake County Park. Planned parks are shown on scenario maps

The Triangle Nature Conservancy (TNC) lists a portion of the basin as an Ecoregional Portfolio Site containing representative examples of species, natural communities, and ecosystems of the North Carolina Piedmont Region. A portion of the basin is also identified in Triangle Greenprint, a regional conservation plan that was adopted by the Wake County Board of Commissioners on March 25, 2002.

Progress Energy land holdings are designated as an important wildlife migration corridor by the Urban Wildlife Project of the NC Wildlife Resources Commission. These lands connect to lands surrounding Jordan Lake providing wildlife corridors between the two lakes. The SWALUP also recognizes as a lower conservation priority the protection of 300 meters of land surrounding the American Tobacco Trail. The Harris

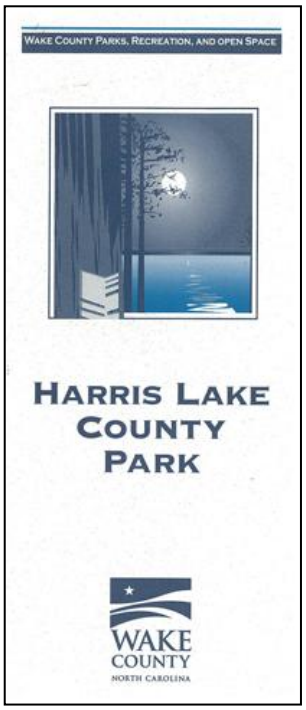
Lake study area includes a short distance of the trail located north of Old US 1 along the abandoned Norfolk Southern railroad to the Bonsal Community. Again, more detail about conservation priorities and efforts can be found in the SWALUP document.

Advanced-level bicyclists riding along New Hill Holleman Road.

H. Watershed Planning

Wake County has long recognized and placed a high importance on protecting water quality. The Harris Lake Watershed Area Open Space Plan, adopted July 2000, aims to protect water quality; wildlife habitat and rare native plant communities; support farmers who want to continue farming; protect historic and cultural resources related to open space; protect recreation land, greenways and bike routes; and preserve places for hunting and fishing within the Harris Lake Watershed. Existing and planned open space and parks are shown on development scenario maps.

The 2000 Watershed Plan and 2007 SWALUP (Section 9) establish methods to protect water resources and restore degraded streams by recommending a series of strategies to protect water resources while making accommodations for future growth. Methods adopted include better management of stormwater runoff through expanding width of required riparian buffers, prohibiting development in floodplains, limiting impervious surface area in new developments, preserving open space, reclaiming wastewater, and providing for development of conservation subdivisions. Conservation subdivisions seek a high level of sustainability by condensing development into the areas of a site most suitable for development while protecting the more environmentally sensitive areas.



I. Historic Resources & Farmland

The SWALUP (Pages 11-17) describes a bit of the history of New Hill, including use of the term “crossroads community.” Historic sites within the Harris Lake Drainage Basin include the Hew Hill Historic District and more than 20 other properties. More detailed information about historic sites can be found in the SWALUP, Section 11.

While the New Hill Historic District is unique in the study area, the “crossroads community” term has application to three other areas. “Crossroads communities” are small assemblages of buildings with landscapes and views reminiscent of how they looked decades ago. These areas are not necessarily slated for additional development, but SWALUP recommendations state that “future infill development should complement existing land uses such as historic properties. Crossroad communities within the study area include:

1. New Hill Historic District (at New Hill Holleman Road / Old US 1)
2. Bonsal (at Bonsal Road / Old US 1)
3. Kelly (at Kelly Road / Old US 1)

4. Holleman's Crossroads (at New Hill-Holleman and Avent Ferry Roads)

Harris Lake County Park, a 680-acre regional park location on a peninsula adjacent to Harris Lake, is located on land leased from Progress Energy. When the lake level is raised, the current park location will be affected by flooding. Progress Energy has indicated a desire to work with the County to relocate the park to higher ground when necessary.

Wake County adopted a farmland preservation program in October 1989. The voluntary program establishes criteria for designating Agricultural Priority Areas (APA). There are several APAs within the study area (Map 5**)**. There is a 148-acre farm owned by the Goodwin Family located in the northwestern portion of the study area along Old US 1 and New Hill Holleman Road. There are several parcels totaling over 700 acres owned by the Burt Family in the southern portion of the study area. These parcels are located along Cass Holt, Burt, and Duncan Cook roads.

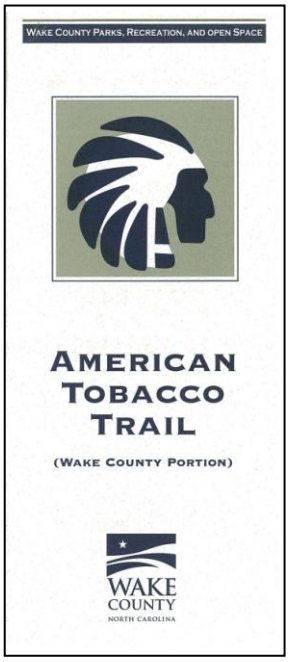
J. Open Space Planning

Wake County has been proactive in efforts to preserve important open space resources; a strategic approach as the County becomes more urban. The Wake County Growth Management Plan supports:

1. Initiatives to establish reliable sources of funding for open space acquisition, maintenance and education.
2. Preservation of linear open spaces through buffers along streams or lakes; use of infrastructure and utility easements; providing adequate width corridors for wildlife movement; creating opportunities for greenway and trail development; and enhancing access to interconnections between open space and transportation networks.
3. Preservation of farmland and farming as a viable economic enterprise through voluntary and incentive-based farmland preservation programs.

The Wake County Consolidated Open Space Plan, adopted in 2002 and updated in 2006, establishes four important and interrelated activities for open space conservation:

1. Identifying key parcels of land and corridors that should be acquired and protected as open space;
2. Recommending new regulatory programs that improve the protection of resources;
3. Establishing a new program of land stewardship to manage open space resources; and



The Wake County portion of the 23-mile American Tobacco Trail could be extended another 6 miles to Harris Lake County Park.

~DRAFT~
Map 5
Existing Land Use

Harris Lake Drainage Basin Land Use Study

Crossroad Communities
Shearon Harris Plant
Public Function Facility
Voluntary Agricultural Districts
Study Area
Buffers around Shearon Harris
Railroads
Major Roads
Major Lakes
Municipal Corporate Limits
Municipal Jurisdictional Boundaries

Land Use Classification

Agriculture
Commercial/Industrial
Historic
Institutional
Mobile Home Park
Multi Family Residential
Residential
Progress Energy
Vacant

May 5, 2009

0 2,400 4,800 9,600 Feet

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NORTH

3mi

5mi

4. Defining recurring sources of revenue that support open space conservation.

The Triangle Rails to Trails Conservancy indicates that when greenway plans in Wake, Durham, and Chatham Counties are implemented there will be a nearly 35-mile, continuous north-south greenway from the Eno River Park north of the City of Durham to Harris Lake County Park in southwest Wake County. Although the Wake County Open Space Plan does not propose a greenway link between the American Tobacco Trail (ATT) and Harris Lake County Park, such a link might be desirable. One of the challenges of providing a link would be choosing the best location and method to go either over or under US 1.

Hikers on the American Tobacco Trail.

Possible link options to consider include:

- New Hill Holleman Road. This road would provide the most direct corridor linking the ATT trailhead north of New Hill with the County Park currently located just off New Hill Holleman Road. New land uses proposed for this road corridor could add vehicular traffic in the future which would lessen the appeal of this route. If or when the roadway is widened, a side path might be considered to accommodate bikers and pedestrians.

- As Progress Energy prepares to build two new nuclear reactors, there is an opportunity for the County to request a greenway link be constructed under or over US 1 in conjunction with the temporary interchange on US 1 that is being proposed to handle construction traffic. The connection could be constructed with the interchange but not opened to the public until after nuclear power plant construction is completed. This opportunity could depend on exactly where the interchange will be built, who owns the interchange (Progress Energy or state-acquired land), and whether or not a connection is feasible. Maintaining security may be a concern of Progress Energy and the Nuclear Regulatory Commission.

Old service station at intersection of Old US 1 and New Hill Holleman Road

K. Growth Management in Wake County

Wake County does not provide water or sewer service. The County works with its municipal partners to determine how and when an area should be served with water and sewer. The goal of infrastructure coordination is to direct the pace and location of development.

According to the SWALUP (pages 13-2 and 13-3) “the County’s water / sewer extension plans recognize and address important needs, but alone are insufficient to manage growth. That is why in November 1999, the Board of Commissioners amended the Land Use Plan to add policies

defining how current development in Urban Services Areas (USAs) should be designed in terms of intensity and provision of water, sewer, transportation facilities, and recreation areas."

"The Urban Services Areas are now split into Short-Range and Long-Range USAs, the Short-Range USA classifications apply to land within those portions of the "wastewatersheds" of municipal sewer line extensions projected to occur in the next 10 years that lie within 1 mile of the extension. For Short-Range USAs, the new development will be required to connect to municipal water and sewer systems where practicable, and encouraged to provide centralized community water or sewer systems elsewhere."

Holleman's Crossroads

"In Short-Range USAs Wake County implements transitional urban development standards that require applicants to meet the development standards of the closest municipal jurisdiction. This ensures that sidewalks and other infrastructure are in place. For Long-Range USAs urban intensities will be discouraged as premature …".

L. Activity Centers

Wake County land use policies also "encourage new development served by centralized sewer be developed at urban intensities and that other new development be designed to facilitate future urban infill development once centralized sewer becomes available. There is a policy that new development be served by urban transportation facilities designed to municipal standards" as per the SWALUP (page 13-3).

These policies strengthen the County's support for activity center creation. Activity centers are focal points where people gather for many reasons, such as shopping, eating, working, spiritual or fellowship activities, learning or playing. As such, a mix of land uses is recommended. A complete description of county policies and guidelines, as they relate to activity centers, is presented in the SWALUP (section 14).

Holly Grove Middle School
under construction

While recognizing additional planning was needed within the Harris Lake Drainage Basin, the SWALUP envisioned several activity centers at strategically located intersections in the drainage basin. A list of SWALUP activity centers in those portions of the Harris Lake Drainage Basin study area that lie outside municipal planning jurisdiction follows (NAC refers to a neighborhood activity center; LRUSA denotes a current designation as the area inside the Long-Range Urban Services Area)

- Friendship Road / Old US 1 NAC (Apex LRUSA)
- New Hill Holleman Road / US 1 NAC (Apex LRUSA)
- New Hill–Olive Chapel Road / Old US 1 NAC (Apex LRUSA)
- Bonsal Road / Old US 1 NAC (Apex LRUSA)

- Avent Ferry Rd/New Hill Holleman Rd NAC (Holly Springs LRUSA)
- Friendship Road / Holly Springs New Hill Road NAC (unresolved USA)
- New Holleman Road (near the county park) NAC (unresolved USA)

At present, there are no existing or planned public schools within Wake County's planning jurisdiction in the Harris Lake Drainage Basin. Holly Grove Elementary, Holly Grove Middle School, and Holly Springs High School are all located on Cass Holt Road near the Avent Ferry Road intersection, just beyond the eastern edge of the study area boundary.

M. Land Use Classifications

Table 4 describes the Land Use Classifications that are applicable to both the Urban Services Areas and Non-Urban Areas in the study area (see Map 4 - Wake County Land Classifications Map) showing existing municipalities and areas of anticipated growth throughout the County. The description and policies associated with these Land Use Classifications applied to Urban Services Areas represent the County's vision for how areas so classified will be developed in conjunction with the provision of urban facilities and services that make urban uses and intensities possible.

Table 4: SWALUP Land Use Classifications

Land Use Classifications	Description
Critical Watershed Area	Land in a water supply watershed that is adjacent and training to the water source, where it is most important to filter out potential pollutants.
Neighborhood Activity Center	Land uses include shopping, services, recreation, and small-scale office and institutional uses needed to meet the day-to-day needs of the neighborhood. Examples are grocery or convenience store, pharmacy, video rental, dry cleaning or laundry, restaurant, service station, medical or dental practice, insurance agency, law firm, small neighborhood business office, school, daycare, church, park, and civic club.
Community Activity Center	Land uses include those uses permitted in neighborhood activity centers, plus uses that provide goods and services needed less frequently than on a daily basis. Examples are commercial, civic or office and institutional, and medium and low density residential.
Residential Area Densities	*Water Supply Watershed Critical Area (Jordan Lake)*: Residential use – cluster and other subdivisions – up to 0.5 dwelling units per acre. The current recommended density for the water supply watershed critical area, which is shown on the SWALUP, is proposed to be changed from a density of 1.75 dwelling units per acre to a recommended density of 0.5 dwelling units per acre.

	Water Supply Watershed Non-Critical Area: The recommended density for this area is up to 1 dwelling unit per acre. *Non-Water Supply Watershed Area (Harris Lake-Cape Fear Watersheds):* The recommended density for this area is up to 0.5 dwelling units per acre. *Non-Water Supply Watershed Area:* The recommended density for this area is up to 1.5 dwelling units per acre.
Main Stream or Lake Buffer	Main stream or lake buffers provide strips of natural vegetation that remove pollutants from stormwater runoff before they reach a water supply source or a watercourse that drains to a water supply source.
Forestry/Light Industry (FLI)	Land uses include mostly forestry or possibly the making of electricity (non-nuclear) where at least 75% of site stays in its natural state. Includes lake/stream buffers.
Office/Research Park (ORP)	Land uses include mostly office, labs, research facilities, maintenance facilities, and lake/stream buffers.
Industrial	Land uses include manufacturing, warehousing, freight handling, wholesaling, research and development activities with office support services.
Office & Institutional (O&I)	Land uses include institutional, office, and limited commercial activities that are less intensive than other commercial districts.
Open Space	Areas of publicly or privately owned natural area that is protected for natural and cultural resources.
Recreational Facility	A facility or site that consists of land dedicated for public recreational use.
Public Function Facility (PFF): • Existing Feltonville Sanitary Solid Waste Facility • Proposed South Wake Sanitary Solid Waste Facility • Proposed Western Regional Wastewater Treatment Facility	A facility or site which functions to serve public, including existing or proposed sanitary landfills, regional wastewater treatment facility, and fire and emergency management stations: • The Feltonville Sanitary Solid Waste Landfill is located on the north side of the terminus of Old Smithfield Road (west of NC 55 Bypass). • The proposed South Wake Sanitary Solid Waste Landfill is to be located on the south side of the terminus of Old Smithfield Road (west of NC 55 Bypass). Planned to begin operation in 2009. • The proposed Western Regional Water Reclamation Facility is to be located southwest of the New Hill Community between US Hwy 1 and Old US Hwy 1. Planned to begin operations in 2011.
Special Function Facility (SFF)	A facility or site designated for a special function that could make typical urban development costly or hazardous to public health and safety. Surrounding land uses should be developed with an awareness of the special function and any particular needs, such as emergency evacuation, that may arise from it.

Section II. Land Use Scenario Planning

The three development scenarios were considered as separate but sequential development scenarios. Scenario 1 was conceived as the lowest-impact, lowest intensity scenario with the least demand for infrastructure improvements and the highest level of protection for natural resources. Although all three scenarios recognize and incorporate the County's vision of activity centers at key road intersections in the upper reaches of the drainage basin, Scenario 1 discourages the need to extend public water and sewer further into the drainage basin.

Railroad crossing on Friendship Road.

Although Scenario 2 envisions more growth and development within the basin, there is still restraint in the designation of low to moderate residential growth areas. This medium density/medium impact development scenario recognizes the need for more public water and sewer infrastructure development and the importance of providing better transportation routing both within the area and out of the area.

Scenario 3 envisions the highest sustainable level of growth and development within the basin, recognizing that the ability of the basin to support higher density residential growth is limited and should be confined to specific areas in the upper reaches of the drainage basin. Scenario 3 requires the highest investment in transportation system improvements and extension of public water and sewer systems to serve higher intensity development.

Land Use Acreage by Scenario

Table 5 compares acreage by land use for each scenario.

Table 5: Land Use Acreage by Scenario - Wake County Planning Jurisdiction

Land Use	Scenario 1	Scenario 2	Scenarios 3 / 3A
Park and Conservation	823[1]	3,711	3,711
Total Residential (other than Mixed-use)	22,166	17,066	13,786
Very Low-Density Residential	*17,353*	*11,819*	*9,564*
Low-Density Residential	*161*	*153*	*349*
Medium-density Residential	*4,652*	*5,094*	*3,873*
Mixed-Use	0	289	2,622
Office / Research Park	462	552	855
Commercial	0	0	126
Industrial	368	1,989	2,508
NAC (Neighborhood Activity Center)	117	70	70
NHHD (New Hill Historic District)	-	73	73
PFF (Public Function Facility)	207	392	392
PEX (Progress Energy Exclusionary Zone)	3,548	3,548	3,548
Total Acres	**27,691**	**27,691**	**27,691**

[1] *Total Park and Conservation acreage equals 3,711 for all scenarios. The 823 acres (Progress Energy land leased to NCSU for research) listed for Scenario 1 is the protected acreage that was delineated on the adopted SWALUP/Scenario 1.*

A. Development Scenarios

Scenario 1: Least Intensity

Scenario 1 represents the land uses adopted by the Wake County Board of Commissioners in the adopted Southwest Area Land Use Plan (SWALUP) on July 9, 2007 and the adopted Fuquay-Varina/Garner Area Land Use Plan on March 15, 2004. (See Map 6 Scenario 1). In comparison with the three land use scenarios crafted for the Harris Lake Drainage Basin Plan, Scenario 1 has the least development intensity, except along both sides of New Hill- Holleman Road on the peninsula (see Section D below) where Scenario 2 proposes less intensity than the adopted plan (Scenario 1). Relative to all other scenarios, Scenario 1 has the lowest infrastructure cost, but also consists of land uses that are taxed at a lower rate. In Scenario 1, most development would have on-site wells and on-site septic systems. As the only scenario that is adopted, Scenario 1 represents the baseline for comparison purposes.

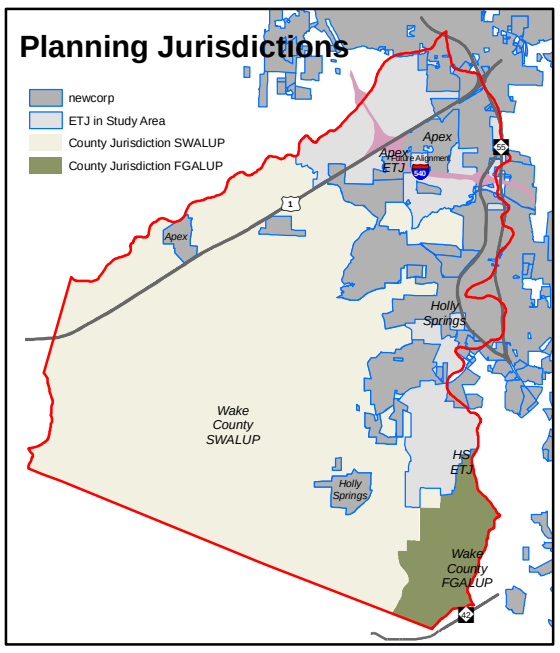
Scenario 2: Medium Intensity

Environmental protection along the peninsula that is bisected by New Hill Holleman Road is a key difference in this scenario and is repeated in Scenarios 3 and 3A (see Map 7 Scenario 2). Many areas adopted as Very Low-Density Residential (Scenario 1) are proposed in Scenario 2 to change to Medium-Density Residential, Mixed-Use, Office/Research Park, or Industrial. All of the proposed changes within a 3-mile radius of the Harris plant are to change from residential to non-residential use. Another distinction of Scenario 2, relative to other scenarios, is the emphasis on Office / Research Park land use at the US 1 / New Hill Holleman interchange. With easy access to the Harris plant less than 3 miles away, this area may be attractive to nuclear industry related enterprise. However, such a demand has not manifested itself in the 20-plus years of power plant operation. The renewed national interest in domestic power production, combined with Progress Energy's application for licensing of two new reactors at Shearon Harris, may give impetus to spin-off office/research park development nearby. If so, Scenario 2 directs such development to the New Hill Holleman Road corridor.

~DRAFT~
Map 6
Scenario 1

Adopted July 9, 2007

Harris Lake Drainage Basin Land Use Study



Residential Land Use Classifications		Comparable Zoning	Units/ Acre	Approx. Lot Size (acres)	Approx. Lot Size (sq. feet)
VLDR	Very Low Density Residential	R 80	1/2 unit per acre	1 unit per 2 acres	80,000
LDR	Low Density Residential	R 40	1 unit per acre	1 unit per acre	40,000
MDR	Medium Density Residential	R 20	2 units per acre	1 unit per 1/2 acre	20,000
		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- Public Function Facilities
- Shearon Harris Plant
- Proposed Interchange
- Park or Recreation Facility
- Study Area
- Major Roads
- Minor Roads
- Railroads
- Fuquay-Varina Proposed ETJ Extension
- Creeks & Streams
- Harris Lake at Current Level (220')
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Hunting Safety Buffer
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries
- Progress Energy Exclusionary Zone

Proposed Land Use

- PEX - Progress Energy Exclusionary Zone
- IND - Industrial
- NAC - Neighborhood Activity Center
- ORP - Office/ Research Park
- PFF - Public Function Facility
- MU - Mixed Use
- MDR - Medium Density Residential
- LDR - Low Density Residential
- VLDR - Very Low Density Residential
- PARK - Park
- CON - Conservation
- NHHD - New Hill Historic District

Parks & Recreation Facilities

Number	Name	Status
1	County Firearms Range	Existing
2	Holly Springs Park	Planned
3	Holly Springs Park	Planned
4	Holly Springs Park	Planned
5	Holly Springs Park	Planned
6	County Regional Park	Existing
7	Progress Energy Marina	Planned
8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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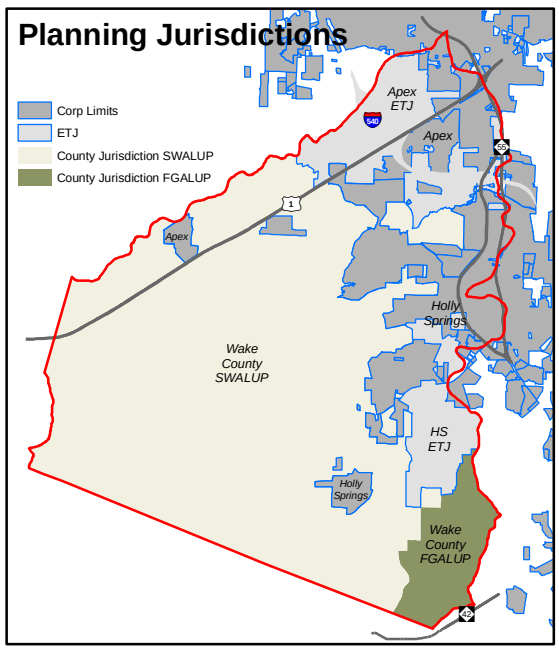
Map 7
Scenario 2

Harris Lake Drainage Basin Land Use Study



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		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- Crossroad Communities
- Shearon Harris Plant
- Public Function Facility
- Park or Recreation Facility
- Study Area
- Fuquay-Varina Proposed ETJ Extension
- Creeks & Streams
- Harris Lake at Current Level
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Hunting Safety Buffer
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries

Proposed Land Use

- PEX - Progress Energy Exclusionary Zone
- IND - Industrial
- CAC - Community Activity Center
- NAC - Neighborhood Activity Center
- COM - Commercial
- MU - Mixed Use
- MDR - Medium Density Residential
- LDR - Low Density Residential
- VLDR - Very Low Density Residential
- ORP - Office/ Research Park
- PFF - Public Function Facility
- PARK - Park
- CONS - Conservation; CON - Conservation
- NHHD - New Hill Historic District

Parks & Recreation Facilities

Number	Name	Status
1	County Firearms Range	Existing
2	Holly Springs Park	Planned
3	Holly Springs Park	Planned
4	Holly Springs Park	Planned
5	Holly Springs Park	Planned
6	County Regional Park	Existing
7	Progress Energy Marina	Planned
8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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Scenario 3: Higher Intensity with Mixed-use (Residential, Office, & Commercial)

In comparison with Scenario 1, Scenario 3 shifts considerable acreage from residential to industrial and mixed-use within the 3- and 5-mile radii of the Harris plant and beyond (see Map 8 Scenario 3). The large mixed-use areas proposed in Scenario 3 would permit residential dwelling units; however, it bears noting these are beyond the 3-mile and within the 5-mile radius of the Harris plant.

Scenarios 3 and 3A would include mixed use such as this future shopping center.

Scenario 3A: Higher Intensity with Mixed-use (Industrial, Office & Commercial)

Like Scenario 3, considerable acreage adopted with residential use in the SWALUP (Scenario 1) is proposed in Scenario 3A to change to industrial and mixed-use (see Map 9 Scenario 3A). In contrast with Scenario 3, the large mixed-use areas along US 1 would not permit residential. Instead, the mix would allow industrial, office and commercial uses. Again, this mixed-use area is within the 5-mile radius of the Harris plant.

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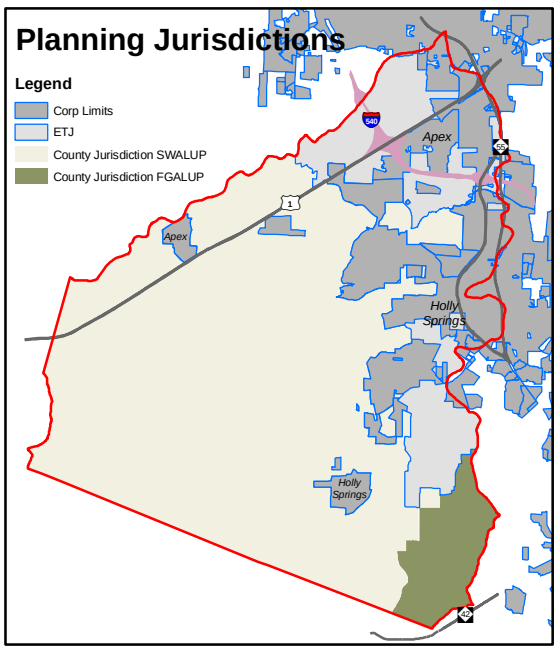
Map 8
Scenario 3

Harris Lake Drainage Basin Land Use Study



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- Crossroad Communities
- Major Facilities
- Shearon Harris Plant
- Park or Recreation Facility
- Study Area
- Fuquay-Varina Proposed ETJ Extension
- Creeks & Streams
- Harris Lake at Current Level
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- Harris Lake at 260 foot
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- Municipal Jurisdictional Boundaries

Proposed Land Use

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- VLDR - Very Low Density Residential
- ORP - Office/ Research Park
- PFF - Public Function Facility
- PARK - Park
- CONS - Conservation
- NHHD - New Hill Historic District
- Mixed Use Overlay - Residential / Office / Commercial

Parks & Recreation Facilities

Number	Name	Status
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3	Holly Springs Park	Planned
4	Holly Springs Park	Planned
5	Holly Springs Park	Planned
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7	Progress Energy Marina	Planned
8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

1 inch = 4,800 feet

Feet
0 2,400 4,800 9,600

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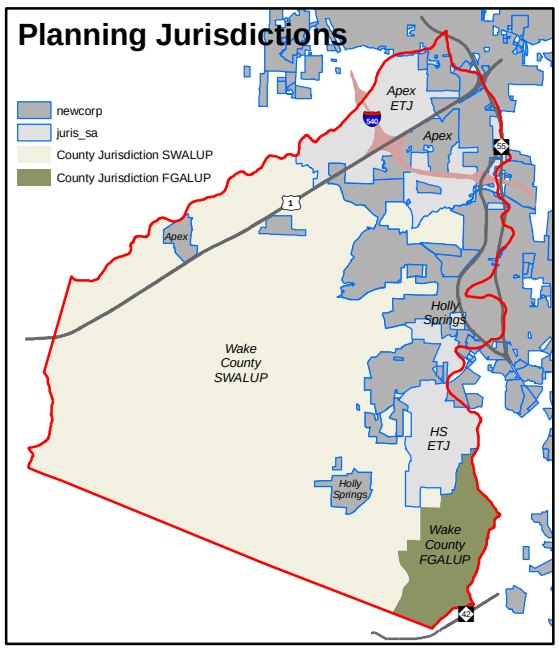
Map 9
Scenario 3a

Harris Lake Drainage Basin Land Use Study



Apex
Kelly
Future Alignment
540
Pleasant Plains Rd
Old US 1 Hwy
Winding Way
Tingen Rd
S Salem St
James St
Perry Rd
US 1 Hwy
E Williams St
Old Holly Springs Apex Rd
NC 55 Hwy
Holly Springs
Closed Feltonsville Landfill
PFF
South Wake Landfill
MU
ORP
NAC
NHHD
LDR
MDR
COM
New Hill
Mason Rd
Bosco Rd
Proposed Interchange at Friendship Road
Friendship Rd
Copperhead Rd
Western Wake Regional Water Reclamation Facility
Friendship Rd
PARK
IND
PFF
CONS
Bonsal
Bonsal Rd
Copper Rd
Proposed Interchange for Shearon Harris Plant
Shearon Harris Rd
Harris Energy and Environmental Center
New Hill Holleman Rd
Holly Springs New Hill Rd
New Hill Rd
W Earp St
Nc 55 Hwy
Progress Energy
Exclusionary Zone
PEX
Shearon Harris Plant
Shooting Ln
County Park Dr
Avent Ferry Rd
VLDR
Cass Holt Rd
Honeycutt Rd
Holleman's Crossroads
Rex Rd
Rouse Rd
Bartley Holleman Rd
Buckhorn Duncan Rd
Moonlit Dr
Adcock Rd
Sweet Springs Rd
Duncan Cook Rd
Tutor Stephens Rd
Burt Rd
Starchase Ln
Mims Rd
O C Hester Rd
3mi
5mi

Crossroad Communities
Major Facilities
Shearon Harris Plant
Park or Recreation Facility
Fuquay-Varina Proposed ETJ Extension
Study Area
Creeks & Streams
Harris Lake at Current Level
Harris Lake at 240 feet
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Hunting Safety Buffer
Municipal Corporate Limits
Municipal Jurisdictional Boundaries

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0 2,400 4,800 9,600 Feet

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Land Use Scenario Differences

The following descriptions for each land use scenario are organized by major roads as a way of linking access and egress with land use. This is a comparison of differences instead of a comprehensive description of similarities. For the sake of clarity, US 1 and Old US 1 are referred to as east-west roads.

A. Shearon Harris Road Corridor – Development is anticipated on both sides of the Shearon Harris Road between the 1-mile Progress Energy Exclusionary Zone boundary and US 1. Access and egress would be via Shearon Harris Road to Old US 1. There is an overcrossing at US 1, but no interchange.

New Hill Valley railroad bridge over Old US Highway 1

Scenario	Land Use
Scenario I (adopted)	Office/Research Park
Scenario 2	Industrial
Scenario 3	Industrial
Scenario 3A	Industrial

B. Old US 1 Corridor – For the purpose of this study, development is shown primarily on the south side of Old US 1 within the study area. Significant acreage is proposed for parkland southwest of the Regional Partnership's preferred site for the Western Wake Regional Water Reclamation Facility. No land use changes are proposed in this corridor outside the 5-mile radius of the Harris plant. Residential uses (Scenario 1) inside the 3-mile radius are shifted to industrial use in Scenarios 2, 3, and 3A.

Scenario	Land Use
Scenario 1 (adopted)	Medium-density Residential
Scenario 2	Medium-density Residential at east end, Industrial near Bonsal
Scenario 3	Mixed-use at east end, Industrial near Bonsal
Scenario 3A	Mixed-use at east end, Industrial near Bonsal

US Highway 1 from the New Hill Holleman Road overpass

C. US 1 Corridor - Development is anticipated on both sides of US 1 within the study area. Land use between US 1 and Old US 1 are described above. Regional access and egress would be via an existing diamond interchange at New Hill Holleman Road and a proposed future interchange at US 1 and Friendship Road. This plan does not propose land use changes in this corridor outside the 5-mile radius of the Harris plant.

Scenario	Land Use
Scenario 1 (adopted)	Very Low-density Residential within 3-mile and 5-mile radii
Scenario 2	Office/Research Park within 3-mile radius and Very Low-density Residential within 3-to-5 mile radii of Harris plant
Scenario 3	Industrial within 3-miles of Harris plant and Mixed-use (Residential, Office, and Commercial) within 3-to-5 mile radii of Harris plant
Scenario 3A	Industrial within 3-miles of Harris plant and Mixed-use (Industrial, Office, and Commercial) within 3-to-5 mile radii of Harris plant

Harris Energy and Environmental Center

D. New Hill Holleman Road Corridor – Development is anticipated on both sides of the road between New Hill and the Harris Energy and the Environmental Center. On the peninsula south of the Center, Scenarios 2, 3, and 3A curtail all development compared with residential development and a neighborhood activity center in Scenario 1 (adopted). South of the bridge, near Holleman's Crossroads, all scenarios are alike. Descriptions above cover areas north of the intersection of Shearon Harris Road / New Hill Holleman Road. Access and egress for areas along New Hill Holleman Road are split with a choice of travel north to the US 1 interchange and Old US 1 or south and then east to Holly Springs and Fuquay-Varina.

Scenario	Land Use
Scenario 1 (adopted)	Office/Research Park at Shearon Harris intersection; Neighborhood Activity Center with Very Low-density Residential on the peninsula; and another Neighborhood Activity Center two miles south at Holleman's Crossroads.
Scenario 2	Industrial at the intersection of Shearon Harris Road / New Hill Holleman Road. Conservation of the peninsula. Neighborhood Activity Center at Holleman's Crossroads.
Scenario 3	Same as Scenarios 2 and 3A
Scenario 3A	Same as Scenarios 2 and 3

New Hill Holleman Rd and Shearon Harris Road Intersection

E. Rex Road Corridor – most of the corridor is planned in all scenarios, including the adopted plan, as very low-density residential uses with one parcel planned for industrial use. The industrial parcel is much larger in Scenarios 2, 3, and 3A than in Scenario 1.

Scenario	Land Use
Scenario 1 (adopted)	Very Low-density Residential with one relatively small industrial parcel
Scenario 2	Very Low-density Residential with larger industrial parcel
Scenario 3	Same as Scenario 2 and 3A
Scenario 3A	Same as Scenarios 2 and 3

Rural intersection within the study area.

F. Old Holly Springs Apex Road Corridor – On the east side of the road, a parcel adjacent to the South Wake Landfill is shown (Scenario 1) as Medium-Density Residential. Scenarios 2, 3, and 3A show this area for expansion of the landfill instead of residential use. (The South Wake Landfill is designated in blue with the acronym PFF (public function facility) on all scenario maps).) A bit north of the landfill, along the west side of Old Holly Springs Apex Road, a site shown in Scenario 1 as Very Low-Density Residential is proposed to change to Mixed-use in Scenarios 2, 3, and 3A.

Scenario	Land Use
Scenario 1 (adopted)	Very Low-density and Medium-density Residential
Scenario 2	Expanded Landfill and Mixed-use
Scenario 3	Same as Scenarios 2 and 3A
Scenario 3A	Same as Scenarios 2 and 3

Holly Springs New Hill Road and Friendship Road Intersection

G. Holly Springs New Hill Road Corridor – a neighborhood activity center (NAC) is shown on the south side of the road at Friendship Road in all scenarios. A very large tract of land is shown in conservation on the west side of the road near the NAC.

Scenario	Land Use
Scenario 1 (adopted)	Very Low-density Residential and Industrial
Scenario 2	Mixed-use and Industrial
Scenario 3	Same as Scenarios 2 and 3A
Scenario 3A	Same as Scenarios 2 and 3

H. Buckhorn Duncan Road Corridor– the road forms a boundary between Very Low-density Residential use on the west side and Medium-density Residential to the east. Scenarios 2, 3, and 3A all change this mix to proposed Medium-Density Residential on both sides of the road.

Scenario	Land Use
Scenario 1 (adopted)	Very Low-density and Medium-density Residential
Scenario 2	Medium-density Residential
Scenario 3	Same as Scenarios 2 and 3A
Scenario 3A	Same as Scenarios 2 and 3

B. Summary of Scenarios

Planning for each of the three development scenarios was based on consideration and incorporation of unique aspects of the Harris Lake Drainage Basin study area. Environmental and growth sustainability were two primary concerns. Issues considered were:

1. Proximity to Shearon Harris Nuclear Power Plant;
2. Impact of potential growth on natural resources;
3. Capacity of existing and planned transportation network; and
4. Cost of providing water and sewer infrastructure to support development.

The three development scenarios were considered as separate but sequential development scenarios. Scenario 1 was conceived as the lowest-impact, lowest intensity development scenario with the least demand for infrastructure improvements and the highest level of protection for natural resources. Although all three scenarios recognize and incorporate the County's vision (in the SWALUP and Fuquay-Varina/Garner Area Land Use Plan) of activity centers at key road intersections in the upper reaches of the drainage basin, Scenario 1 diminishes the extent to which public water and sewer extensions are needed in the drainage basin.

Although Scenario 2 envisions more growth and development within the basin, there is still restraint in the designation of low to moderate residential growth areas. This medium density/medium impact development scenario recognizes the need for more public water and sewer infrastructure development and the importance of providing better transportation routing both within the area and out of the area.

Scenario 3 envisions the highest level of growth and development within the basin recognizing that the ability of the basin to support higher density residential growth is limited and should be confined to specific areas in the upper reaches of the drainage basin. Scenario 3 requires the highest investment in transportation system improvements and extension of public water and sewer systems to serve higher intensity development.

Scenario 1 criteria

- Environmental protection focus
- Predominance of VLDR (80,000 square foot lots); limited MDR (10,000 – 20,000 square foot lots) north of US 1 and in the southeastern corner of the study area
- Limited mixed use designations south of US 1
- Neighborhood activity centers (NAC) at designated intersections
- VLDR with NAC on peninsula near Harris County Lake Park
- Relatively small sites for Industrial use
- Office/research and retail at US 1/New Hill-Holleman Road interchange
- Public water or wells; on-site septic systems/limited public sewer
- Lower infrastructure cost

Scenario 2 criteria

- More equal weighting of environmental protection and development potential
- VLDR density within 5 mile radius; expansion of MDR densities in southeast portion of study area
- Mixed use designations north and south of US 1
- Neighborhood activity centers at designated intersections
- Conservation of land on peninsula near Harris County Lake Park
- Larger sites for industrial use near the Harris plant
- Office/research at US 1/New Hill-Holleman Road interchange
- Public water or wells; limited use of on-site septic systems/public sewer
- Infrastructure costs higher than Scenario 1, lower than Scenarios 3 and 3A

Scenarios 3 and 3A criteria

- More emphasis on higher intensity development potential
- Mostly non-residential within 3-mile radius; MDR density in southeast portion of study area, mixed-use with residential between the 3- and 5-mile radii
- Mixed use designations around north and south of US 1
- Neighborhood activity centers at designated intersections
- Conservation of land on peninsula near Harris County Lake Park
- Larger sites for industrial use near the Harris plant
- Public water or wells; limited use of on-site septic systems/public sewer
- Possible interchange in vicinity of Friendship Road on US 1 south of US 1 / NC540 freeway-to-freeway interchange to capture additional non-residential tax revenues/provide regional services to community and traveling public on US 1
- Highest infrastructure costs among scenarios

C. Summary of Case Studies

To assist planning efforts in the Harris Lake Drainage Basin, areas around four other nuclear power plants in the eastern United States were studied for comparison. While each case is unique, there are a host of lessons learned that may be considered and tailored to Wake County. The case studies sites were near Charlotte Washington D.C., Philadelphia, and New York City. Table 6 highlights comparisons of characteristics of each case study.

Table 6: Summary of Case Studies

	Raleigh	Charlotte	Washington D.C.	Philadelphia	New York City
Distance to Reactor	13 miles	17 miles	46 miles (20 miles to Annapolis)	20 miles	24 miles
Nuclear Site	Shearon Harris 1 reactor; 1983 Progress Energy	McGuire Station 2 reactors; 1981/'83 Duke Energy	Calvert Cliffs 2 reactors; Constellation Energy	Limerick Station 2 reactors; 1986/'90 Exelon Energy	Indian Point 2 reactors, 1974/'76 Entergy Corp
Land Acres Conserved	Farm, forest, and gamelands; 680-acre county park. Progress Energy - 16,815 acres.	568 acre power plant site	4,300 acres	Extensive farms and forest	Very little adjacent to power plant. Vacant sites will be developed
Land Uses in Active use	Small crossroad-type communities; encroaching suburbs	600 high-end homes in 2-mile radius. Power plant-related offices adjacent to McGuire	2 schools, clustered dev., town centers, scattered subdivisions	Scattered towns and villages. Recent suburbs between Historic towns.	Heavy industrial; elementary school; community center; very low density residential
Population Growth (fastest decade)	+204,000 residents countywide (1990 – 2000). US Census 2000 data indicate 64,520 people lived within a 10-mile radius	+184,000 residents Countywide (1990 – 2000)	+ 14,000 residents countywide (1970-1980)	+72,000 residents countywide (1990 – 2000)	+48,000 residents countywide (1990 – 2000). Now: 288,000 in 10-mile radius; 20 million within 50-miles
Number of cities/counties in 10-mile radius	4 municipalities, 4 counties	4 cities, 5 counties	No municipalities, 3 counties	42 municipalities, 3 counties	n/a. entire power plant is within Village of Buchanan
Comments		Road APF Ordinance since 1983	TDR Ordinance		

While there are many differences among the case studies, when viewed as a whole the case studies show the following patterns:

- **Inter-governmental communication and cooperation must be ongoing in lieu of single-agency control of development**. All the areas described in the case studies emphasize regional planning efforts. Those areas with fewer governmental units involved within a 10-mile radius realize it is easier to coordinate actions and land use policy. Strong state planning laws such as Maryland's smart growth policies and North Carolina's annexation laws are helpful. The lesson offered here is that Wake County should remain actively involved in planning activities and coordinating communications between all municipal and county governments that are within 10 miles of the Harris plant.

- **Emergency planning and land use planning handled separately.** The comprehensive land use plans of the communities in the case studies identify the nuclear power plant; however, emergency planning is not addressed in depth in any of the comprehensive plans. Emergency planning for all the studied facilities is addressed in a separate document published by each utility company. The extent to which land use planning in the comprehensive plans consider the nuclear facilities (for example, evacuation route planning) is not obvious. As the comprehensive plan is the framework for community growth, it would make sense to incorporate the findings of evacuation plans into planning policies and infrastructure capital improvement programs.

- **Buffering.** Development will encroach close to nuclear power plants, as shown in the studies of McGuire (near Charlotte) and Indian Point (near New York City). Before this happens, it may make sense to purchase surrounding lands or restrict activities to minimize the impact of development immediately adjacent to plants, as is done near McGuire Power Station and Shearon Harris. Doing this may ease evacuation planning as fewer people will need to be evacuated in case of an event and the adverse impacts of an incident at a plant will be minimized. Calvert County, Maryland strategically capitalized on opportunities created with the tobacco buyout program to purchase tobacco fields from private landowners near the nuclear facility preserving more than 24,000 acres of land, matching grants with about $2 million in county funds annually since 1999.

- **Remote may not be remote in 10 years.** In two of the case studies, Calvert County and Mecklenburg County, the plants were originally located in what were then considered remote areas. However, development caused by nearby employment centers generated residential growth. This growth will come and it is better to be proactive in planning as plans will take a while to be implemented.

- **Details in evacuation planning.** Each utility company featured here has an evacuation plan that detailed routes for residents to take in the event of an incident. The more detailed the plans are, the easier it will be to steer residents effectively to shelters.

- **Advanced technology has a role.** As communities grow, the use of GIS and the internet can provide localized information to residents as shown in the New York case study. Residents can be apprised of land use changes and obtain customized evacuation routes based on specific locations. This can be a great tool in areas that are highly built up or experiencing rapid change.

- **Proactive Land Use.** Where growth is anticipated, clustering and town center concepts should be incorporated well in advance of growth. Implementation of this type of planned growth requires adherence to clearly defined planning policies to achieve the desired vision. Mecklenburg and Calvert counties provide good examples.

- **County and Municipal.** It is important to have established working relationships among county and municipal governments, much like Duke Energy has done in the Charlotte region. If procedures are clearly spelled out and each party has distinct roles and responsibilities in planning efforts, potential future conflicts can be minimized.

Section III. Infrastructure Planning

A. Municipal Urban Services: Apex, Fuquay-Varina & Holly Springs

In North Carolina, a municipality's planning jurisdiction is the land that lies within its corporate limits plus its extraterritorial jurisdiction (ETJ). Since development occurring within municipal planning jurisdictions greatly affects what occurs within the County's planning jurisdiction, and vice versa, the Land Use Plan, Area Plan, and Drainage Basin Plan should be coordinated with municipal plans, goals, and objectives. State law authorizes municipalities to have ETJ so they can control development in areas that are expected to come within their corporate limits in the near future. This enables municipalities to better ensure that development patterns and associated infrastructure will allow the efficient provision of urban services. In Wake County, the Board of Commissioners must agree to any extension of a municipality's ETJ, and may rescind its approval of an ETJ extension.

Three municipalities are actively participating in the study.

The following criteria are used by Wake County to evaluate an ETJ request:

1. Classification as Urban Services Area
2. Commitment to Comprehensive Planning
3. Adoption of Special Regulations
4. Municipal Water and Sewer Service
5. Evidence of Feasibility for Urban Density Development
6. Annexation within Ten Years
7. Existing ETJs

B. Roadway Comparison

Most public roads within the Harris Lake Drainage Basin are owned and maintained by the North Carolina Department of Transportation (NCDOT) as part of the State's secondary road system. The surface elevation of Harris Lake is about 220 feet now; however, Progress Energy has applied to the United States Government for approval to build two additional nuclear reactors. If approved, the elevation of Harris Lake would have to be increased to at least 240 feet. At that level, several roads that cross the lake may be impacted. These are: New Hill Holleman Road, Friendship Road, Holly Springs New Hill Road, Cass Holt Road, Sweet Springs Road, County Park Drive, and Shearon Harris Road. The cost of modifying existing roads and bridges at these inundation areas is not included in this study.

New Hill Holleman Road over-crossing at US 1 interchange.

The largest transportation facility within the study area is a federal highway, US 1, which runs northeast to southwest through the study area. Within the study area, US 1 is a freeway with a grass median and two travel lanes in each direction. US 1 is a controlled-access facility with access only at grade-separated interchanges. Interchanges in the study area exist at NC 55 and at New Hill Holleman Road. An approved interchange will be built on US 1 at the Western Wake Parkway (tolled

turnpike) at a location that is slightly more than two miles west of the NC 55 interchange and nearly four miles east of the New Hill Holleman Road interchange. These interchange separations satisfy federal minimum spacing requirements of two miles between a major (freeway-to-freeway) interchange and any other interchange.

Another new interchange on US 1 at Friendship Road (in the study area) is included in the adopted Capital Area Metropolitan Planning Organization's (CAMPO) 2035 Long-Range Transportation Plan; however, approvals have not been granted by NCDOT or the Federal Highway Administration. To meet the two-mile minimum spacing requirement, an interchange would require building a new over crossing west of the existing Friendship Road crossing of US 1. Additional planning for such an interchange is beyond the scope of this Drainage Basin plan.

View along
Old US Highway 1

NC 55, a major thoroughfare, traverses the eastern edge of the Harris Lake Drainage Basin study area. NC 55 is a major north-south transportation route for western and southwestern Wake County. The NC 55 cross-section varies from 2 lanes to 4- and 5-lane sections.

Other important secondary roads within the study area include Old US 1, New Hill–Holleman Road, Holly Springs New Hill Road, Friendship Road, Old Holly Springs Apex Road, Avent Ferry Road, Rex Road, Buckhorn–Duncan Road, and Cass Holt Road. These are important routes because they are all part of evacuation plans published by Progress Energy in case of an event at the Harris plant. These secondary roads are predominantly 2-lane facilities. (Progress Energy is required to maintain an evacuation plan for this area – at the time of document printing more info could be found at:
http://www.progress-energy.com/aboutenergy/powerplants/harris.pdf

The NC Turnpike Authority (NCTA) began construction in fall 2009 on NC 540, also known as the Western Wake Parkway. This new 12.6 mile section of highway will extend from NC 55 near Alston Avenue north of Cary to NC 55 at Old Smithfield Road between Apex and Holly Springs. This new section of highway, along with an already open portion of I-540 from I-40 to NC 55 in Cary, will become one of the first toll highway facilities within North Carolina.

The NCTA awarded the design-build construction contract for NC 540 in September 2009. The highway is projected to be open to traffic in late 2011. The purpose of the NC 540 project is to provide a fast-track, high-speed, multi-lane, controlled-access freeway to accommodate increasing transportation demands in western Wake County. The facility will be operated as an open road toll with electronic toll collection (no toll booths or cash receipts).

The completion of NC 540 is expected to accelerate the need for improvements to other thoroughfares and secondary roads within the Harris Lake Drainage Basin. Improvements will be necessary to ensure traffic is guided safely and efficiently onto NC 540, US 1, and US 64 (a major east-west corridor located just north of the study area).

In addition to improving current secondary roads (widening and adding lanes), the County has anticipated that new collector streets will be required as rural areas within the County develop. Completed in 2004, the Wake County Collector Street Plan attempts to anticipate and provide for improved traffic circulation as rural areas of the County develop over time. The collector street system serves to collect traffic from local streets and channels that traffic to larger thoroughfare facilities. Collector streets may cross through and between neighborhoods, distributing trips from thoroughfare system roadways through the area to driver destinations.

As a rural area develops, local streets would be built that would connect to the collector street system. The primary function of the local street system is to service adjacent land uses by providing direct driveway access to abutting lots and connecting these land uses to the collector road system or thoroughfare system. The local street system offers the lowest level of mobility compared to higher order roadway systems.

Door-to-door service is available to all residents in the study area residing in non-urbanized areas.

Human-service transportation is contracted by Wake County. Transportation services are provided for agency-eligible participants. With eligibility based on sponsorship by participating agencies/programs such as Medicaid, Public Health, Mental Health, Work First and other programs. Human Services transportation is available Monday through Friday, and on Saturday for dialysis and employment. Service hours vary daily, depending on appointments and scheduling, but generally from 5 a.m.- 8 p.m.

Door-to-door public transportation is available to all residents of Wake County residing in non-urbanized areas via the TRACS (Transportation and Rural Access) program. Service is delivered within zones. The Southwest service zones cover the area west of US 401, south of Ten Ten Road stretching from the outskirts of Fuquay-Varina to Morrisville (see map in Southwest Area Land Use Plan (SWALUP) Section 6). TRACS service is available Monday-Friday. Service hours are 7 a.m.- noon and 1-6 p.m. There is a nominal charge per person per trip for TRACS service. Service is by reservation, first-come, first-served, on a seat-available basis.

C. Evacuation Clearance Time Comparison

A broad-brushed “sketch planning” technique is used that translates CAMPO regional travel demand model data into maximum expected evacuation travel demand for each land development scenario. Demand

was then compared to the expected evacuation service volume for each road studied. Nationally-recognized evacuation experts at PBS&J state that "if one assumes that the rough estimate of evacuation travel demand divided by evacuation service volume yields an estimate of raw number of hours of evacuation clearance time required, then this sketch analysis leads to the following conclusions":

1. The most congested evacuation roadway segment given expected demand and ambient background traffic is US 1 from New Hill Holleman Road to NC 55. Clearance time requirements in this segment of US 1 vary from 3.6 hours (Scenario 1) to 4.1 hours (Scenario 2) or 4.4 hours (Scenarios 3 and 3A).

2. Land development Scenarios 3 and 3A generally yield the longest clearance times relative to Scenarios 1 and 2.

3. "Clearance time requirements for the immediate five mile EPZ are relatively modest if everyone responds immediately. However, behavioral scientists have clearly shown that public response is a direct function of perceived threat and clarity of evacuation instructions from local officials. Generally, response is metered out over several hours. Since there is very limited nuclear power plant real time evacuation experience, anticipating behavioral response is somewhat theoretical at best."

Clearance time in emergencies is analyzed for year 2035 traffic and roadway conditions.

Fortunately, there is only the 1979 evacuation after the Three Mile Island nuclear power plant incident to provide actual experience in the United States. All other information is based on theoretical calculations or storm evacuations. For the most part, storm evacuations are different because of the advance warning capabilities.

The analysis is cursory; but it provides a relative comparison among scenarios. PBS&J provides a disclaimer stating "evacuation decisions should be based on clearance times calculated in accordance with NRC requirements and contained in NRC approved Progress Energy EPZ planning documents. Time estimates noted or implied in the analysis are only for comparison of long range land use plan alternatives and are not a substitute for existing times contained in existing emergency management plans." The estimates reported by PBS&J include only the time required to drive to the study area edge, omitting the additional time required to reach a pre-designated "reception center".

Evacuation route on Old US Highway 1

Progress Energy's website has emergency evacuation procedures, evacuation routes, and reception centers for the Harris plant in a "2009 Harris Nuclear Plant Safety Information" brochure available at: http://www.progress-energy.com/aboutenergy/powerplants/harris.pdf

The following excerpts are provided verbatim:

"As part of regulatory requirements, emergency exercises are conducted every other year with plant personnel and state and county officials participating. In the unlikely event of an emergency at the [Harris] plant, numerous pole-mounted sirens located in the 10-mile emergency planning zone (EPZ) around the plant would be activated to alert the public. Hearing the sirens does not mean you should evacuate. The sounding of the sirens is probably just a test, but there could be an emergency at the plant. The sirens will sound several times for three-minute intervals if there is an emergency that could affect the public. Officials might also travel along selected county and state roads in the 10-mile EPZ in vehicles equipped with flashing lights and loudspeakers. They might also go door-to-door in selected areas. Residents living within the five-mile radius of the plant have been given tone alert radios that will alarm and give a brief instruction if there is an emergency at the plant."

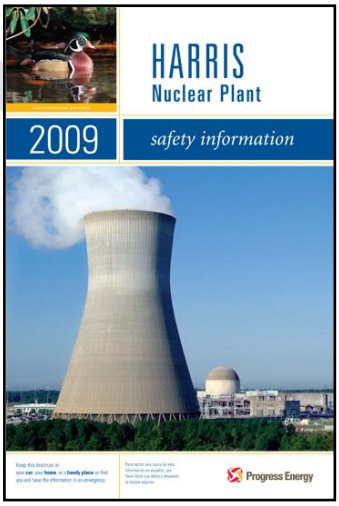
"If there is an emergency at the plant, radio or television might instruct you to shelter in place as a precaution. If there is an emergency at the plant, people in some sub-zones might be asked to evacuate as a precautionary measure. Evacuation routes and reception centers for each sub-zone are listed on pages 13-18" [of the safety brochure].

"As you evacuate …follow the evacuation route to the designated reception center for the area where you live or the relocation school for your child's school … if unfamiliar with the route to travel, follow the blue evacuation signs provided on all major roads."

The 10-mile area around the Harris plant is divided into 14 sub-zones, each marked with a different letter. (Sub-zone map is shown on pages 9 and 10 of the safety brochure.

The brochure presented on the Progress Energy website includes turn-by-turn instructions for people in each sub-zone to evacuate to "a pre-designated facility outside the Plume Exposure EPZ (minimum is 15 miles from utility) at which the evacuated public can register" and receive assistance. Reception facilities for the Harris plant include Southern Lee High School, Chatham Central High School, Jordan-Matthews High School, Norwood High School, Harnett Central Middle School, Garner High School, Southeast Raleigh High School, and Sanderson High School. To minimize roadway delays, the evacuation directions for each sub-zone routes evacuees along different roads, to the extent possible.

Table 6 presents theoretical travel times that assume build out of the study area according to each land use scenario, widened roads to the extent identified in Map 10, and motorists who follow emergency evacuation procedures. The travel times reported in Table 7 are only to the edge of the study area. Additional time would be required to reach designated reception centers (e.g. high schools in Garner and Raleigh).



Progress Energy's safety brochure for Harris Lake includes turn-by-turn instructions for people in each subzone to evacuate to a "predesignated facility"

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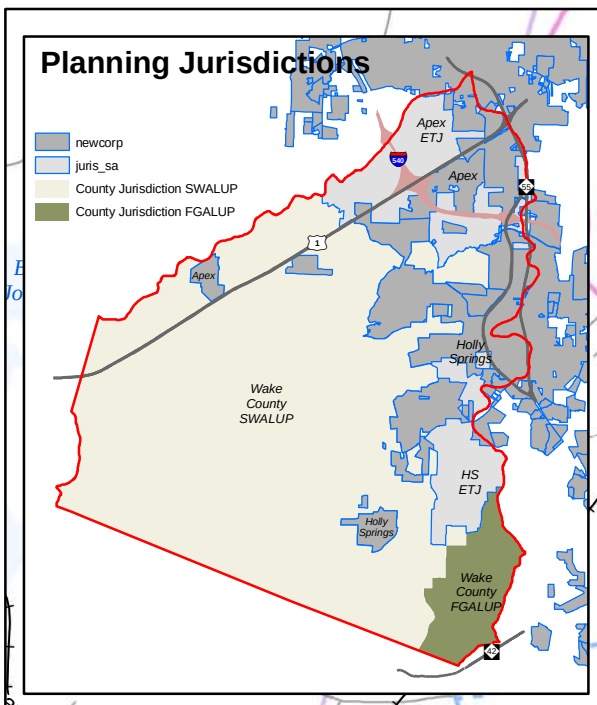
Map 10
Transportation Systems

Harris Lake Drainage Basin Land Use Study



3mi

5mi

Road	Distance (miles)	Existing	Scenario 1	Scenario 2	Scenarios 3/3a
US 1	6.9	4-lane freeway	6-lane fwy	6-lane fwy	6-lane fwy
Old US 1 east of New Hill Holleman Road	2.5	2-lane road	4-lane th'fare	4-lane th'fare	6-lane th'fare
Old US 1 from New Hill Holleman Road to Shearon Harris Rd	3.0	2-lane road		3-lane road	4-lane th'fare
New Hill Holleman Rd north of Friendship Road	1.0	2-lane road	4-lane th'fare	6-lane th'fare	6-lane th'fare
New Hill Holleman Rd south of Friendship Road	3.6	2-lane road		4-lane th'fare	6-lane th'fare
Bartley Holleman Rd	2.7	2-lane road			
Rex Rd	2.1	2-lane road			3-lane road
Cass Holt Rd east of Buckhorn-Duncan Road	2.1	2-lane road	4-lane th'fare	4-lane th'fare	4-lane th'fare
Cass Holt Rd west of Buckhorn-Duncan Road	2.6	2-lane road			3-lane road
Buckhorn-Duncan Rd	2.6	2-lane road	3-lane road	3-lane road	3-lane road
Piney Grove-Wilbon Rd north of Wilbon Road	1.8	2-lane road	3-lane road	3-lane road	4-lane th'fare
Piney Grove-Wilbon Rd south of Wilbon Road	1.7	2-lane road			3-lane road
Avent Ferry Road	2.9	2-lane road	6-lane th'fare	6-lane th'fare	6-lane th'fare
Holly Springs New Hill Road	2.4	2-lane road	4-lane th'fare	4-lane th'fare	6-lane th'fare
Friendship Road east of Holly Springs New Hill Rd	2.2	2-lane road			4-lane th'fare
Friendship Road west of Holly Springs New Hill Rd	1.3	2-lane road		3-lane road	3-lane road

Notes:

- Cross Roads
- Railroads
- Major Roads
- Primary Roads
- Freeway
- Freeway (new location)
- Other Major Roadway
- Collector
- Collector (new location)
- 2-lane
- 2-lane (new location)
- Community Street (36-foot)
- Community Street (36-foot, new location)
- 4-lane with median
- 4-lane with median (new location)
- 5-lane
- 5-lane (new location)
- Proposed TTA Rail
- Shearon Harris Buffers
- Corporate Limits
- ETJ

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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Table 7 is organized by sub-zone; that is, a term used by Progress Energy in its 2009 Safety Information brochure. Sub-zone A is entirely within the 3-mile radius of the Harris plant. Sub-zones B, C, and D comprise the Wake County area that lies between the 3-mile and 5-mile radii of the Harris plant.

Table 7:
Emergency Evacuation Clearance Time Requirements to Drive to Study Area Boundary
(Assumes Roads are Widened as recommended)

Sub-zone	Route	Assumed Road Sections	Combined route time
A	Primary route: New Hill Holleman Rd. north, then east on US 1	New Hill Holleman Rd: 2 lanes (sc. 1) 3 lanes (sc.2) 6 lanes (sc. 3/3A) US 1: 6 lanes (all scenarios)	5.4 hrs. (sc. 1) 5.7 hrs. (sc. 2) 6.7 hrs. (sc. 3/3A)
A	Alternate route: New Hill Holleman Rd. north, then west on US 1	New Hill Holleman Rd: 2 lanes (sc. 1) 3 lanes (sc.2) 6 lanes (sc. 3/3A) US 1: 6 lanes (all scenarios)	5.4 hrs. (sc. 1) 5.3 hrs. (sc. 2) 6.1 hrs. (sc. 3/3A)
B	Primary route from south of US 1: New Hill Holleman Rd. north, then east on US 1	New Hill Holleman Rd: 2 lanes (sc. 1) 3 lanes (sc.2) 6 lanes (sc. 3/3A) US 1: 6 lanes (all scenarios)	5.4 hrs. (sc. 1) 5.7 hrs. (sc. 2) 6.7 hrs. (sc. 3/3A)
B	Primary route from north of US 1: New Hill Holleman Rd. south, then east on US 1	New Hill Holleman Rd: 4 lanes (sc. 1) 6 lanes (sc.2) 6 lanes (sc. 3/3A) US 1: 6 lanes (all scenarios)	5.4 hrs. (sc. 1) 6.0 hrs. (sc. 2) 6.6 hrs. (sc. 3/3A)
C	Primary route from Holly Springs New Hill Rd: East to NC 55 bypass	Holly Springs New Hill Rd: 4 lanes (sc. 1) 4 lanes (sc.2) 6 lanes (sc. 3/3A)	1.5 hrs. (sc. 1) 1.5 hrs. (sc. 2) 2.0 hrs. (sc. 3/3A)
C	Primary route from New Hill Holleman Rd: South on New Hill Holleman, then east on Avent Ferry Rd.	New Hill Holleman Rd: 2 lanes (sc. 1) 4 lanes (sc.2) 6 lanes (sc. 3/3A) Avent Ferry Rd: 6 lanes (all scenarios)	2.8 hrs. (sc. 1) 3.4 hrs. (sc. 2) 3.8 hrs. (sc. 3/3A)
D	Primary route: Northeast on Cass Holt Rd. to Avent Ferry Road	Cass Holt Rd south of Buckhorn Duncan Rd: 2 lanes (sc. 1) 2 lanes (sc.2) 3 lanes (sc. 3/3A) Cass Holt Rd north of Buckhorn Duncan Rd: 4 lanes (all scenarios)	1.7 hrs. (sc. 1) 3.0 hrs. (sc. 2) 3.7 hrs. (sc. 3/3A)

Sub-zone A clearance times begin at the intersection of Friendship Road / New Hill Holleman Road and end at the study area boundary near the US 1 / NC 55 interchange (primary route) or on US 1 at the Chatham / Wake county line (alternate route). Travel time on this 3.6 mile route is normally less than 5 minutes.

Clearance times begin at the intersection of Friendship Road / New Hill Holleman Road

Sub-zone B clearance times for areas south of US 1 begin at the intersection of Friendship Road / New Hill Holleman Road and end at the study area boundary near the US 1 / NC 55 interchange. Travel time is normally about 4 minutes. For areas north of US 1, clearance times begin at the intersection of Old US 1 / New Hill Holleman Road and end at the study area boundary near the US 1 / NC 55 interchange. Travel time on this 4.4-mile route is normally about 5 minutes.

Sub-zone C clearance times for areas along Holly Springs New Hill Road begin at the intersection of Friendship Road / Holly Springs New Hill Road and end at the study area boundary just east of the NC 55 bypass. Travel time on this 2.4-mile route is normally less than 5 minutes. This evacuation route continues north on the NC 55 bypass (beyond the boundary for this study). Clearance times for areas of sub-zone C that are along New Hill Holleman Road begin at the intersection of Friendship Road / New Hill Holleman Road and the study area boundary at the intersection of Avent Ferry Road / Cass Holt Road. Travel time on this 6.5-mile route is normally about 10 minutes. This evacuation route continues northeast along Avent Ferry Road and then north on the NC 55 bypass, beyond the boundary for this study.

Sub-zone D clearance times for areas in Wake County begin at the intersection of Cass Holt Road / Sweet Springs Road and end at the study area boundary at the intersection of Cass Holt Road / Avent Ferry Road. Travel time on this 4.7-mile route is normally less than 10 minutes.

D. Water & Wastewater Comparison

Wake County's designation of Short-Range Urban Services Areas (SRUSAs) and Long-Range Urban Services Areas (LRUSAs) indicate that public water and sewer service is expected to serve portions of the Harris Lake Drainage Basin (see Maps 11 through 17). Service area boundaries for the towns of Apex and Holly Springs have not been resolved for the portion of the drainage basin roughly bounded by US 1, Harris Lake, and Friendship Road. As most of the drainage basin is still

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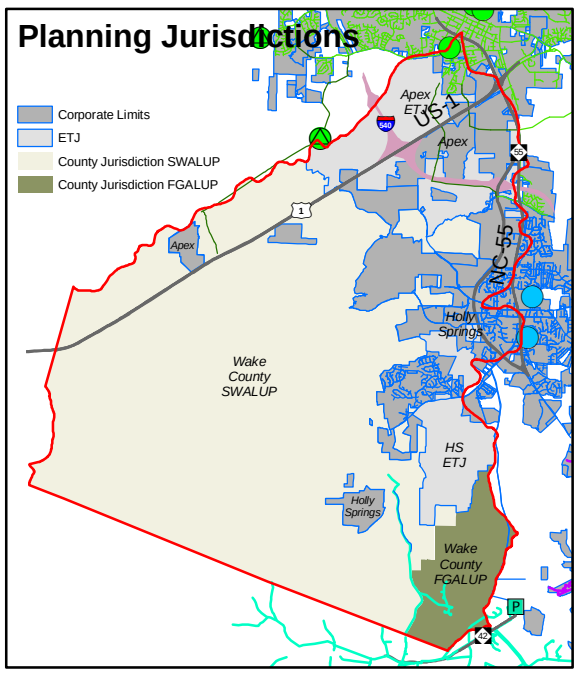
Map 11
Scenario 1
with Water Infrastructure

Harris Lake Drainage Basin Land Use Study



Proposed Waterlines
- 12" Proposed Water Line
- 16" Proposed Water Line
- Crossroad Communities
- Public Function Facility
- Shearon Harris Plant
- Study Area
- Shearon Harris Buffers
- Apex Existing Water Tank
- Apex Existing Waterlines
- Near Apex Term Designed Waterlines
- Harnett Co. Booster PS
- Holly Springs Existing Water Tank
- Holly Springs Existing Waterlines
- Harnett County Existing Waterlines
- Harnett County Utility Distict Hollly Springs
- Harnett County Utility District Fuquay Varina
- Harris Lake at Current Level
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries
- Progress Energy Exclusionary Zone

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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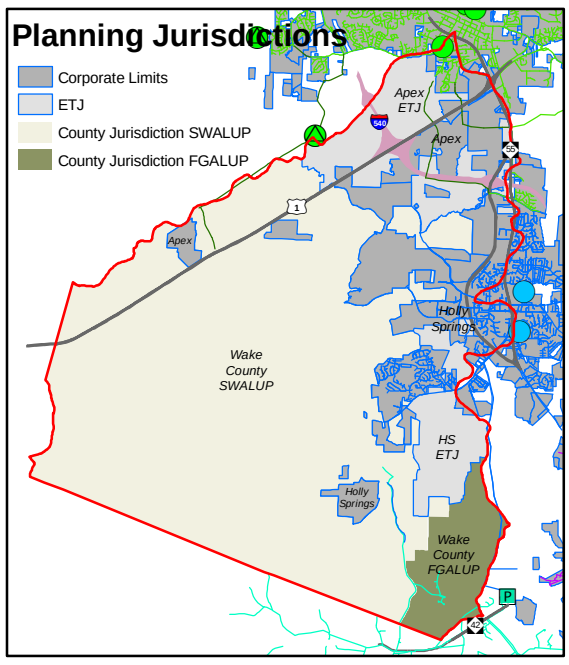
Map 12
Scenario 2
with Water Infrastructure

Harris Lake Drainage Basin Land Use Study



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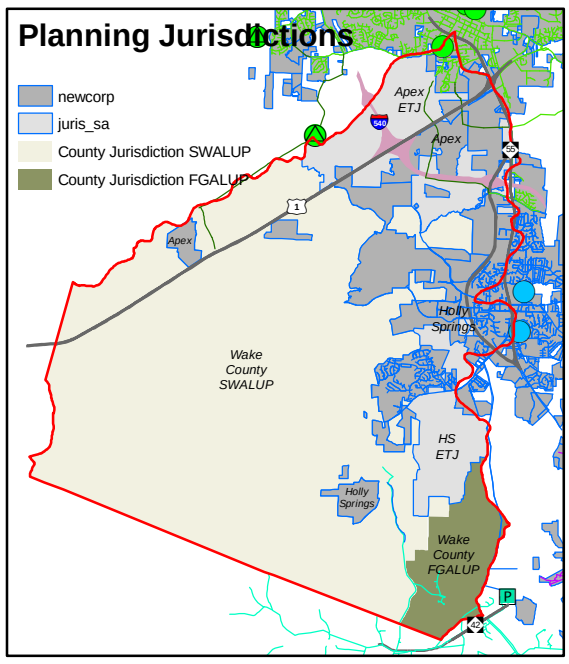
Map 13
Scenario 3/3a
with Water Infrastructure

Harris Lake Drainage Basin Land Use Study



Kelly
New Hill
Bonsal
Holleman's Crossroads
Progress Energy
Shearon Harris Plant
Exclusionary Zone
3mi
5mi
Apex
Holly Springs
Future Alignment
Western Wake Regional Water Reclamation Facility
South Wake Landfill
Closed Feltonsville Landfill
Harris Energy and Environmental Center
Harnett County Utility District Holly Springs
Harnett County Utility District Fuquay Varina
James St
E Salem St
Perry Rd
Tingen Rd
US 1 Hwy
E Williams St
Old US 1 Hwy
Pleasant Plains Rd
Wimbling Way
Old Holly Springs-Apex Rd
NC 55 Hwy
N Main St
Mason Rd
Bosco Rd
Friendship Rd
Copperhead Rd
Old Holly Springs Apex Rd
Friendship Rd
New Hill Holleman Rd
Shearon Harris Rd
Holly Springs New Hill Rd
New Hill Rd
W Earp St
Cooper Rd
Bonsal Rd
Shooting Ln
County Park Dr
Avent Ferry Rd
Cass Holt Rd
Honeycutt Rd
Rouse Rd
Rex Rd
Buckhorn Duncan Rd
Moonlit Dr
Adcock Rd
Duncan Cook Rd
Starchase Ln
Burt Rd
Mims Rd
O C Hester Rd
Tutor Stephens Rd
Sweet Springs Rd
Barnley Holleman Rd
Shearon Harris Longleaf Pine Forest
NCSU Harris Research Tract
Utley Creek Slopes
County Regional Park
Hollemans Crossroads Slopes
Hollemans Crossroads Salamander Pools
Jim Branch/ Buckhorn Creek Forests
1
42
55
P

Proposed Waterlines
- 12" Proposed Water Line
- 16" Proposed Water Line
- Study Area
- Major Facilities
- Shearon Harris Plant
- Crossroad Communities
- Apex Existing Water Tank
- Apex Existing Waterlines
- Near Apex Term Designed Waterlines
- Harnett Co. Booster PS
- Holly Springs Existing Water Tank
- Holly Springs Existing Waterlines
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- Harris Lake at Current Level
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries

1 in = 4,800 ft

0 2,400 4,800 9,600 Feet

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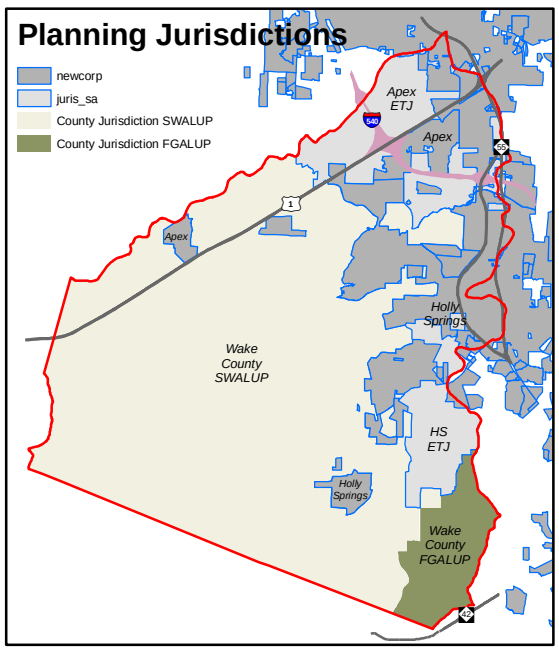
Map 14
Scenario 1
with
Wastewater Infrastructure

Harris Lake Drainage Basin Land Use Study



Residential Land Use Classifications		Comparable Zoning	Units/ Acre	Approx. Lot Size (acres)	Approx. Lot Size (sq. feet)
VLDR	Very Low Density Residential	R 80	1/2 unit per acre	1 unit per 2 acres	80,000
LDR	Low Density Residential	R 40	1 unit per acre	1 unit per acre	40,000
MDR	Medium Density Residential	R 20	2 units per acre	1 unit per 1/2 acre	20,000
		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- Crossroad Communities
- Proposed Pump Station
- Proposed Sewer Basins
- Public Function Facilities
- Shearon Harris Plant
- Proposed Interchange
- Park or Recreation Facility
- Study Area
- Fuquay-Varina Proposed ETJ Extension
- Major Roads
- Minor Roads
- Railroads
- Creeks & Streams
- Harris Lake at Current Level
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Hunting Safety Buffer
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries
- Progress Energy Exclusionary Zone

Proposed Land Use

- PEX - Progress Energy Exclusionary Zone
- IND - Industrial
- NAC - Neighborhood Activity Center
- ORP - Office/ Research Park
- PFF - Public Function Facility
- MU - Mixed Use
- MDR - Medium Density Residential
- LDR - Low Density Residential
- VLDR - Very Low Density Residential
- PARK - Park
- CON - Conservation
- NHHD - New Hill Historic District

Parks & Recreation Facilities

Number	Name	Status
1	County Firearms Range	Existing
2	Holly Springs Park	Planned
3	Holly Springs Park	Planned
4	Holly Springs Park	Planned
5	Holly Springs Park	Planned
6	County Regional Park	Existing
7	Progress Energy Marina	Planned
8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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May 5, 2009

N:\Wake_County\Countywide\Harris_Lake\mxds\Document_Maps\Map14_ScenarioE_FLUP_11x17_REV.mxd 6/18/2009 @ 1:14:24 PM

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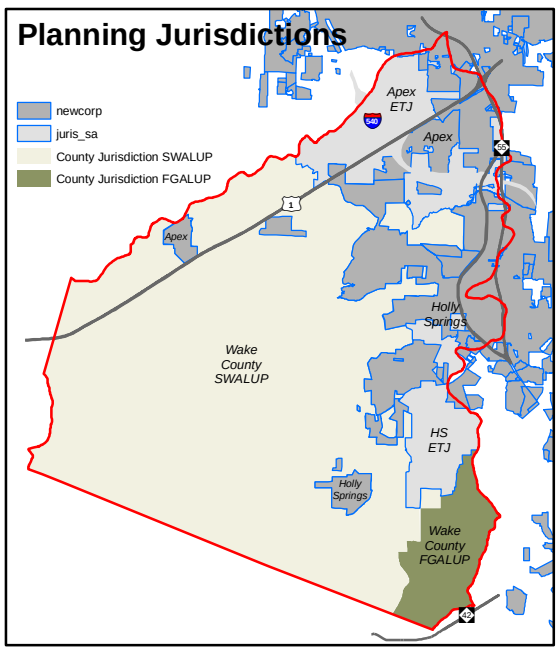
Map 15
Scenario 2
with
Wastewater Infrastructure

Harris Lake Drainage Basin Land Use Study



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		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- Proposed Pump Station with Number
- Proposed Sewer Basins
- Public Function Facilities
- Shearon Harris Plant
- Crossroad Communities
- Park or Recreation Facility
- Study Area
- Fuquay-Varina Proposed ETJ Extension
- Creeks & Streams
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Proposed Land Use

- PEX - Progress Energy Exclusionary Zone
- IND - Industrial
- CAC - Community Activity Center
- NAC - Neighborhood Activity Center
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Parks & Recreation Facilities

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8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

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NORTH

May 5, 2009

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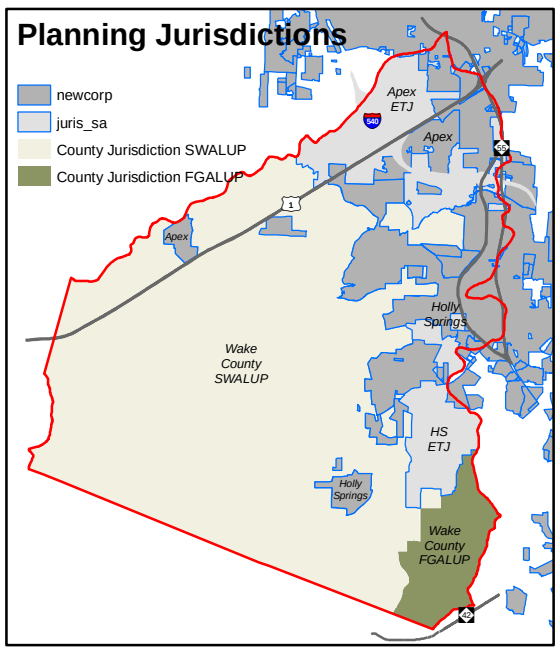
Map 16
Scenario 3
with
Wastewater Infrastructure

Harris Lake Drainage Basin Land Use Study



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		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- P S 20 3, 20
- sc3_prop_sewerbasins
- Crossroad Communities
- Major Facilities
- Shearon Harris Plant
- Park or Recreation Facility
- Study Area
- Fuquay-Varina Proposed ETJ Extension
- Creeks & Streams
- Harris Lake at Current Level
- Harris Lake at 240 feet
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Proposed Land Use

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- COM - Commercial
- MU - Mixed Use
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- LDR - Low Density Residential
- VLDR - Very Low Density Residential
- ORP - Office/ Research Park
- PFF - Public Function Facility
- PARK - Park
- CONS - Conservation
- NHHD - New Hill Historic District
- Mixed Use Overlay - Residential / Office / Commercial

Parks & Recreation Facilities

Number	Name	Status
1	County Firearms Range	Existing
2	Holly Springs Park	Planned
3	Holly Springs Park	Planned
4	Holly Springs Park	Planned
5	Holly Springs Park	Planned
6	County Regional Park	Existing
7	Progress Energy Marina	Planned
8	Boat Ramp	Existing
9	Progress Energy Boat Ramp	Planned
10	County Park	Planned

1 inch = 4,800 feet

0 2,400 4,800 9,600 Feet

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NORTH

May 5, 2009

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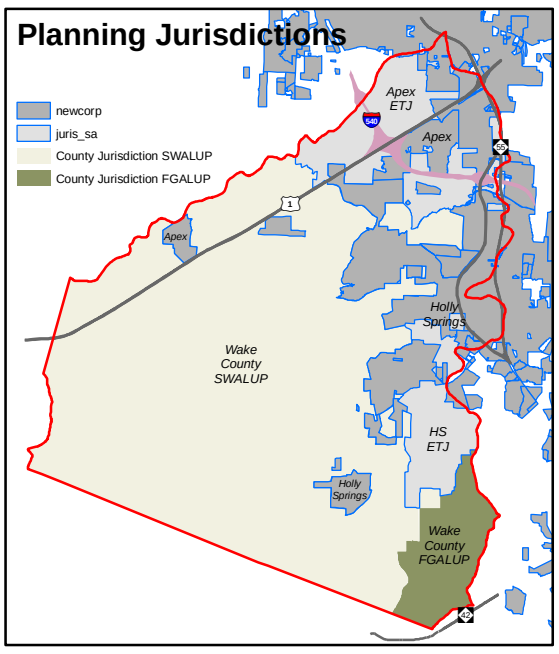
~DRAFT~
Map 17
Scenario 3a
with
Wastewater Infrastructure

Harris Lake Drainage Basin Land Use Study



Residential Land Use Classifications		Comparable Zoning	Units/ Acre	Approx. Lot Size (acres)	Approx. Lot Size (sq. feet)
VLDR	Very Low Density Residential	R 80	1/2 unit per acre	1 unit per 2 acres	80,000
LDR	Low Density Residential	R 40	1 unit per acre	1 unit per acre	40,000
MDR	Medium Density Residential	R 20	2 units per acre	1 unit per 1/2 acre	20,000
		R 10	4 units per acre	1 unit per 1/4 acre	10,000

- Crossroad Communities
- Public Function Facilities
- Shearon Harris Plant
- Park or Recreation Facility
- Fuquay-Varina Proposed ETJ Extension
- Study Area
- Creeks & Streams
- Harris Lake at Current Level
- Harris Lake at 240 feet
- Harris Lake at 260 foot
- Hunting Safety Buffer
- Municipal Corporate Limits
- Municipal Jurisdictional Boundaries

Proposed Land Use

- PEX - Progress Energy Exclusionary Zone
- IND - Industrial
- NAC - Neighborhood Activity Center
- COM - Commercial
- MU - Mixed Use
- MDR - Medium Density Residential
- LDR - Low Density Residential
- VLDR - Very Low Density Residential
- ORP - Office/ Research Park
- PFF - Public Function Facility
- PARK - Park
- CONS - Conservation
- NHHD - New Hill Historic District
- Mixed Use Overlay - Industrial / Office / Commercial

Parks & Recreation Facilities

Number	Name	Status
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NORTH

May 5, 2009

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outside existing municipal extraterritorial planning boundaries and corporate limits, public water and sewer services have not reached extensively into the drainage basin. Most homes within the drainage basin have on-site wells and wastewater disposal (septic) systems.

Public water and sewer services are available primarily in the upper reaches of the drainage basin. Utility providers include the towns of Apex, Holly Springs, and Fuquay-Varina. Harnett County, which provides water to the Town of Fuquay-Varina, also provides water to low-density residential areas just north of the Wake-Harnett County line including some new subdivisions within the Fuquay-Varina planning jurisdiction. Apex, Holly Springs, Fuquay-Varina, and Harnett County have plans to expand water and sewer services within the Harris Lake Drainage Basin.

A regional water reclamation facility (WRF) is proposed by a partnership of municipalities for a 200-acre site located just north of US 1 and west of New Hill-Holleman Road near the historic New Hill crossroads community. The siting of the facility in this location has been controversial. The WRF is to be owned and operated by the Western Wake Partners – the towns of Apex, Cary, Morrisville and Holly Springs. The project will provide regional wastewater treatment service and will return treated wastewater to the Cape Fear River Basin. Treatment of effluent is required by the NC Department of Environment and Natural Resources (NC DENR).

Historic roadside motel in New Hill

Phase 1 facilities with capacity to treat 24 million gallons per day (mgd) of wastewater will meet the Partners' wastewater treatment needs through 2020. Phase 2, planned to be online by 2020, will provide for a discharge capacity of 38 mgd which will meet the projected needs of the Partners through 2030. Original plans were to discharge treated effluent to the Cape Fear River below the Buckhorn Dam (the Harris Lake dam) but discussions are being held about the possibility of discharging treated water to Harris Lake.

Water infrastructure is estimated for each land development scenario using the following assumptions:

- Water lines are planned only along existing roads
- Cost for waterlines within municipal corporate limits or ETJ areas are not included
- Water lines are not assumed in areas with the following existing or proposed land uses:
  - Very Low-density Residential (VLDR)
  - Conservation, Park, or Open Space
  - Progress Energy Harris plant Exclusionary Zone
- Major stream crossings are minimized where possible

- Water lines are approximated based on providing typical flows for proposed land uses
- For each scenario, proposed water lines are cataloged and compiled into a database to determine the total length of water main required to serve the total area. Stream crossings and road crossings are counted and included in the database.
- Line lengths, stream crossings, road crossings, gate valves, hydrant assemblies and erosion control are included in the cost estimates.
- Costs are estimated in 2008/9 dollars
- Locations are not assumed, nor are costs included, for elevated storage tanks
- Costs are not included for additional pressure zones likely needed below elevation 390'. The system would need pressure reducing valves at the pressure zone switch and possible booster pumps to pump back to a higher pressure zone
- Costs include a contingency factor of 20% of estimated construction costs
- Costs include engineering design assumed to be 15% of estimated construction costs

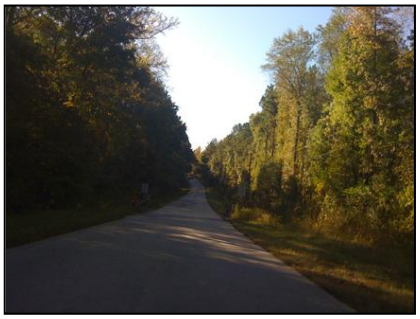
Sewer infrastructure was planned for each land development scenario using the following assumptions:

- Sewer service to an area is considered only if water service is assumed
- Pump stations are located to maximize the area draining to the pump station while minimizing the number of needed pump stations
- Very Low Density Residential areas will not be served with sewer
- LIDAR (LIDAR is an acronym for **li**ght **d**etection **a**nd **r**anging. It is used to detect elevation data and contours) topographic contour data is used to determine the areas draining to each pump station
- Municipal corporate limits are not included in areas draining to pump stations
- Average flows to each pump station are determined by the projected land use types within each drainage area. The following flow rates are assumed:
    - Residential sewer use of 360 gallons per dwelling unit per day
    - Industrial, commercial, office research park use of 880 gallons per acre per day
    - Flow rates from ETJ areas likely to be served with the proposed pump stations are based on the highest density land use within the drainage area
- Pump station capacity assumed to be 2.5 times higher than the estimated average flow
- Planned mixed use areas assumed with the following mix:

  - 70% residential of which 60% varies from 4 to 8 dwelling units/acre; 40% at 2 to 4 dwelling units/acre (weighted average of 5 dwelling units per acre used to estimate flows in residential portion of mixed-use areas)
  - 30% industrial, commercial, and office use
- Cost scale used to estimate the cost of a pump station varies by flow rate, in terms of gallons per minute (gpm) of flow, from $200,000 (120 gpm or less) to $1.75 million (3,000 gpm or more)
- Costs do not include piping systems to transport flow from source to pump stations. To do so, more information is needed to predict how land would develop or where force mains would need to discharge.
- Costs do not include force main leaving pump stations
- Costs include a contingency factor of 20% of estimated construction costs
- Costs include engineering design assumed to be 15% of estimated construction costs

E. Summary of Infrastructure Study Results

Roads



All emergency evacuation clearance times reported in this document assume $176 million or higher investment in road widening in the study area. No estimates have been made for the time to evacuate on existing roads.

In comparison with Scenario 1 (adopted), Scenarios 2, 3, and 3A yield longer evacuation clearance times. Relative to Scenario 1, clearance times for people in evacuation sub-zones B, C, and D (all of whom are in the study area between the 3- and 5-mile radii) would increase by 30 to 90 minutes (Scenario 2) or 30 to 120 minutes (Scenarios 3 and 3A). Evacuation clearance times in sub-zone D would increase the most (up to two hours) with Scenarios 3 and 3A due to congestion on Cass Holt Road. PBS&J recommends “a much more detailed and robust evacuation analysis be performed” that would refine these estimates and consider additional mitigation measures.

Rough calculations show approximately 3.6 hours to clear US 1 in Scenario 1, increasing to 4.1 to 4.4 hours for the other scenarios. All other study area roads would clear in 3.1 hours or less. A key assumption in the year 2035 analysis summarized here is the expenditure of $176 million (Scenario 1) to $212 million (Scenario 2) or $290 million (Scenarios 3 and 3A) for roadway widening. Cost estimates do not include escalation, debt service, right-of-way, utilities, or design.

The estimated cost to widen roads varies by scenario:

Scenario	Estimated Cost
Scenario 1	$176 million
Scenario 2	$212 million
Scenario 3	$290 million
Scenario 3A	$290 million

An important observation is the need for a unique implementation tool that funds roadway widening projects along an entire corridor at the same time that development occurs. Without such a tool, the typical major corridor widening project lags development by as much as ten years. Within the Harris Plant EPZ, delayed roadway widening would significantly lengthen evacuation times reported above.

Water

Planning for serving public water along road corridors to some new development in the study area beyond existing corporate and ETJ limits is considered for each scenario. Assumptions are made that new water lines would follow existing roads, but would not serve areas designated as Very Low-Density Residential, Conservation, or inside the Progress Energy Exclusionary Zone (one mile radius of the Harris plant). Cost estimates include water lines, stream crossings, roadway crossings, gate valves, hydrant assemblies, and erosion control.

Costs are approximations in preparing opinions of cost; for example, costs are not included for escalation, debt service, elevated storage tanks, additional pressure booster pumps, or pressure reducing valves. Cost estimates include a 20 percent contingency and an additional 15 percent for engineering design. The primary purpose of providing water infrastructure cost estimates is for comparative purposes among the various scenarios.

The estimated cost to provide water varies by scenario:

Scenario	Estimated Cost
Scenario 1	$7.1 million
Scenario 2	$11.0 million
Scenario 3	$14.2 million
Scenario 3A	$14.2 million

Fuquay-Varina purchases some of its water from Harnett County. This study does not assume which areas will be served by which municipalities. Service decisions are to follow adoption of this plan.

Sewer

A study assumption is made that any area receiving public water service would also receive public sewer service. LIDAR topographic contour mapping tools were used to layout approximate pump station locations including attempts to minimize the number of pump stations and maximize the area draining to each new pump station. Land within existing municipal corporate limits are not included in pump station drainage area layouts.

The average flow to each pump station was determined by the designated land use. Residential sewer use is assumed to average 360 gallons per household per day. Industrial, commercial, office, and research park sewer use is assumed to average 880 gallons per acre per day. Mixed-use area sewer use is assumed to average 1,525 gallons per acre each day.

Approximations are made in preparing opinions of cost; for example, costs are not included for escalation, debt service, force mains leaving pump stations, or piping systems to transport flow from source to pump stations. Cost estimates include a 20 percent contingency and 15 percent for engineering design.

The estimated cost to provide public sewer service varies by scenario:

Scenario	Estimated Cost
Scenario 1	$4.6 million
Scenario 2	$9.3 million
Scenario 3	$13.4 million
Scenario 3A	$11.8 million

Section IV. Recommendations

Stakeholders participated in identifying land use designations for evaluation in this study. In some locations, revisions to the adopted SWALUP land use plan were considered in Scenarios 2, 3, and 3A.

A. Amendment of the Southwest Area Land Use Plan (SWALUP)

The first recommendation is to amend the existing Southwest Area Land Use Plan (SWALUP) to meet the planning principles identified by the Harris Lake Drainage Basin Study stakeholders. The recommended SWALUP changes would more closely align proposed land uses, especially in areas close to municipalities, with the land uses shown on adopted municipal land use plans for the area.

Proposed SWALUP revisions are intended to provide a more accurate picture of what is likely to occur in the future. Plan changes would allow for municipal development in certain areas within the 5-mile Emergency Planning Zone.

Recommended changes also propose to designate a large area (1,490 acres) along US Highway 1 as a business park. This revision is intended to encourage future job creation in an area that takes the best advantage of existing roadways and utilities.

Another proposed change is to designate the majority of Progress Energy's land within the study area (14,470 acres) as a Utility / Environmental Stewardship district. This change is intended to allow the company to use and lease the property as needed so long as the potential impacts to the natural environment are carefully considered.

B. Ongoing Cooperation

Future success is dependent on consensus and cooperation among the four local governments with jurisdiction within the Harris Lake area. Continued cooperation is necessary to ensure adherence to plan goals and successful implementation of plan objectives.

The exact framework for continuing cooperation can be determined by the affected governments, but at a minimum, the four units of government should commit at the highest levels to support and follow plan principles. Continuous planning / coordination can only be achieved through a structured process that brings interested parties – local governments and other interested agencies – together on a regular basis to discuss

progress and how to address issues that will arise as the area continues to develop.

C. Interlocal Agreement

Following adoption of the Harris Lake Drainage Basin Study and amendment of the SWALUP, the four local governments should immediately begin to develop an interlocal agreement committing each entity to supporting and implementing study principles. Interested public and non-profit agencies should be invited to participate or comment on the particulars of the interlocal agreement, especially concerning transportation improvements and protection of environmental and historic/cultural resources.

At a minimum, an interlocal agreement should consider:

- Designation of Short Range and Long Range Urban Services Areas.
- Joint consideration of any future modifications to land use plans within the area.
- Extension of municipal public water and sewer services into the area.
- Commitment to adhere to environmental stewardship, conservation development[1], and sustainability/low impact design[2] standards that build upon the general principles / guidelines of the Study.

D. Municipal Services – Public Water and Sewer

The provision of public water and sewer typically steers where and when higher intensity development will occur. The SWALUP land use designations that are recommended in this study reflect current land use planning policies of the three municipalities within the area – Apex, Holly Springs, and Fuquay-Varina. If the municipalities choose to extend public utilities into other areas within the Harris Lake Basin this would impact the land use patterns recommended by the study.

Municipal services should only be extended into areas that have been identified, either now or in the future, as appropriate for development that requires public water and sewer to support the desired land development pattern. The costs for extending municipal water and sewer (Table 3) should primarily be borne by the land developer, not by the general public.

E. Transportation / Traffic

Conduct a joint study among four local governments and NCDOT / CAMPO to evaluate the impact of full build-out of the preferred land use development scenario (SWALUP amendment) not only in terms of daily traffic but for emergency / evacuation planning purposes. Study should consider:

- Timing of planned future public road improvements including completion of I-540/Western Wake Expressway to NC 55 Bypass in Holly Springs; Friendship Road interchange on US Highway 1 and Harris Plant/Bonsal temporary / permanent interchange on US Highway 1.
- Impacts/benefits of Harris Plant/Bonsal interchange as a permanent rather than temporary interchange (evaluated as part of Harris Plant expansion permitting process).
- Upgrade of bridge replacements associated with higher lake level as part of Harris Lake expansion permitting process to accommodate projected future traffic volumes (or at a minimum to design and construct so that future bridge widening can be accomplished at lower public cost).
- Setting goals for developer participation in the improvement of the transportation system network including how to prioritize developer contributions, including directing state and possibly local funding to ensure priority installation of improvements along most heavily traveled routes.
- Develop and seek sponsorship of special enabling legislation that would allow local governments to assess transportation impact fees to ensure adequate road capacity for daily traffic and for more timely area evacuation if the need should ever arise. Special enabling legislation can be argued because of the unique nature of allowing development to encroach around the Harris Plant and the risk inherent in doing so unless evacuation routes are evaluated and expanded concurrently with new development.

F. Preservation of Natural and Historic/Cultural Resources

Throughout the Harris Lake Drainage Basin Study planning process, stakeholders were keenly aware of the natural and historic / cultural resources that are unique to this essentially undeveloped area of the fast urbanizing Wake County / Research Triangle area. Preservation of these precious resources should remain a top implementation priority as future development occurs within the area. Local jurisdictions that have land use control will determine the fate of these resources.

Protection efforts should address:

- Appropriate balance of protection of significant natural and historic/cultural resources with the desired land development pattern.
- Preservation of the rural character and historic value of the New Hill Historic District and surrounds through development and adoption of land use development standards appropriate for the area.
- Preservation of scenic byway vistas along New Hill/Holleman – Olive Chapel/New Hill Road recognizing that vistas can be preserved to the greatest extent possible while accommodating future traffic volumes if development standards are adopted and enforced by the local jurisdictions having land use regulation authority along the corridor.
- Preference for conservation development and low impact development (LID) techniques for development within the Harris Lake Drainage Basin.
- Preservation of the Progress Energy-owned green buffer at the 260' contour level to protect the new 240' lake level required to accommodate Harris Plant expansion.
- Ongoing protection of Progress Energy-owned properties for utility uses and environmental stewardship.

Harris Lake Land Use Scenario Comparison

Comparison of Trip Generation and Potential Roadway Facility Improvement Costs

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Project No. 10004.00

April 2009

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Exhibits (located after report text):

Appendices:

Introduction

Various land use planning scenarios were developed for the Harris Lake Study Area. The purpose of this report was to provide a comparison of the transportation improvements that would be associated with each of those alternative scenarios. Further, a planning-level opinion of cost is also provided to assist planners in determining the viability of various scenarios. It is important to note that the data presented in this report is based on planning-level land use assumptions, and meant to be used as a tool for comparing scenario, not budgeting for roadway improvements.

Throughout this report, the scenarios developed for consideration will be referred to as the development scenarios. Four are presented for analysis, referred to as Scenario 1 (based on existing area land use plan), Scenario 2, and Scenario 3/3A (note that a Scenario 3 and Scenario 3A were developed for this study, since the was little relative change between 3 and 3A with respect to overall volumes, these two were treated as one scenario). Detailed descriptions and definitions for each can be found in the report developed for the land use planning portion of this study.

Volume Estimation

The first step in the study was to analyze the various land use scenarios, and to attempt to calculate roadway volumes that would result from each. This was accomplished by first calculating the acreage of each development category contained within each transportation analysis zone (TAZ), converting acreage of development for each type to dwelling units and employment. Employment totals were further categorized into industrial, retail,

highway retail, office and service employment. This data was provided to the Capital Area Metropolitan Planning Organization (CAMPO) staff so that they could develop TransCAD model runs for each of the land use scenarios. Additionally, the dwelling unit and employment data was compared to trip generation rates found in the Institute of Transportation Engineers (ITE) Trip Generation Manual in order to assist in determining the impact each scenario might have on the roadway network. Since the data provided is based on planning-level estimates, only the overall daily volume is estimated on each facility, not hourly data or turning movement data. The following sections detail how each step was accomplished.

Trip Generation

Trip generation for the TransCAD model analysis was accomplished by providing the number of dwelling units in each TAZ. Dwelling unit totals were calculated by using the density definition provided for each residential land use category in the planning scenarios. Those density definitions are as follows:
Very Low Density – 0.5 dwelling units per acre
Low Density - 1.0 dwelling unit per acre
Medium Density (R-20) – 2 dwelling units per acre
Medium Density (R-10) – 4 dwelling units per acre

Additionally, since the data was being compared to the existing Southwest Area Land Use Plan, there were two categories, 1 dwelling unit per acre and 1.5 dwelling unit per acre that were also factored into the calculations.

Dwelling unit totals for the existing conditions were derived from the socio-economic (SE) data contained in the current CAMPO model. This data was chosen as the base line since the model was to be used to develop comparative scenarios from each of the land use plan alternatives. Thus, the model comparison assumes that the existing SE data is consistent with the current land use and development plan for the area.

Next, the four land use plan scenarios were overlaid on the model TAZ map, and area of each residential density type was calculated. In this way, the density data above was used to calculate the number of dwelling units in each TAZ based on a dwelling unit per acre times acreage calculation. However, the land use scenarios do not provide full coverage of each TAZ. In other words, there are TAZs for which only a portion of the overall area will be changed by a given scenario. To account for this, a weighted average calculation was performed. Thus, the analysis assumes that for any portion of any zone not identified in the land use scenario, the dwelling unit data will match the CAMPO model dwelling unit total.

In addition to dwelling unit data, employment data was also calculated. Only the industrial category of employment was identified in any of the three land use scenarios analyzed. If the overall acreage of industrial land use was unchanged, then the CAMPO industrial employment total was assumed to be valid for the three development scenarios. However, there were a small number of zones for which the three development scenarios identified industrial land use, while the existing data identified no industrial use. Since there was no direct correlation between acreage of industrial land use and number of employees in the model, additional research was done to assist in this calculation.

Based on a similar study found, the estimation was made that industrial land use identified in the three land use scenarios would yield an average of eight (8) employees per acre. Thus, industrial employment for these zones was calculated with that density.

There was also an additional category that needed to be addressed in this analysis, that of “mixed use” development. This grouping was the most difficult to quantify as it is the broadest of all the categories. Mixed use development in this application refers to allowing residential development to occupy the same acreage as commercial development. Typically, the two are planned is such a way as to provide a symbiotic relationship as the residential component provides customers for retail establishments while the office and service employment attractors draw from the potential workforce nearby. The difficulty in determining the actual travel added to the system comes in the fact that at this point, only the fact that mixed use development will be allowed. There is little to no information regarding the specific types of employment, nature of the housing, or the relationship that might exist between the two.

The benefit in utilizing a transportation model to assess the potential trip generation and distribution for this type of development is that the model assumes trips to be generated from the home, and attracted to employment. The attraction is typically based on the size of the employment, and related to the relative distance to other employment. Thus, the model will likely predict that a number of trips will be captured within the zones where mixed use development is planned, and not assign all trips to the outside network.

The calculation of the dwelling unit and employment totals was accomplished by researching other such studies. One in particular addressed the same situation facing this study, and assigned both a residential (dwelling unit) and employment density to the mixed use category. That methodology was repeated in this study in order to estimate dwelling units and employment for mixed use areas, as density was multiplied by area to estimate the data.

In addition to estimating the overall employment total that would exist, the employment data had to be further stratified into type. This was accomplished by assuming that mixed use employment would fall into one three of the five employment categories, retail, service and office. Typically, industrial employment is not found in mixed use developments, as industrial uses are often thought to be incompatible with residential developments. Additionally, highway retail was also omitted from this category, as “low-impact” uses are typically preferred. While some types of traditional highway retail may be allowed, their contribution to the overall development was considered to be small, thus allowing the assumption that the employment would not be allocated to this use.

The employment allocation to each of three chosen uses (retail, office, service) was made based on the zones current allocation. The assumption being made that these uses would continue to be supported based on their current levels. For zones currently having no employment in those categories, employment generated by new mixed use development was allocated equally to the three uses.

TransCAD Model

The result of the assumptions and calculations described above was dwelling unit totals and employment totals for each of the five groupings included in the model. This data was provided to CAMPO so that the TransCAD model could be re-run for each of the three development scenarios. The purpose for this modeling exercise was to develop a comparison of total traffic on each of the modeled facilities in the study area for the existing conditions, as well as the three development scenarios. The following table provides a summary of the results of that comparison.

Table 1: Model Volume Comparison (in daily traffic)

Road - Section	Alternative 1	Alternative 2	Alternative 3/3A
Avent Ferry Road			
New Hill Road - Eastern Planning Limits	28,127	29,572	32,158
Bartley Holleman Road			
Western Planning Limits - New Hill Road	4,000	2,000	2,000
Buckhorn-Duncan Road			
Cass Holt Road - Southern Planning Limit	12,913	15,167	15,835
Cass Holt Road			
Sweet Springs Road - Buckhorn-Duncan Road	800	6,100	10,400
Buckhorn-Duncan Road - Avent Ferry Road	17,651	23,595	24,208
Friendship Road			
New Hill Road - Holly Springs-New Hill Road	8,135	10,170	15,347
Holly Springs-New Hill Road - Old US 1	9,433	7,341	22,617
Holly Springs-New Hill Road			
Eastern Planning Limit - Friendship Road	17,467	17,357	31,818
New Hill Road			
Old US 1 - US 1	20,479	30,138	34,931
US 1 - Friendship Road	14,380	25,746	37,066
Friendship Road - Avent Ferry Road	6,533	17,680	28,154
Old US 1			
Buckhorn Street - Sharon Harris Road	4,816	8,317	9,078
Sharon Harris Road - NC 751	8,715	12,096	17,619
NC 751 - Friendship Road	18,042	20,446	29,368
Piney Grove - Wilbon Road			
Southern Planning Limit - Wilbon Road	10,005	9,982	10,850
Wilbon Road - Northern Planning Limit	15,854	15,994	17,284
Rex Road			
Avent Ferry Road - Cass Holt Road	2,600	7,800	12,100
US 1			
Western Planning Boundary - NC 751	69,393	71,333	73,685
NC 751 - Eastern Planning Boundary	70,049	79,031	84,921

ITE Trip Generation Comparison

In addition to the model analysis, trip generation calculations were also preformed based on the methodology described in the *Institute of Transportation Engineers' (ITE) Trip Generation Manual* (7th edition). This was meant to provide both a "reasonableness check" of the model output, but also as a stand-alone tool for comparing the various land use scenarios.

Since employment by trip type had already been calculated, this data was utilized as the input into the ITE equations. The ITE manual provides equations for specific types of employment rather than broad categories such as "industrial". However, detailed development data is not available within the parameters of this study. Thus, individual uses were chosen to best represent the overall groupings in the hope that the comparative information would be beneficial. The categories noted below were chosen based on applicability to the employment category, and the existence of an equation based on number of employees. The data is meant for comparative purposes only.

The land use codes chosen to represent each employment category are as follows:

- Industrial – Code 110 General Light Industrial
- Retail – Code 815 Free standing discount store
- Highway Retail – omitted from comparison as all categories had the same total and comprises on 4.6% of the total employment in the study area.
- Office – 710 General Office
- Service – 610 Hospital

Note that the calculations described in this section are not meant to determine the forecasted traffic exiting any particular zone. Many factors affect traffic assignment, including pass by and internal capture as well as the amount of inter-zonal travel. Thus the actual totals from this exercise are not repeated in the table. Rather, the goal of this section is to identify the overall change in trip generation that would be associated with each of the three proposed land use scenarios. The table below compares the trip generation of each scenario as a percentage of the trip generation associated with the Scenario 1 (which is based on the existing area land use plan). As noted in the table, Scenario 2 would likely produce 27% more trips than Scenario 1, and Scenario 3/3A would likely produce 113% more trips than the existing model shows.

Table 2: Comparison of Trip Generation Based on ITE Methodology

Scenario	Percentage of Trip Generation of Scenario 1
Scenario 2	127 %
Scenario 3	213 %

Capacity Estimates

Physical data was collected on the major roads in the planning area so that a capacity analysis could be performed. Highway Capacity Software (HCS) was utilized to calculate a level of service (LOS) for each. The LOS was based on factors such as number of lanes, percent no-passing areas, overall distance to lateral obstruction, and number of signals per mile. Based on this data, a single capacity was calculated for each cross section found in the study area. The resulting capacities for each section are shown in vehicles per day (vpd) as follows:

- Two-lane roadway – 10,600 vpd
- Four-lane arterial – 25,300 vpd
- Six-lane arterial – 45,200 vpd
- Four-lane freeway – 56,200 vpd
- Six-lane freeway – 85,000 vpd

Improvements and Cost

Improvements were assumed to be needed for each facility found to have a future volume to capacity ratio (v/c) of 1.0 or greater. The improvements suggested are based on increasing capacity through adding travel lanes. Only road widening improvements were considered, as intersection analysis and improvement or other improvement methodologies (travel demand management, public transportation, access management, etc.) were not included in the scope of this study. Those detailed improvements would be considered as more detailed planning data (such as site plan data) became available.

The cost data provided for this study should be used for comparative purposes only. These costs are based on assumed per mile cost estimations, and are not appropriate for budgeting or bid purposes. Cost data was developed using the NCDOT cost per mile estimating procedure (dated Feb 2008).

Table 3: Summary of Improvements and Opinion of Cost

Road - Section	Length (Miles)	Alternative 1 Recommended Cross Section	Alternative 2 Recommended Cross Section	Alternative 3/3A Recommended Cross Section	Alternative 1 Cost	Alternative 2 Cost	Alternative 3/3A Cost
Avent Ferry Road							
New Hill Road - Eastern Planning Limits	2.9	6-lane	6-lane	6-lane	$32,915,000	$32,915,000	$28,913,000
Bartley Holleman Road							
Western Planning Limits - New Hill Road	2.7	no improvement	no improvement	no improvement	$0	$0	$0
Buckhorn-Duncan Road							
Cass Holt Road - Southern Planning Limit	2.6	3-lane	3-lane	3-lane	$10,062,000	$10,062,000	$10,062,000
Cass Holt Road							
Sweet Springs Road - Buckhorn-Duncan Road	2.6	no improvement	no improvement	no improvement	$0	$0	$0
Buckhorn-Duncan Road - Avent Ferry Road	2.1	4-lane	4-lane	4-lane	$14,805,000	$14,805,000	$14,805,000
Friendship Road							
New Hill Road - Holly Springs-New Hill Road	1.3	no improvement	no improvement	3-lane	$0	$0	$5,031,000
Holly Springs-New Hill Road - Old US 1	2.2	no improvement	no improvement	4-lane	$0	$0	$15,510,000
Holly Springs-New Hill Road							
Eastern Planning Limit - Friendship Road	2.4	4-lane	4-lane	6-lane	$16,920,000	$16,920,000	$27,240,000
New Hill Road							
Old US 1 - US 1	0.9	4-lane	6-lane	6-lane	$6,345,000	$10,215,000	$10,215,000
US 1 - Friendship Road	0.1	3-lane	6-lane	6-lane	$387,000	$1,135,000	$1,135,000
Friendship Road - Avent Ferry Road	3.6	no improvement	4-lane	6-lane	$0	$25,380,000	$40,860,000
Old US 1							
Buckhorn Street - Sharon Harris Road	1.6	no improvement	no improvement	no improvement	$0	$0	$0
Sharon Harris Road - NC 751	1.4	no improvement	3-lane	4-lane	$0	$5,418,000	$9,870,000
NC 751 - Friendship Road	2.5	4-lane	4-lane	6-lane	$17,625,000	$17,625,000	$28,375,000
Piney Grove-Wilbon Road							
Southern Planning Limit - Wilbon Road	1.7	no improvement	no improvement	3-lane	$0	$0	$6,579,000
Wilbon Road - Northern Planning Limit	1.8	3-lane	3-lane	4-lane	$6,966,000	$6,966,000	$12,690,000
Rex Road							
Avent Ferry Road - Cass Holt Road	2.1	no improvement	no improvement	3-lane	$0	$0	$8,127,000
US 1							
Western Planning Boundary - NC 751	3.4	6-lane FW	6-lane FW	6-lane FW	$34,476,000	$34,476,000	$34,476,000
NC 751 - Eastern Planning Boundary	3.5	6-lane FW	6-lane FW	6-lane FW	$35,490,000	$35,490,000	$35,490,000
				Total Cost	$175,991,000	$211,407,000	$289,378,000

Appendix A – Calculation Spreadsheets

Appendix B – LOS Analysis Output

Road - Section	Length (Miles)	Alt 1 Land Use Plan (model volume)	Alt 2 Land Use Plan (model volume)	Alt 3/3A Land Use Plan (model volume)	Existing Cross Section	Existing Capacity	Alt 1 v/c (with no improvements)	Alt 2 v/c (with no improvements)	Alt 3/3A v/c (with no improvements)	Alternative 1 Recommended Cross Section	Alternative 2 Recommended Cross Section	Alternative 3/3A Recommended Cross Section	Alternative 1 Cost	Alternative 2 Cost	Alternative 3/3A Cost
Avent Ferry Road															
New Hill Road - Eastern Planning Limits	2.9	28127	29572	32158	2-Lane	10,600	2.7	2.8	3.0	6-lane	6-lane	6-lane	$32,915,000	$32,915,000	$28,913,000
Bartley Holleman Road															
Western Planning Limits - New Hill Road	2.7	4000	2000	2000	2-Lane	10,600	0.4	0.2	0.2	no improvement	no improvement	no improvement	$0	$0	$0
Buckhorn-Duncan Road															
Cass Holt Road - Southern Planning Limit	2.6	12913	15167	15835	2-Lane	10,600	1.2	1.4	1.5	3-lane	3-lane	3-lane	$10,062,000	$10,062,000	$10,062,000
Cass Holt Road															
Sweet Springs Road - Buckhorn-Duncan Road	2.6	800	6100	10400	2-Lane	10,600	0.1	0.6	1.0	no improvement	no improvement	3-Lane	$0	$0	$0
Buckhorn-Duncan Road - Avent Ferry Road	2.1	17651	23595	24208	2-Lane	10,600	1.7	2.2	2.3	4-lane	4-lane	4-lane	$14,805,000	$14,805,000	$14,805,000
Friendship Road															
New Hill Road - Holly Springs-New Hill Road	1.3	8135	10170	15347	2-Lane	10,600	0.8	1.0	1.4	no improvement	3-lane	3-lane	$0	$0	$5,031,000
Holly Springs-New Hill Road - Old US 1	2.2	9433	7341	22617	2-Lane	10,600	0.9	0.7	2.1	no improvement	no improvement	4-lane	$0	$0	$15,510,000
Holly Springs-New Hill Road															
Eastern Planning Limit - Friendship Road	2.4	17467	17357	31818	2-Lane	10,600	1.6	1.6	3.0	4-lane	4-lane	6-lane	$16,920,000	$16,920,000	$27,240,000
New Hill Road															
Old US 1 - US 1	0.9	20479	30138	34931	2-Lane	10,600	1.9	2.8	3.3	4-lane	6-lane	6-lane	$6,345,000	$10,215,000	$10,215,000
US 1 - Friendship Road	0.1	14380	25746	37066	2-Lane	10,600	1.4	2.4	3.5	3-lane	6-lane	6-lane	$387,000	$1,135,000	$1,135,000
Friendship Road - Avent Ferry Road	3.6	6533	17680	28154	2-Lane	10,600	0.6	1.7	2.7	no improvement	4-lane	6-lane	$0	$25,380,000	$40,860,000
Old US 1															
Buckhorn Street - Sharon Harris Road	1.6	4816	8317	9078	2-Lane	10,600	0.5	0.8	0.9	no improvement	no improvement	no improvement	$0	$0	$0
Sharon Harris Road - NC 751	1.4	8715	12096	17619	2-Lane	10,600	0.8	1.1	1.7	no improvement	3-lane	4-lane	$0	$5,418,000	$9,870,000
NC 751 - Friendship Road	2.5	18042	20446	29368	2-Lane	10,600	1.7	1.9	2.8	4-lane	4-lane	6-lane	$17,625,000	$17,625,000	$28,375,000

Piney Grove-Wilbon Road															
Southern Planning Limit - Wilbon Road	1.7	10005	9982	10850	2-Lane	10,600	0.9	0.9	1.0	no improvement	no improvement	3-lane	$0	$0	$6,579,000
Wilbon Road - Northern Planning Limit	1.8	15854	15994	17284	2-Lane	10,600	1.5	1.5	1.6	3-lane	3-lane	4-lane	$6,966,000	$6,966,000	$12,690,000
Rex Road															
Avent Ferry Road - Cass Holt Road	2.1	2600	7800	12100	2-Lane	10,600	0.2	0.7	1.1	no improvement	no improvement	3-lane	$0	$0	$8,127,000
US 1															
Western Planning Boundary - NC 751	3.4	69393	71333	73685	4-Lane FW	56,200	1.2	1.3	1.3	6-lane FW	6-lane FW	6-lane FW	$34,476,000	$34,476,000	$34,476,000
NC 751 - Eastern Planning Boundary	3.5	70049	79031	84921	4-Lane FW	56,200	1.2	1.4	1.5	6-lane FW	6-lane FW	6-lane FW	$35,490,000	$35,490,000	$35,490,000
												Total Cost	$175,991,000	$211,407,000	$289,378,000

Appendix B – LOS Analysis Output

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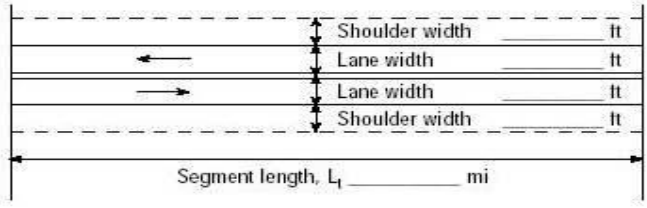
TWO-WAY TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		*Site Information*
Analyst	*Freeman*	Highway
Agency or Company	*Gibson*	From/To
Date Performed	*12/3/2008*	Jurisdiction
Analysis Time Period		Analysis Year

Project Description: *Generic capacity for 18' 2-lane facility*

Input Data



☑ Class I highway ☐ Class II highway

Terrain ☐ Level ☑ Rolling

Two-way hourly volume	*1313* veh/h
Directional split	*60 / 40*
Peak-hour factor, PHF	*0.90*
No-passing zone	*100*
% Trucks and Buses , P_T	*2%*
% Recreational vehicles, P_R	*0%*
Access points/mi	*12*

Average Travel Speed

Grade adjustment factor, f_G (Exhibit 20-7)	*0.99*
Passenger-car equivalents for trucks, E_T (Exhibit 20-9)	*1.5*
Passenger-car equivalents for RVs, E_R (Exhibit 20-9)	*1.1*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.990*
Two-way flow rate[1], v_p (pc/h)=V/(PHF * f_G * f_{HV})	*1488*
v_p * highest directional split proportion[2] (pc/h)	*893*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Field Measured speed, S_{FM}	*mi/h*	Base free-flow speed, $BFFS_{FM}$	*60.0 mi/h*
Observed volume, V_f	*veh/h*	Adj. for lane width and shoulder width[3], f_{LS} (Exhibit 20-5)	*3.5 mi/h*
Free-flow speed, FFS FFS=S_{FM}+0.00776(V_f/f_{HV})	*mi/h*	Adj. for access points, f_A (Exhibit 20-6)	*3.0 mi/h*
		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*53.5 mi/h*

Adj. for no-passing zones, f_{np} (*mi/h*) (Exhibit 20-11)	*1.6*
Average travel speed, ATS (*mi/h*) ATS=FFS-0.00776v_p-f_{np}	*40.3*

Percent Time-Spent-Following

Grade Adjustment factor, f_G (Exhibit 20-8)	*1.00*
Passenger-car equivalents for trucks, E_T (Exhibit 20-10)	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 20-10)	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*
Two-way flow rate[1], v_p (pc/h)=V/(PHF * f_G * f_{HV})	*1459*
v_p * highest directional split proportion[2] (pc/h)	*875*
Base percent time-spent-following, BPTSF(%)=100(1-$e^{-0.000879v_p}$)	*72.3*
Adj. for directional distribution and no-passing zone, $f_{d/np}$(%)(Exh. 20-12)	*7.7*
Percent time-spent-following, PTSF(%)=BPTSF+$f_{d/np}$	*80.0*

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 20-3 for Class I or 20-4 for Class II)	*D*
Volume to capacity ratio, v/c=V_p/3,200	*0.47*
Peak 15-min veh-miles of travel, VMT_{15} (veh-*mi*)= 0.25L_t(V/PHF)	*365*

Peak-hour vehicle-miles of travel, VMT_{60}(veh- *mi*)=V*L_t	*1313*
Peak 15-min total travel time, TT_{15}(veh-h)= VMT_{15}/ATS	*9.0*
Notes	
1. If Vp >= 3,200 pc/h, terminate analysis-the LOS is F. 2. If highest directional split Vp>= 1,700 pc/h, terminated anlysis-the LOS is F.	

Peak-hour vehicle-miles of travel, VMT_{60}(veh-*mi*)=V*L_t *1313*

B

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Phone: Fax: E-Mail:

PLANNING ANALYSIS

Analyst: Freeman Agency/Co.: Gibson Date Performed: 12/3/2008Analysis Time Period:Urban Street: Direction of Travel: Jurisdiction: Analysis Year:Project ID: Generic 4-Lane Arterial LOS

Traffic Characteristics

Annual average daily traffic, AADT 20789 vpdPlanning analysis hour factor, K 0.100 Directional distribution factor, D 0.600 Peak-hour factor, PHF 0.900 Adjusted saturation flow rate 1800 pcphgplPercent turns from exclusive lanes 0 %

Roadway Characteristics

Number of through lanes one direction, N 2 Free flow speed, FFS 45 mphUrban class 2 Section length 1.00 miles Median No Left-turn bays No

Signal Characteristics

Signalized intersections 5 Arrival type, AT 3 Signal type (k = 0.5 for planning) Actuated Cycle length, C 120.0 sec Effective green ratio, g/C 0.600

Results

Annual average daily traffic, AADT 20789 vpdTwo-way hourly volume 2078 vphHourly directional volume 1246 vphThrough-volume 15-min. flow rate 1384 v Running time 109.0 sec v/c ratio 0.80 Through capacity 1726 vphProgression factor, PF 1.000 Uniform delay 18.5 sec Filtering/metering factor, I 0.496 Incremental delay 2.0 sec Control delay 20.5 sec/v

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Total travel speed, Sa 17.0 mphTotal urban street LOS
D

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Phone: Fax: E-Mail:

PLANNING ANALYSIS

Analyst: Freeman Agency/Co.: Gibson Date Performed: 12/3/2008Analysis Time Period:Urban Street: Direction of Travel: Jurisdiction: Analysis Year:Project ID: 6-Lane Arterial Generic Capacity

Traffic Characteristics

Annual average daily traffic, AADT 32169 vpdPlanning analysis hour factor, K 0.100 Directional distribution factor, D 0.600 Peak-hour factor, PHF 0.900 Adjusted saturation flow rate 1800 pcphgplPercent turns from exclusive lanes 0 %

Roadway Characteristics

Number of through lanes one direction, N 3 Free flow speed, FFS 45 mphUrban class 2 Section length 1.00 miles Median No Left-turn bays No

Signal Characteristics

Signalized intersections 5 Arrival type, AT 3 Signal type (k = 0.5 for planning) Actuated Cycle length, C 120.0 sec Effective green ratio, g/C 0.600

Results

Annual average daily traffic, AADT 32169 vpdTwo-way hourly volume 3216 vphHourly directional volume 1929 vphThrough-volume 15-min. flow rate 2143 v Running time 109.0 sec v/c ratio 0.83 Through capacity 2590 vphProgression factor, PF 1.000 Uniform delay 19.1 sec Filtering/metering factor, I 0.452 Incremental delay 1.5 sec Control delay 20.5 sec/v

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Total travel speed, Sa 17.0 mphTotal urban street LOS
D

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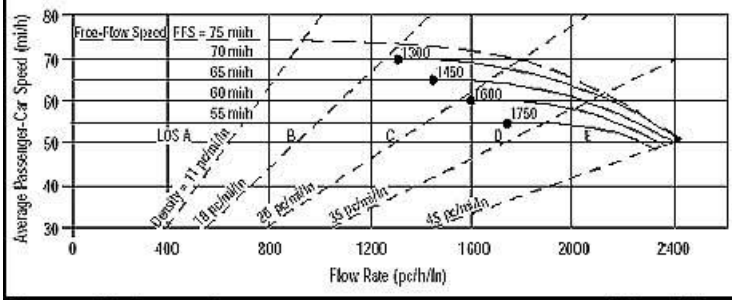
BASIC FREEWAY SEGMENTS WORKSHEET



Application	Input	Output
Operational (LOS)	FFS, N, v_p	LOS, S, D
Design (N)	FFS, LOS, v_p	N, S, D
Design (v_p)	FFS, LOS, N	v_p, S, D
Planning (LOS)	FFS, N, AADT	LOS, S, D
Planning (N)	FFS, LOS, AADT	N, S, D
Planning (v_p)	FFS, LOS, N	v_p, S, D

General Information		*Site Information*	
Analyst	*Freeman*	Highway/Direction of Travel	
Agency or Company		From/To	
Date Performed	*12/3/2008*	Jurisdiction	
Analysis Time Period		Analysis Year	

Project Description

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs				
Volume, V	*5178*	veh/h	Peak-Hour Factor, PHF	*0.90*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Rolling*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
Driver type adjustment	*1.00*		Up/Down %	

Calculate Flow Adjustments			
f_p	*1.00*	E_R	*2.0*
E_T	*2.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.917*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width	*12.0*	ft	f_{LW}		mi/h
Rt-Shoulder Lat. Clearance	*6.0*	ft	f_{LC}		mi/h
Interchange Density	*0.50*	I/mi	f_{ID}		mi/h
Number of Lanes, N	*3*		f_N		mi/h
FFS (measured)	*65.0*	mi/h	FFS	*65.0*	mi/h
Base free-flow Speed, BFFS		mi/h			

LOS and Performance Measures			Design (N)		
Operational (LOS)			Design (N)		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*2090*	pc/h/ln	Design LOS		
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h
S	*59.7*	mi/h	S		mi/h
D = v_p / S	*35.0*	pc/mi/ln	D = v_p / S		pc/mi/ln
LOS	*D*		Required Number of Lanes, N		

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits23-8, 23-10	f_{LW} - Exhibit 23-4
V - Hourly volume	D - Density	E_T - Exhibits 23-8, 23-10, 23-11	f_{LC} - Exhibit 23-5
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 23-12	f_N - Exhibit 23-6
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 23-2, 23-3	f_{ID} - Exhibit 23-7
DDHV - Directional design hour volume			

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Appendix C – Model Data

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OBJECTID_1	TAZ	DU05	DU35	HH35	POP35	IND	IND35	RET	RET35	HWY	HWY35	OFF	OFF35	SER	SER35	EMP_05	EMP_35	TAZ
419	1384	8	1826	1607	4412	0	0	482	482	69	69	0	0	311	311	862	862	1384
297	1385	623	2256	2076	5560	345	2139	80	1189	55	258	63	485	104	1254	647	5325	1385
413	1396	10	270	243	649	0	0	103	103	22	22	7	7	174	174	306	306	1396
292	1397	89	549	505	1353	2	416	450	450	0	0	0	0	5	5	457	871	1397
411	1398	31	68	64	171	0	0	1	1	0	0	0	0	4	4	5	5	1398
412	1399	179	738	679	1819	0	0	0	0	0	0	0	216	17	1268	17	1484	1399
293	1400	147	478	440	1178	0	0	1	6	4	4	0	0	11	11	16	21	1400
420	1406	14	103	96	255	0	0	0	533	0	115	0	0	1	693	1	1341	1406
536	1407	6	22	22	60	0	0	866	934	705	685	0	0	2206	2027	3777	3646	1407
538	1408	69	619	563	1459	4	4	0	138	0	40	0	0	2	215	6	397	1408
423	1409	36	261	240	622	0	0	1	1	0	0	13	13	8	8	22	22	1409
421	1410	4	28	28	74	11	11	0	0	0	0	0	0	0	0	11	11	1410
422	1411	2	4	4	12	0	0	0	0	0	0	0	0	0	0	0	0	1411
206	1412	9	136	121	319	8	8	0	0	0	0	0	0	0	0	8	8	1412
300	1413	20	52	47	125	0	0	0	0	0	0	0	91	18	18	18	109	1413
783	1420	549	1270	1206	3276	224	307	10	121	0	162	3	695	336	650	573	1935	1420
785	1422	0	0	0	0	0	0	0	0	0	0	100	142	83	312	183	454	1422
535	1507	43	1522	1446	3928	8	47	3	187	0	0	0	196	9	428	20	858	1507
417	1508	566	981	932	2532	34	44	83	672	29	299	15	17	161	1007	322	2039	1508
296	1515	728	2725	2507	6715	0	0	0	162	0	124	5	5	13	135	18	426	1515
299	1521	1	28	28	27	0	0	0	0	0	0	0	0	0	0	0	0	1521
664	1536	56	3486	3312	8998	0	47	0	655	3	321	0	390	3	1271	6	2684	1536
662	1737	39	2680	2546	6941	1009	1323	11	491	25	388	2	907	60	2144	1107	5253	1737
290	1749	182	471	433	1160	3	3	0	24	0	5	0	17	3	44	6	93	1749
203	1754	84	457	420	1125	3	186	30	30	0	0	0	0	6	13	39	229	1754

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294	1755	34	580	528	1404	0	0	0	235	0	51	0	0	3	307	3	593	1755
537	1768	67	891	838	2285	3	277	0	112	0	82	0	872	15	332	18	1675	1768
298	1774	25	114	105	280	0	0	0	0	0	0	0	0	12	12	12	12	1774
301	1775	57	946	861	2223	4	31	0	6	1	3	0	614	0	307	5	961	1775
295	1776	0	15	14	32	20	20	0	0	62	62	0	0	0	0	82	82	1776
205	1777	10	10	9	24	0	0	0	0	0	0	0	0	0	0	0	0	1777
204	1778	0	44	40	92	0	0	0	0	0	0	0	0	0	0	0	0	1778

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Revisions to CAMPO model data based on land use scenarios

TAZ	Scenario	Rev DU	Rev IND35	Rev RET35	Rev HWY35	Rev OFF35	Rev SER35	Total Employees
1385	E	2256	2139	1189	258	485	1254	5325
	1	2087	2139	1410	258	575	1487	5868
	2	3877	2139	2193	258	894	2312	7796
	3	3877	2139	2193	258	894	2312	7796
1397	E	549	416	450	0	0	5	871
	1	630	0	450	0	0	5	455
	2	2090	0	450	0	0	5	455
	3	2343	0	450	0	0	5	455
1400	E	478	0	6	4	0	11	21
	1	394	0	6	4	0	11	21
	2	499	0	6	4	0	11	21
	3	709	0	6	4	0	11	21
1406	E	103	0	533	115	0	693	1341
	1	338	0	533	115	0	693	1341
	2	4648	0	2551	115	0	3317	5983
	3	4648	0	2551	115	0	3317	5983
1407	E	22	0	934	685	0	2027	3646
	1	17	0	934	685	0	2027	3646
	2	39	0	934	685	0	2027	3646
	3	39	0	934	685	0	2027	3646
1408	E	619	4	138	40	0	215	397
	1	1505	4	138	40	0	215	397
	2	4941	4	2013	40	0	3137	5194
	3	2427	4	1030	40	0	1605	2680
1409	E	261	0	1	0	13	8	22
	1	919	0	1	0	13	8	22
	2	2690	0	119	0	1549	953	2621
	3	49	4	1	0	13	8	26

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Revisions to CAMPO model data based on land use scenarios

TAZ	Scenario	Rev DU	Rev IND35	Rev RET35	Rev HWY35	Rev OFF35	Rev SER35	Total Employees
1410	E	28	11	0	0	0	0	11
	1	164	11	0	0	0	0	11
	2	2074	11	686	0	686	686	2069
	3	1896	11	627	0	627	627	1891
1411	E	4	0	0	0	0	0	0
	1	7	0	0	0	0	0	0
	2	94	0	31	0	31	31	94
	3	14	346	5	0	5	5	360
1412	E	136	8	0	0	0	0	8
	1	24	773					773
	2	24	773					773
	3	24	773					773
1413	E	52	0	0	0	91	18	109
	1	2	2260			91	18	2369
	2	0	3239			91	18	3348
	3	0	3703			91	18	3812
1507	E	1522	47	187	0	196	428	858
	1	2265	47	438	0	459	1002	1946
	2	2839	47	438	0	459	1002	1946
	3	3283	47	438	0	459	1002	1946
1515	E	2725	0	162	124	5	135	426
	1	1122	0	162	124	5	135	426
	2	1122	0	162	124	5	135	426
	3	1122	0	162	124	5	135	426
1521	E	28	0	0	0	0	0	0
	1	0	0					0
	2	0	0					0
	3	0	0					0

`

Revisions to CAMPO model data based on land use scenarios

TAZ	Scenario	Rev DU	Rev IND35	Rev RET35	Rev HWY35	Rev OFF35	Rev SER35	Total Employees
1749	E	471	3	24	5	17	44	93
	1	630	3	24	5	17	44	93
	2	2363	3	24	5	17	44	93
	3	2410	3	24	5	17	44	93
1754	E	457	186	30	0	0	13	229
	1	1317	2415	30			13	2458
	2	1892	2415	30			13	2458
	3	3043	2415	30			13	2458
1755	E	580	0	235	51	0	307	593
	1	527	0	235	51		307	593
	2	533	0	235	51		307	593
	3	546	0	235	51		307	593
1774	E	114	0	0	0	0	12	12
	1	89	0				12	12
	2	89	561				12	573
	3	164	978				12	990
1775	E	946	31	6	3	614	307	961
	1	378	2108	6	3	614	307	3038
	2	288	2088	6	3	614	307	3018
	3	288	2088	6	3	614	307	3018
1776	E	15	20	0	62	0	0	82
	1	45	0		62			62
	2	45	0		62			62
	3	45	0		62			62
1777	E	10	0	0	0	0	0	
	1	33	1155					
	2	33	1155					
	3	33	1155					

`

TAZ	Scenario	Rev DU	Rev IND35	Rev RET35	Rev HWY35	Rev OFF35	Rev SER35	Total Employees
1778	E	44	0	0	0	0	0	
	1	38	0					
	2	38	0					
	3	38	0					

Note: At the time that model runs were performed, the land use scenarios were labeled Existing, Scenario 1, Scenario 2, and Scenario 3. After the

model work had been done, the scenarios were revised as follows: Existing became Scenario 1, Scenario 1 became Scenario 2, original Scenario 2 was dropped, Scenario 3 became Scenario 3/3A. The labels in this file are consistent with the original naming convention

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Appendix D – Cost Calculations

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GIBSON ENGINEERS, PC
PO BOX 700 • Fuquay-Varina, NC 27526
PHONE 919.552.2253 • FAX 919.552.2254

SUBJECT: HARRIS LAKE OPINION OF COST
PROJECT: _____ COUNTY: _____
PREPARED BY: _____ DATE: _____ STATION: _____
CHECKED BY: _____ DATE: _____ STR NO.: ____ SHEET ___ OF ____

UPGRADE 2-LANE FACILITY TO :

3-LANE	4-LANE	6-LANE FW (FROM 4-LANE)
2,250,000	4,100,000	5,900,000
X 1.3 MISC	1.3 misc	X 1.3
1.15 E+C	1.15	1.15
1.15 TERRAIN	1.15	1.15
3870000	~~7,000~~ 7,050,000	10,140,000

FOR ALL OTHER 6-L (NON-FW)
DON'T HAVE 2L TO 6-L, SO USE 2-L SHLDR TO 4L SHOULDER, THEN MULT BY ~~1.5~~ 2.0

3,300,000
X 2
X 1.3
1.15
1.15
11,350,000

Instructions **2/28/2008**

Step No.	Description
1	Multiply your Typical Section Cost Per Mile by your Proposed Length.
2	Cost for Bridges along the Main Line must be added.
3	Railroad Crossings (At Grade) – Add Cost for Signals ($110,000 without Gates, and $150,000 with Gates), and Concrete Railroad Crossings ($800/LF for One Track and $1,200/LF for Two Tracks).
4	Water and Sewer Lines not located under Existing Pavement will have to be relocated ($70/LF for Water and $60/LF for Sewer).
5	**Full Control of Access Highways** Grade Separations and Interchanges must be added. Bridges over Streams will also have to be added. ITS items (if needed) must be added.
6	Add Step 1 through Step 5 that pertain to the Project you are estimating. Multiply by 0.30 (30%) for a Miscellaneous Factor to add to your estimate (**This Sub-total is your Contract Cost)**
7	Multiply Step 6 by fifteen percent (0.15) on Federal Funded, or ten percent (0.10) on State Funded projects. **(This is your Engineering and Contingencies Cost)**
8	Add step 6 and Step 7. **(This is your Construction Cost)**

TERRAIN ADJUSTMENT FACTOR			
Coastal = 1.00	Piedmont = 1.15	Mountain = 2.00	Rough Mt. = 2.50
Multiply Step 8 by the appropriate Adjustment Factor for your Area of the state.			

Note: Design Cost usually is about four to ten percent (4% to 10%) of the Construction Cost (If you need a Design Cost, just Multiply Step 8 by 0.06).

Right-of-Way and Wight-of-Way Utility Costs are not included in any of the Costs shown in the Cost Per Mile Table.

If assistance is needed contact Doug Lane: Phone 919-250-4128
Email dlane@dot.state.nc.us

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Project Services Unit
Preliminary Estimate Section
Construction Cost Per Mile

New Location	**Cost Per Mile**
2-Lane Shoulder Section W/2'PS	$2,800,000
3-Lane Curb & Gutter (40'F-F)	$3,700,000
4-Lane Curb & Gutter (52'F-F)	$4,100,000
4-Lane Curb & Gutter w/ Raised Median	$4,800,000
5-Lane Curb & Gutter (64'F-F)	$4,700,000
5-Lane Shoulder Section (Undivided)	$4,500,000
4-Lane Shoulder Section w/ Median (Non-Freeway)	$4,800,000
4-Lane Shoulder Section w/ Median (Freeway)	$5,600,000
6-Lane Shoulder Section w/ Median (Freeway)	$7,800,000
Widen Existing 2-Lane Shoulder Section To:	
3-Lane Curb & Gutter	$2,250,000
4-Lane Curb & Gutter	$3,300,000
4-Lane Curb & Gutter w/ Raised Median	$4,100,000
5-Lane Curb & Gutter	$3,700,000
5-Lane Shoulder Section	$3,600,000
4-Lane Shoulder Section w/ median (Non-Freeway)	$3,800,000
4-Lane Should Section w/ median (Freeway)	$4,500,000
Widen Existing 4-Lane w/ Median To:	
6-Lane (Existing 30' to 22' Median) Interstate	$12,300,000
6-Lane (Existing 70" to 46" Median) Interstate	$5,900,000
8-Lane (Existing 68" to 22" Median) Interstate	$12,200,000
Widen Existing 18' to 24' Shoulder Section	$1,250,000
Other Special Costs to be Added (Not Included in above Costs)	
New Bridges over Streams (All new location projects)	$105/SqFt
Widen Existing Bridges over Streams	$140/SqFt
Grade Separations	$1.850,000/Each
Simple Diamond Interchange	$7,300,000/Each
Half-Clover Interchange	$9,800,000/Each
Full Clover Interchange	$17,900,000/Each
w/ 1 Collector-Distributor	$21,000,000/Each
w/ 2 Collector-Distributors	$24,500,000/Each
w/ 3 Collector-Distributors	$27,700,000/Each
w/ 4 Collector-Distributors	$30,900,000/Each
Simple Flyover Interchange	$7,300,000/Each
3-Level Flyover Interchange	$18 to $33,000,000/Each
Urban Diamond Interchange	$21,000,000/Each
Single Point Diamond Interchange	$22 to $27,000,000/Each
Freeway to Freeway Directional Interchange	$57 to $115,000,000/Each
Utility Construction (Water Line $70/LinFt, Sewer line $60/LinFt)	
Add Turn Lane to Existing 4-Lane Divided	$320 to $350/LinFt
Super Street Intersection (No Lt. Turn Lanes Existing)	$640,000/Each
Super Street Intersection (W/ Existing Lt. Turn Lanes)	$460,000/Each

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Appendix B

Water, Wastewater Infrastructure Quantities & Cost Estimates

- Water – Scenario 1
- Water – Scenario 2
- Water – Scenario 3/3a

- Wastewater – Scenario 1
- Wastewater – Scenario 2
- Wastewater – Scenario 3
- Wastewater – Scenario 3a

ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Water Infrastructure - Scenario 1

THE WOOTEN COMPANY **4/29/2009**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	12" DI Water Main	LF	65,000	$52.00	$3,380,000.00
2	16" DI Water Main	LF	7,000	$65.00	$455,000.00
3	Stream Crossings by Horizontal Directional Drill with 14" HDPE	LF	450	$250.00	$112,500.00
4	24" Steel Encasement w/ 12" DI Water Main by Dry Bore and Jack	LF	1,300	$260.00	$338,000.00
5	30" Steel Encasement w/ 16" DI Water Main by Dry Bore and Jack	LF	150	$350.00	$52,500.00
6	12" Gate Valve	EA	82	$2,200.00	$180,400.00
7	16" Gate Valve	EA	12	$7,000.00	$84,000.00
8	Fire Hydrant Assembly	EA	145	$3,000.00	$435,000.00
9	Undercut of Unstable Soils	CY	1,800	$15.00	$27,000.00
10	Rock Excavation	CY	1,800	$50.00	$90,000.00
11	Erosion and Sediment Control	LS	1	$100,000.00	$100,000.00

Estimated Construction Cost	$5,254,400.00
Contingency	$1,048,914.29
Engineering (Design, CA &CI)	$786,685.71
ESTIMATED TOTAL PROJECT COST	**$7,090,000.00**

NOTES:

[1]- Costs are estimated for project bid in 2008.
- Line Sizes are approximated based on typical flows needed for planned zoning.
- No costs are included for additional pressure zones that would likely be needed as you go below elevation 390'. System would need pressure reducing valves at the pressure zone switch and possible booster pumps to pump back to higher pressure zone.
- No costs are included for elevated storage tanks.

Preliminary
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THE WOOTEN COMPANY
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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Water Infrastructure - Scenario 2

THE WOOTEN COMPANY **5/19/2008**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	12" DI Water Main	LF	90,000	$52.00	$4,680,000.00
2	16" DI Water Main	LF	7,000	$65.00	$455,000.00
3	Stream Crossings by Horizontal Directional Drill with 14" HDPE	LF	600	$250.00	$150,000.00
4	24" Steel Encasement w/ 12" DI Water Main by Dry Bore and Jack	LF	3,000	$260.00	$780,000.00
5	30" Steel Encasement w/ 16" DI Water Main by Dry Bore and Jack	LF	150	$350.00	$52,500.00
6	12" Gate Valve	EA	105	$2,200.00	$231,000.00
7	16" Gate Valve	EA	12	$7,000.00	$84,000.00
8	Fire Hydrant Assembly	EA	195	$3,000.00	$585,000.00
9	Undercut of Unstable Soils	CY	2,300	$15.00	$34,500.00
10	Rock Excavation	CY	2,300	$50.00	$115,000.00
11	Erosion and Sediment Control	LS	1	$200,000.00	$200,000.00

Estimated Construction Cost	$7,367,000.00
Contingency	$2,101,300.00
Engineering (Design, CA &CI)	$1,576,000.00
ESTIMATED TOTAL PROJECT COST	**$11,044,300.00**

NOTES:

[1]- Costs are estimated for project bid in 2008.
- Line Sizes are approximated based on typical flows needed for planned zoning.
- No costs are included for additional pressure zones that would likely be needed as you go below elevation 390'. System would need pressure reducing valves at the pressure zone switch and possible booster pumps to pump back to higher pressure zone.
- No costs are included for elevated storage tanks.

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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Water Infrastructure - Scenario 3/3a

THE WOOTEN COMPANY **5/19/2008**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	12" DI Water Main	LF	130,000	$52.00	$6,760,000.00
2	16" DI Water Main	LF	7,000	$65.00	$455,000.00
3	Stream Crossings by Horizontal Directional Drill with 14" HDPE	LF	1,600	$250.00	$400,000.00
4	24" Steel Encasement w/ 12" DI Water Main by Dry Bore and Jack	LF	4,200	$260.00	$1,092,000.00
5	30" Steel Encasement w/ 16" DI Water Main by Dry Bore and Jack	LF	150	$350.00	$52,500.00
6	12" Gate Valve	EA	176	$2,200.00	$387,200.00
7	16" Gate Valve	EA	12	$7,000.00	$84,000.00
8	Fire Hydrant Assembly	EA	286	$3,000.00	$858,000.00
9	Undercut of Unstable Soils	CY	3,200	$15.00	$48,000.00
10	Rock Excavation	CY	3,200	$50.00	$160,000.00
11	Erosion and Sediment Control	LS	1	$206,000.00	$206,000.00

Estimated Construction Cost	$10,502,700.00
Contingency	$2,101,300.00
Engineering (Design, CA &CI)	$1,576,000.00
ESTIMATED TOTAL PROJECT COST	**$14,180,000.00**

NOTES:

[1]- Costs are estimated for project bid in 2008.
- Line Sizes are approximated based on typical flows needed for planned zoning.
- No costs are included for additional pressure zones that would likely be needed as you go below elevation 390'. System would need pressure reducing valves at the pressure zone switch and possible booster pumps to pump back to higher pressure zone.
- No costs are included for elevated storage tanks.

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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Wastewater Pump Stations - Scenario 1

THE WOOTEN COMPANY **4/28/2009**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	Pump Station 1 - 80 gpm	LS	1	$200,000.00	$200,000.00
2	Pump Station 2 - 80 gpm	LS	1	$200,000.00	$200,000.00
3	Pump Station 3 - 80 gpm	LS	1	$200,000.00	$200,000.00
4	Pump Station 4 - 80 gpm	LS	1	$200,000.00	$200,000.00
5	Pump Station 5 - 80 gpm	LS	1	$200,000.00	$200,000.00
6	Pump Station 6 - 80 gpm	LS	1	$200,000.00	$200,000.00
7	Pump Station 7 - 1,200 gpm	LS	1	$800,000.00	$800,000.00
8	Pump Station 8 - 3,000 gpm	LS	1	$1,000,000.00	$1,000,000.00
9	Pump Station 9 - 570 gpm	LS	1	$550,000.00	$550,000.00

Estimated Construction Cost	$3,550,000.00
Contingency	$585,000.00
Engineering (Design, CA &CI)	$435,000.00
ESTIMATED TOTAL PROJECT COST	**$4,570,000.00**

NOTES:
[1]- Costs are estimated for project bid in 2008.
- Cost of the piping system required to transport flow from the source to the pump station is not considered in the cost.
- Force main leaving the pump station is not included in the cost.

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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Wastewater Pump Stations - Scenario 2

THE WOOTEN COMPANY **4/28/2009**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	Pump Station 1 - 85 gpm	LS	1	$200,000.00	$200,000.00
2	Pump Station 2 - 80 gpm	LS	1	$200,000.00	$200,000.00
3	Pump Station 3 - 100 gpm	LS	1	$200,000.00	$200,000.00
4	Pump Station 4 - 80 gpm	LS	1	$200,000.00	$200,000.00
5	Pump Station 5 - 80 gpm	LS	1	$200,000.00	$200,000.00
6	Pump Station 6 - 80 gpm	LS	1	$200,000.00	$200,000.00
7	Pump Station 7 - 170 gpm	LS	1	$300,000.00	$300,000.00
8	Pump Station 8 - 1,700 gpm	LS	1	$1,000,000.00	$1,000,000.00
9	Pump Station 9 - 250 gpm	LS	1	$400,000.00	$400,000.00
10	Pump Station 14 - 340 gpm	LS	1	$400,000.00	$400,000.00
11	Pump Station 15 - 3,600 gpm	LS	1	$1,750,000.00	$1,750,000.00
12	Pump Station 16 - 1,500 gpm	LS	1	$800,000.00	$800,000.00
13	Pump Station 17 - 80 gpm	LS	1	$200,000.00	$200,000.00
14	Pump Station 18 - 180 gpm	LS	1	$300,000.00	$300,000.00

Estimated Construction Cost	$6,350,000.00
Contingency	$1,665,000.00
Engineering (Design, CA &CI)	$1,245,000.00
ESTIMATED TOTAL PROJECT COST	**$9,260,000.00**

NOTES:

[1]- Costs are estimated for project bid in 2008.
- Cost of the piping system required to transport flow from the source to the pump station is not considered in the cost.
- Force main leaving the pump station is not included in the cost.

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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Wastewater Pump Stations - Scenario 3

THE WOOTEN COMPANY **4/28/2009**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	Pump Station 1 - 85 gpm	LS	1	$200,000.00	$200,000.00
2	Pump Station 2 - 80 gpm	LS	1	$200,000.00	$200,000.00
3	Pump Station 3 - 100 gpm	LS	1	$200,000.00	$200,000.00
4	Pump Station 4 - 80 gpm	LS	1	$200,000.00	$200,000.00
5	Pump Station 5 - 80 gpm	LS	1	$200,000.00	$200,000.00
6	Pump Station 6 - 80 gpm	LS	1	$200,000.00	$200,000.00
7	Pump Station 7 - 170 gpm	LS	1	$300,000.00	$300,000.00
8	Pump Station 8 - 3,500 gpm	LS	1	$1,750,000.00	$1,750,000.00
9	Pump Station 9 - 250 gpm	LS	1	$400,000.00	$400,000.00
10	Pump Station 10 - 380 gpm	LS	1	$400,000.00	$400,000.00
11	Pump Station 11 - 150 gpm	LS	1	$300,000.00	$300,000.00
12	Pump Station 12 - 595 gpm	LS	1	$550,000.00	$550,000.00
13	Pump Station 13 - 205 gpm	LS	1	$400,000.00	$400,000.00
14	Pump Station 14 - 760 gpm	LS	1	$800,000.00	$800,000.00
15	Pump Station 15 - 3,600 gpm	LS	1	$1,750,000.00	$1,750,000.00
16	Pump Station 16 - 1,530 gpm	LS	1	$1,000,000.00	$1,000,000.00
17	Pump Station 17 - 80 gpm	LS	1	$200,000.00	$200,000.00
18	Pump Station 18 - 180 gpm	LS	1	$300,000.00	$300,000.00
19	Pump Station 19 - 80 gpm	LS	1	$200,000.00	$200,000.00
20	Pump Station 20 - 80 gpm	LS	1	$200,000.00	$200,000.00
21	Pump Station 21 - 80 gpm	LS	1	$200,000.00	$200,000.00
				Estimated Construction Cost	$9,950,000.00
				Contingency	$1,988,571.43
				Engineering (Design, CA &CI)	$1,491,428.57
				ESTIMATED TOTAL PROJECT COST	**$13,430,000.00**

NOTES:

[1]- Costs are estimated for project bid in 2008.

- Cost of the piping system required to transport flow from the source to the pump station is not considered in the cost.
- Force main leaving the pump station is not included in the cost.

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ESTIMATE OF PROBABLE PROJECT COST[1]
Harris Lake Drainage Basin Plan
Wake County, North Carolina
Wastewater Pump Stations - Scenario 3a

THE WOOTEN COMPANY **4/28/2009**

	DESCRIPTION	UNITS	TOTAL QUANTITY	UNIT COST	EXTENDED COST
1	Pump Station 1 - 85 gpm	LS	1	$200,000.00	$200,000.00
2	Pump Station 2 - 80 gpm	LS	1	$200,000.00	$200,000.00
3	Pump Station 3 - 100 gpm	LS	1	$200,000.00	$200,000.00
4	Pump Station 4 - 80 gpm	LS	1	$200,000.00	$200,000.00
5	Pump Station 5 - 80 gpm	LS	1	$200,000.00	$200,000.00
6	Pump Station 6 - 80 gpm	LS	1	$200,000.00	$200,000.00
7	Pump Station 7 - 170 gpm	LS	1	$300,000.00	$300,000.00
8	Pump Station 8 - 1,800 gpm	LS	1	$1,000,000.00	$1,000,000.00
9	Pump Station 9 - 250 gpm	LS	1	$400,000.00	$400,000.00
10	Pump Station 10 - 220 gpm	LS	1	$400,000.00	$400,000.00
11	Pump Station 11 - 85 gpm	LS	1	$200,000.00	$200,000.00
12	Pump Station 12 - 340 gpm	LS	1	$400,000.00	$400,000.00
13	Pump Station 13 - 120 gpm	LS	1	$200,000.00	$200,000.00
14	Pump Station 14 - 760 gpm	LS	1	$800,000.00	$800,000.00
15	Pump Station 15 - 3,600 gpm	LS	1	$1,750,000.00	$1,750,000.00
16	Pump Station 16 - 1,530 gpm	LS	1	$1,000,000.00	$1,000,000.00
17	Pump Station 17 - 80 gpm	LS	1	$200,000.00	$200,000.00
18	Pump Station 18 - 180 gpm	LS	1	$300,000.00	$300,000.00
19	Pump Station 19 - 80 gpm	LS	1	$200,000.00	$200,000.00
20	Pump Station 20 - 80 gpm	LS	1	$200,000.00	$200,000.00
21	Pump Station 21 - 80 gpm	LS	1	$200,000.00	$200,000.00
				Estimated Construction Cost	$8,750,000.00
				Contingency	$1,748,571.43
				Engineering (Design, CA &CI)	$1,311,428.57
				ESTIMATED TOTAL PROJECT COST	**$11,810,000.00**

NOTES:
[1]- Costs are estimated for project bid in 2008.
- Cost of the piping system required to transport flow from the source to the pump station is not considered in the cost.
- Force main leaving the pump station is not included in the cost.

Preliminary
Do Not Use for Construction

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Harris Lake Drainage Basin

Case Studies

Wake County, North Carolina

Calvert Cliffs Nuclear Power Plant

Calvert County, MD

McGuire Power Station

Mecklenburg County, NC

Limerick Generating Station

Montgomery County, PA

Indian Point Energy Center

Westchester County, NY

DRAFT – November 2, 2009

Case Studies

Introduction

As development encroaches into the Harris Lake Drainage Basin and nears the Shearon Harris Nuclear Power Plant, the need for coordinated planning between Wake County and the municipalities within the region is essential to protect the unique natural resources within the area and to protect residents from potential incidents at the Plant. To assist these governments with planning for land use, four case studies were conducted of similar communities with nuclear power plants. The case studies were selected to show how areas of differing population densities, environmental constraints, and growth patterns have handled growth and development around sensitive facilities.

The four case studies chosen include:

- **Calvert Cliffs Nuclear Power Plant, Calvert County, Maryland**

  Calvert County has the lowest population density of the four case studies. There are numerous environmental constraints present in Calvert County; however, the population is increasing at rates that exceed growth within Wake County. Calvert County is largely rural, much like the Harris Lake Drainage Basin, and evidences similar characteristics. Several of the lessons learned from the experiences of Calvert County might be applicable to Wake County.

- **McGuire Power Station, Mecklenburg County, North Carolina**

  This area was selected as it is relatively well known in North Carolina and can be a useful case study to understand how other jurisdictions within North Carolina have handled growth and development near sensitive facilities. The area is experiencing growth rates similar to those in Wake County.

- **Limerick Generating Station, Montgomery County, Pennsylvania**

  Unlike the previous two case studies, the area around the Limerick Generating Station is quite developed. This area was selected for comparison as there are still pockets of rural land use existing in close proximity to the Plant. The governmental structure in the Limerick area is quite different from that of Wake County which provides guidance as to what types of policies are easier to implement with fewer local governments.

- **Indian Point Energy Center, Westchester County, New York**

  The area around the Indian Point facility is the most heavily developed of the four case studies. As the plant is located near New York City, it has received extensive media coverage of the risks associated with nuclear power generating facilities. This case was selected to illustrate methods that are being used to inform residents of evacuation planning as some innovative methods have been developed by the counties within 10 miles of the plant.

All four case studies contribute information that might be useful to local policy makers as they determine how best to accommodate development, preserve sensitive natural resources, and protect residents in the Harris Lake Drainage Basin.

Case Study Organization

Each of the four case studies is analyzed on the following eight factors:

1. Demographics
2. Land Use
3. Environmental Resources
4. Governance
5. Growth Management
6. Property Ownership
7. Infrastructure
8. Emergency Preparedness

And each case study is summarized under “Lessons Learned”. A summary of lessons learned from all four case studies is included at the end of this section.

NRC Emergency Planning Requirements

The Nuclear Regulatory Commission (NRC) as the agency responsible for informing the public of an emergency at a nuclear facility has established principles for emergency management planning around power plants. The NRC has established four event levels to indicate the

severity of an emergency at a nuclear facility. The levels are explained in order of increasing severity:

- Unusual Event – Any event that is out of the ordinary is reported to federal, state, and local authorities. This type of event does not pose any danger to the public, but notification is made so that the situation can be monitored in case it worsens. No response is necessary at this level.
- Alert – This level is only reached if there is an actual or possible reduction in plant safety. State and County emergency officials are notified and kept up to date. State emergency agencies would recommend public action. This classification would allow emergency management officials to alert and ensure that additional emergency response personnel are available to respond if needed.
- Site Emergency – An incident at this level indicates that conditions at the site have worsened such that a radioactive release to the air or water is possible. State and County Emergency Operations Centers would be staffed. Precautionary measures such as the closing of parks and schools might be required. Sirens would most likely be sounded to alert residents to listen to the radio for further information.
- General Emergency – This level indicates that many safety systems have failed and would lead to the release or the threat of release of radiation. State and County emergency officials would direct protective actions for residents living near the plant. People would be instructed to take shelter indoors or to evacuate.

After the Three Mile Island incident at the Three Mile Island Plant outside Harrisburg, PA, *"The President's Commission on the Accident at Three Mile Island"* (often referred to as the "Kemeny Commission") that investigated the incident noted the need for better emergency management planning. Consequently, each nuclear facility in the United States is now required to have in place an approved emergency plan for the evacuation of the public within ten miles of the facility. There is not official guidance, however, for land use planning around nuclear facilities.

Security Issues

In preparing the case studies it was interesting to note how issues between public safety, facility security, and land use planning were handled. In general, while all plants had evacuation plans, these plans

often did not highlight at-risk populations nor provide any additional information on evacuation times. The visitor centers at most plants were also closed to the public or could only be visited by groups on a pre-arranged basis. It was also not possible to obtain routing estimates or evacuation times for the individual facilities.

Case Study #1

Calvert Cliffs

Calvert County, MD

General Overview

Calvert County, Maryland has seen explosive population growth over the past few decades. The area has transformed from a rural county primarily dominated by agriculture, specifically tobacco as evidenced by the presence of a tobacco leaf on the County's official flag, to a bedroom suburb of the Washington, DC and Baltimore, MD metropolitan areas. According to the Maryland State Data Center and US Census Bureau figures, the County has the highest commute time of 39.8 minutes out of all the counties in Maryland. This statistic provides some measure of the increased draw of employment centers outside the County.

10 mile radius of Calvert Cliffs

The County is home to the Calvert Cliffs Nuclear Power Plant situated on a 2,300 acre site on the Chesapeake Bay. The plant is surrounded on the north by the Calvert County Flag Ponds Nature Center and on the

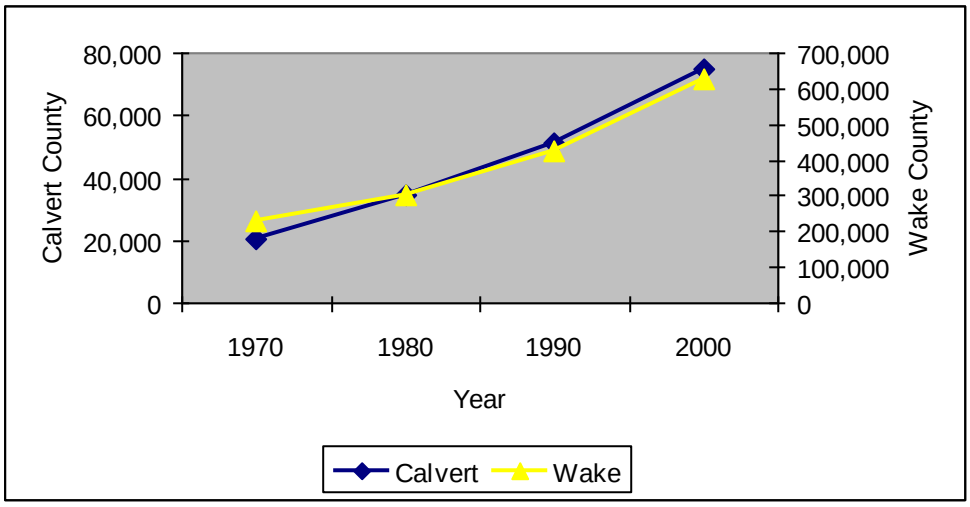
south by the State of Maryland Calvert Cliffs State Park. The two facilities combined provide an additional 1,956 acres of open space around the plant. In addition to Calvert County, portions of both Dorchester and St. Mary's counties are within ten miles of the plant.

Demographics

The population of Calvert County in 2000 was 74,563 persons, of whom 62,578 (83.9%) were White and 9,773 (13.1%) were Black/African American. The median household age was 35.9 years, with 59.1% of the population between 20 and 64 years of age. In 2000, 8.9% of the population was more than 65 years of age, 25.1% were between 5 and 19 years of age, and 6.8% were below 5 years of age.

The population of the County grew by 53,881 persons or 260.5% between 1970 and 2000. The fastest 10-year period of growth during this time was from 1970 to 1980 when the population grew by 13,956 persons or 67.48%.

Figure 1: Population Growth Comparison of Calvert and Wake Counties



Source: US Census.

Although Calvert County has a much smaller population than Wake County, as Table 1 indicates, both counties have experienced rapid growth over the past 35 years. However, it appears that Calvert County already has been through its most rapid growth period at rates that exceed those of Wake County. Calvert County is physically smaller (215 square miles) than Wake County (834 square miles), but larger than the

Harris Lake Study Area (61 square miles). The overall more rural nature of Calvert County is more similar to the state of development within the Harris Lake Drainage Basin than to the more urbanized areas of Wake County and as such represents a comparable study area.

Table 1: Population Comparison Calvert and Wake Counties

	Calvert County		Wake County	
Year	Population	% Change from Previous Census	Population	% Change from Previous Census
1970	20,682		229,006	
1980	34,638	67.48%	301,429	31.62%
1990	51,372	48.31%	423,380	40.46%
2000	74,563	45.14%	627,846	48.29%

Source: US Census.

Land Use

Maryland delegates land use authority to counties and municipalities within the state. Zoning was enacted in Calvert County in 1967 and the County's last Comprehensive Plan Update was in 2004. As there are only two municipalities within Calvert County, both of which lie beyond 10 miles from the nuclear power plant, the County maintains primary land use authority in the area closest to the Calvert Cliffs Plant.

The Calvert County seat, Prince Frederick, is located 46 miles southwest of Washington DC and 64 miles south of Baltimore, MD. The proximity to these two metropolitan areas, combined with availability of land, rural character, lower cost of living, waterfront, and low crime, attract new residents to Calvert County. The County is also within commuting distance of Annapolis, MD (the State Capital twenty miles to the north) and the Patuxent Naval Air Station. The Station is located in Lexington Park in St. Mary's County across the Patuxent River via the Thomas Johnson Bridge from Calvert County and is anticipated to grow due to Base Realignment and Closure activity. These later two employment centers have further increased the County's attractiveness to new residents.

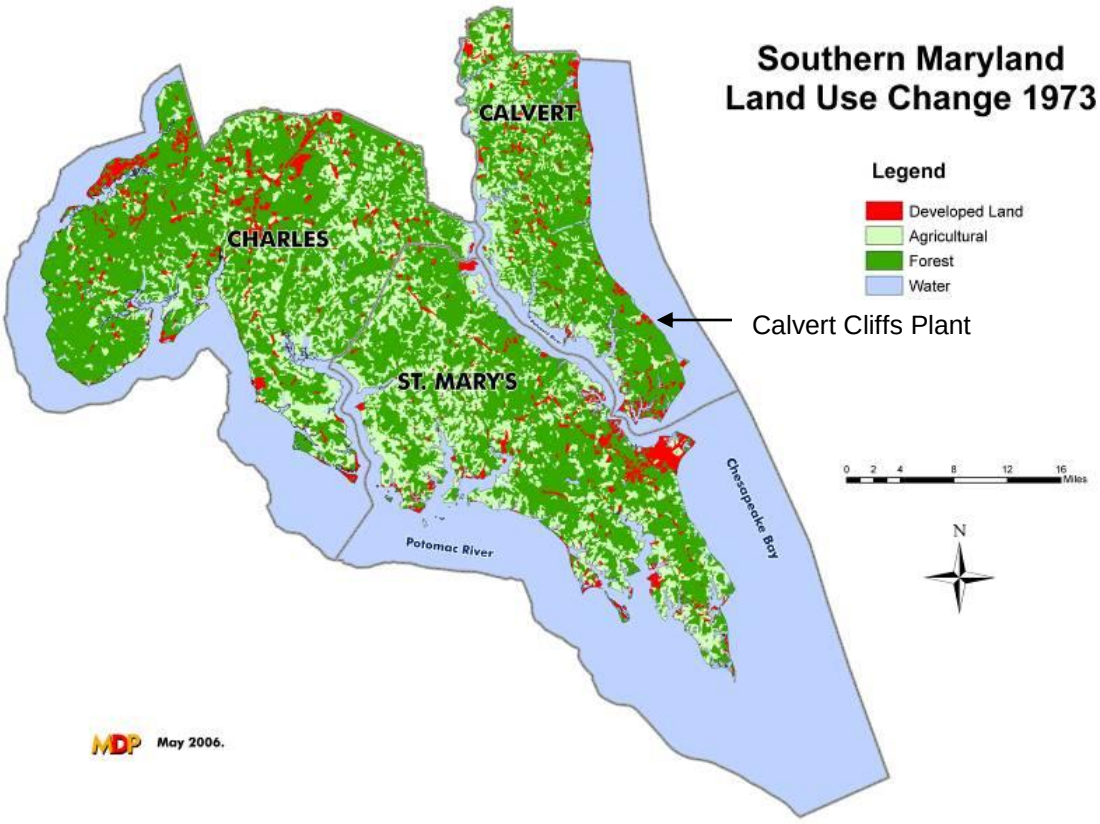
1990 Land Use in Calvert County

Employment growth has been a catalyst for residential growth, but two events in particular have facilitated growth in Calvert County: widening improvements to Maryland State Routes 2 and 4 and the State's tobacco

buyout program. These highway projects improved accessibility while the tobacco buyout program increased the likelihood of farms being sold as it became more difficult to profit from farming.

Calvert County's planning has generally maintained the County's rural land use patterns. Large tracts of farmland still exist and natural areas are found throughout the County, especially along the Patuxent River and Chesapeake Bay. Pockets of concentrated development are located at the town centers though there are still scattered residential subdivisions. The Calvert Cliffs Nuclear Power Plant is located in an area zoned for light industrial use (I-1) where the facility is a special exception use.

Figure 2: Land Use in Southern Maryland in 1973



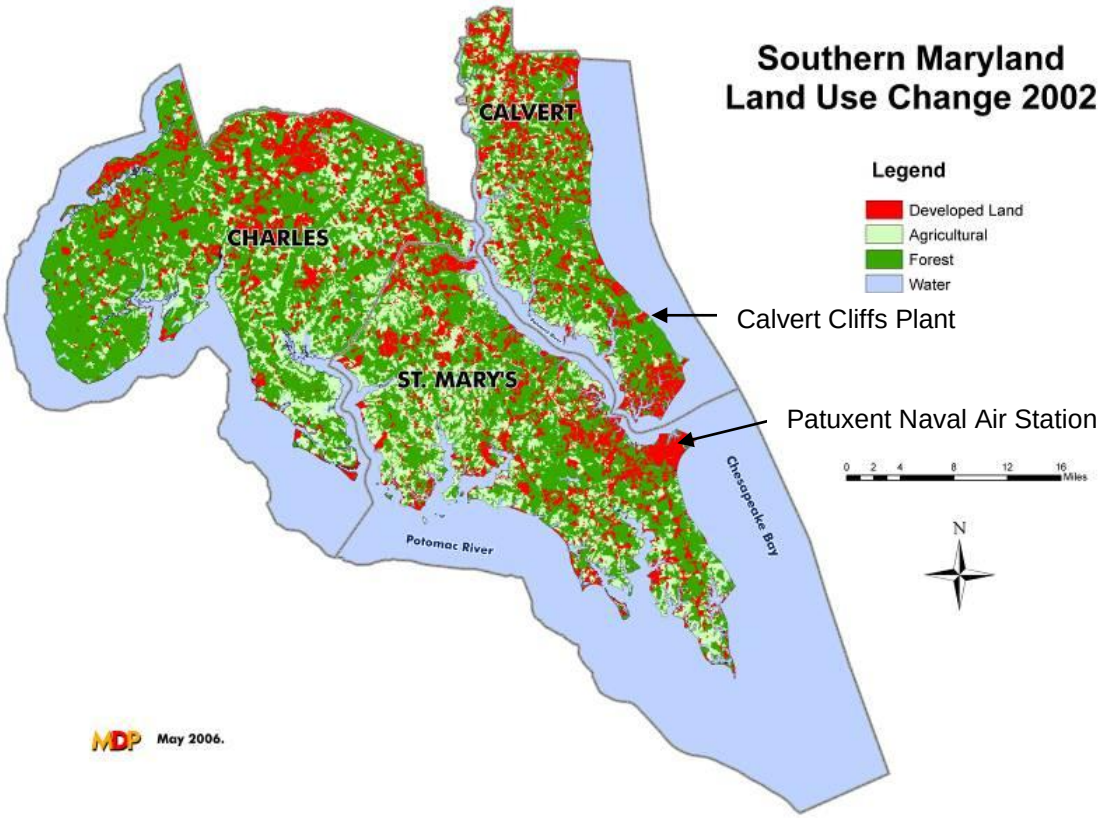
Map courtesy of the Maryland Department of Planning

The Calvert Cliffs Plant began operation on July 31, 1974 and was the first nuclear power plant to receive a license extension (20-years) from the U.S. Nuclear Regulatory Commission in 2000. The plant currently consists of two separate reactors, the second of which began operation

on November 30, 1976. Constellation Energy owns and operates the plant which only occupies 380 acres of the 2,100 acre site. The bulk of the land surrounding the plant has been maintained in a natural state. In addition to this land, both the State of Maryland and Calvert County maintain parkland immediately adjacent to the lands owned by Constellation Energy.

Calvert County owns and maintains Flag Ponds Nature Park (327 acres) immediately north of the plant, while the State owns and maintains Calvert Cliffs State Park (1,629 acres) for a total of nearly 2,000 acres of additional undeveloped land around the Plant. These lands are bounded by the Chesapeake Bay to the east and Maryland Route 2-4 to the west. On the west side of Route 2-4, is the small rural community of White Sands that provides water service and has a population of approximately 500 people. There is a middle school, Southern Middle School, located south of the plant on the east side of Route 2-4 that is surrounded by Calvert Cliffs State Park.

Figure 3: Land Use in Southern Maryland in 2002



Case Studies

Map courtesy of the Maryland Department of Planning

The County and State-owned park lands are within Calvert County Farm and Forest District (FFD) where development is limited to 1 unit per 20 acres following a recent down zoning. However, landowners within this zone can create lots under the County's Transfer of Development Rights (TDR) program which can be sold to increase density in the County's Town Center and Residential Districts. The FFD extends across MD Route 2-4 towards and up to the Patuxent River. Across MD Route 2-4 are two small pockets of Rural Community (RCD) and Residential Zoning (RD). The RCD zoning also extends across the peninsula just north of the Flag Ponds Nature Center. Base density in the RCD is one unit per 20 acres, though the density can be increased through purchase of TDRs. The RD zoning has a base density of one unit per 4 acres, though this density too can be increased through purchase of TDRs.

Calvert Cliffs
Source: Smithsonian

Environmental Resources

Due to its peninsular geography, Calvert County contains many environmental resources that have contributed to the County's character and attracted new residents. The most notable of these are the Chesapeake Bay and the Patuxent River Estuary. Both are tidal waters and development near them is limited by Maryland's Critical Area Law which regulates building within 1,000 feet of the shoreline of the bay and its tributaries. In addition, the law prohibits most new development within 100 feet of the bay. The many creeks and inlets in the County offer prime habitat for land and marine based species and are a major recreational asset. The bay and river are both prime grounds for crab and other seafood.

The geography of Calvert County has also played a role in its growth as a farming community. The peninsula is more wooded and ends in steep cliffs of between 125-135 feet towards the Chesapeake Bay while fields generally slope downwards from this ridge towards the Patuxent River. The western part of the County, with more level topography, is often referred to as "bottom land" that is generally more productive than other parts of the County. This area of the County rises to between 10 to 40 feet above sea level.

Calvert County Farm (notice the Tobacco barn)

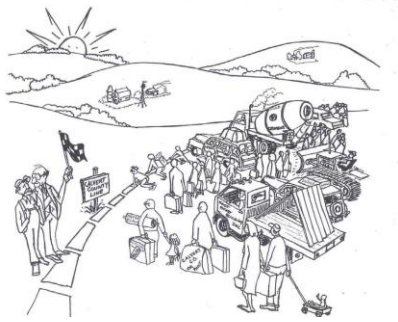
In 1999, Calvert County increased the goal for permanently preserved land from 20,000 to 40,000 acres. As of June 2007, the County has preserved over 24,000 acres either in State and County park land, the

Case Studies

Maryland Agricultural Land Preservation Foundation (MALPF - the State's agricultural land program), the State's Rural Legacy Program, or the County's agricultural land preservation program. Preservation efforts have greatly increased in recent years, which may have offset some development on former tobacco farms. Since 1999, Calvert County has allocated an additional $2 million per year toward land preservation with $500,000 directed to the Purchase and Retirement (PAR) Fund, $500,000 in local support to the MALPF, and $1 million to a new County leveraging program.

Governance

Calvert County is governed by a 5-member Board of County Commissioners elected to staggered 4 year terms. The Calvert County Planning and Zoning Department is responsible for planning areas outside of municipal jurisdictions.



Cartoon from the 1970's
(Source: Calvert County)

Calvert County began to experience the first waves of growth in the early 1970's. Recognizing the threat of development to the rural character of the County, in the 1974 Comprehensive Plan County Commissioners decreased lot density in rural areas to one house per five (5) acres, developed a transfer of developable rights (TDR) program, and adopted a voluntary clustering program. As growth continued, the 1983 Comprehensive Plan addressed residential sprawl and strip commercial development. The County Commissioners implemented the 1983 Plan by adopting a town center concept for development, the State's agricultural land preservation program, and adequate public facilities ordinances; establishing mandatory clustering; creating protection areas for preservation; and beginning to purchase and retire development rights.

Dunkirk Town Center

The town center concept seeks to promote mixed use development around seven population centers to avoid scattered and/or strip commercial development along MD Route 2-4 and to reduce growth within agricultural and forest areas. To achieve this goal, the County also rezoned areas within a one mile radius of the town centers to allow for higher densities which could be achieved through the purchase of Transferable Development Rights (TDRs). These actions were intended to steer new single-family and higher density residential development to town centers.

Case Studies

As a result, town centers have evolved into community centers with offices, businesses, and residences and development of mixed uses to promote economic development, create jobs, expand cultural opportunities, reduce traffic congestion, prevent strip commercial development, provide a full range of housing opportunities, and provide convenient access to goods and services to County residents. These actions have resulted in more compact and efficient development patterns that minimize costs to provide support infrastructure such as water, sewer, schools, and roads. The town centers also reinforce the TDR program by clearly defining areas into which development rights can be transferred.

St. Leonard Town Center

During the 1997 Comprehensive Plan Update, Calvert County renewed the commitment to the town center concept and rural preservation efforts. The 1997 Plan also addressed issues relating to traffic capacity on MD 2-4, school costs, and environmental impacts. The plan presented various build-out scenarios along with road and school improvements that would be required to accommodate growth. As a result, the 1997 Plan reduced the County's ultimate build-out goal from 54,000 households to 37,000 households, reduced the annual rate of growth from 3.7% in 1997 to 1.9% in 2005, strengthened the commitment to land preservation, and directed growth to appropriate locations. Calvert County also updated the zoning ordinance to further reduce density in rural areas that effectively limited new subdivisions to a density of 1 unit per 20 acres. As a result, in 2005 only 1% of newly developed lots were within protection areas.

The latest 2004 Comprehensive Plan Update includes new goals to evaluate and improve regulations; streamline plan review; provide better protection to the environment; promote agritourism, ecotourism, and heritage tourism; and promote affordable housing. Calvert County has continually monitored development and updated comprehensive plans to address both new state requirements (discussed later) and evolving local concerns.

Calvert County is also a member of the Tri-County Council for Southern Maryland which is comprised of Calvert, Charles, and St. Mary's counties. The group was established in 1964 to better coordinate development and planning activities among the counties. The Council serves as a forum to resolve region-wide issues and to attain regional goals. The Council is also responsible for regional transportation, regional transit service

coordination, regional transportation plan development and implementation, and air quality planning. As the main regional planning organization in southern Maryland, the Council has improved coordination and region wide planning among the three counties.

Growth Management

Farm in Calvert County

The key components of growth management within Calvert County have been efforts to preserve agricultural and rural land and to embrace the town center concept. The primary means for land preservation are the County's Purchase of Development Rights (PDR) and Transferable Development Rights (TDR) programs and State programs such as the Maryland Agricultural Land Preservation Foundation (MALPF) and Rural Legacy. These efforts began in earnest after the 1983 Comprehensive Plan Update and are now beginning to achieve many of the County's stated goals.

County efforts at growth management have been complimented by Maryland State Law and policies. Although county and municipal governments maintain control over land use planning, the State of Maryland plays an influential role in planning. The 1992 Economic Growth Resource Protection and Planning Act articulated seven visions (an eighth vision was added in 2000) of Smart Growth Planning for Maryland. State law requires that all eight visions be incorporated into all local comprehensive plans. The law also mandates that local plans be reviewed, and if needed, updated every six years.

Subsequent to the 1992 law, Maryland passed the 1997 Priority Funding Areas (PFA) Act. This Act provided a geographic focus for State investments in growth related projects such as roads, water and sewer, economic development, and construction of new state facilities. Existing communities and areas in counties that met density, water and sewer availability, and other requirements were designated as growth areas in which the State would spend money on public improvements. In 2006, the law was amended to require that municipal and county comprehensive plans include a water resources element that relates planned growth to the availability of water resources for both safe drinking water and waste disposal, and to require designation of municipality annexation areas. In addition, the law required counties that have been certified by the MALPF program as meeting certain criteria to designate

priority preservation areas in order to continue receiving additional state funding for land preservation. The law also outlines how workforce housing can be incorporated into local plans.

Calvert County has been certified by the MALPF program and receives greater funding for land preservation through the state program. In addition, the town centers meet PFA requirements and the preservation areas in the County meets the criteria specified in State Law. Due to age, approximately 4,100 parcels of land (or one-quarter of potential future households) that were subdivided in the late 1960's and early 1970's are exempt from most current subdivision and planning regulations (except those regulations related to public health and safety). The County is currently working to address the issues these parcels raise. There are also approximately 1,300 acres of undeveloped land in scattered locations in rural parts of the County. These areas were zoned prior to the policy directing growth to designated town centers. The County is working with these landowners to enroll the properties in land preservation programs or to serve as receiving areas for TDRs.

Property Ownership

In addition to the land for the Calvert Cliffs Plant, Constellation Energy owns 2,100 acres of surrounding land which has not been developed and is maintained as a buffer to the nuclear power facility. The County and State own significant lands that are maintained as park, some of which further buffer the plant from adjacent development. The State maintains the Jefferson Patterson Park and Calvert Cliffs Park. The County maintains Flag Ponds Nature Park, King's Landing Park, Battle Creek Cypress Swamp Sanctuary, Hughes Memorial Tree Farm, Hutchins' Fishing Pond and Biscoe Gray Reserve in addition to the Breezy Point Beach and Campground. Private property in the area is largely residential or farmland.

Infrastructure

Calvert County maintains most roadways within the County. The most notable transportation feature in Calvert County is Maryland Route 2-4, which is maintained by the Maryland Department of Transportation as a divided, dual lane highway. This roadway runs roughly north-south through the middle of the County.

Maryland Route 2-4

Maryland State Law requires that each County prepare a water and sewer plan that must be updated every 10 years. The plan demonstrates how the County will provide adequate water and sewer service to support planned redevelopment and new growth. The plan must be consistent with the local comprehensive plan and must be approved by the Maryland Department of the Environment. The most recent Calvert County water and sewer plan shows water and sewer service in some areas of the County (which would fall into the PFA areas); however, the majority of the County is not served by public water and sewer. Given the constrained peninsular geography, the County obtains most of its drinking water from groundwater sources, mostly from the easily accessible high yield aquifers. These aquifers are generally below regulatory thresholds for management, but as future growth will require additional withdrawals, the County is monitoring the aquifers to ensure they are able to be maintained as drinking water sources.

Except for a few wastewater treatment plants, most residences rely on septic tanks to dispose of waste water. These tanks may be a concern for the County in the future as total maximum daily load (TMDL) requirements are being considered by the Maryland Department of the Environment for watersheds as part of the Chesapeake Bay program.

Emergency Preparedness

Both the Calvert Cliffs Nuclear Power Plant and the Dominion Cove Point Liquid Natural Gas facility are located in Calvert County. Both facilities are mentioned in the Comprehensive Plan in the land use and property ownership chapters and in more detail in the energy component of the Plan. Detailed information on evacuation routes for incidents at these facilities, as well as for natural events, is found in the Calvert County Emergency Management Plan. The main natural events of concern are hurricanes, floods, tornadoes, and winter storms. Calvert County has a highly-trained and very pro-active emergency management division.

Although the Calvert Cliffs plant is located within Calvert County, portions of both St. Mary's and Dorchester counties are within 10 miles of the plant. Dorchester County lies across the Chesapeake Bay from Calvert County on the Eastern Shore of Maryland. St. Mary's County is across the Patuxent River south of Calvert County.

Most public information concerning an evacuation event due to an incident at the Calvert Cliffs Plant is on the Constellation Energy website. The area within the 10-mile radius is divided into eight evacuation zones, which allows authorities to phase protective actions and better guide residents to appropriately sized reception centers. Different evacuation routes and reception centers are identified for each zone.

Lessons Learned

Calvert County has received numerous accolades for its growth management efforts. Here are a few lessons learned from Calvert County that may apply to the Harris Lake Area:

- **Few planning agencies.** Calvert County retains land use control over most of the land within county boundaries making it easier to manage transitions from developed areas to preserved areas. Given that there are only two municipalities within the county, there are fewer agencies to coordinate in order to ensure that population centers and associated densities complement surrounding rural areas.
- **Buffering.** Whether intentional or not, the County and State parks that surround the privately-owned lands associated with the Calvert Cliffs Plant provide additional buffering between the plant and residences. This helps reduce the number of people who could be impacted by an incident thereby reducing the number of people who may need to evacuate during an incident.
- **Long-term planning**. The County is only recently seeing how concepts first proposed several years ago are coming to fruition. It has taken about 20 years, since the 1983 Plan Update, to see developments fully realized.
- **Constant evaluation.** Calvert County has continually monitored and modified plans to reflect changing conditions. As development occurred and impacts were felt, the County modified planning goals.
- **Comprehensive.** The County made efforts to both preserve land and increase density. Both preservation and development areas were clearly delineated, which aided the development and success of the TDR program.

- **Grew with facility.** County zoning was implemented at the same time the nuclear power plant was being developed. This allowed the County to shape development regulations around the plant rather than having to modify regulations to accommodate the plant.
- **Road growth.** The improvements of highway access greatly increased County growth rates.
- **Adapting to changes in agriculture.** As the State tobacco buyout program began, Calvert County more aggressively funded land conservation efforts. These efforts have helped preserve farmland that might have otherwise been developed.
- **Environmental regulations.** As environmental regulations become more stringent, local governments must consider how to minimize the impacts of stormwater run-off and on-site sewage treatment. Compact development may make it less costly to provide centralized water and sewer if on-site septic systems are no longer feasible on a large scale.
- **Focused investments.** Maryland policies focus investments in infrastructure to reduce overall costs of the systems for the County. Growth decisions, notably the reduction in build-out density, in part have been made based on the costs to provide roads and schools to meet population demands.

Case Studies

*Photo courtesy of Maryland Bay Area website – (www.thebaynet.com)

McGuire Nuclear Power Station

Mecklenburg County, NC

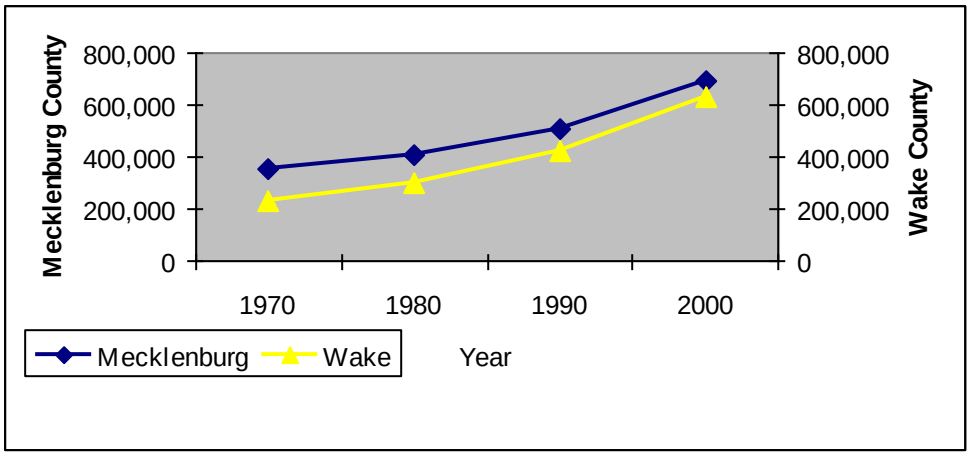
General Overview

The McGuire Nuclear Power Station, located in the Town of Huntersville, Mecklenburg County, North Carolina, is seventeen miles northwest of the City of Charlotte. The facility is located on Lake Norman, a 32,500-acre lake created by Duke Power in 1963 for the Cowans Ford Hydroelectric Station. Parts of five counties fall within the 10-mile Emergency Preparedness Zone (EPZ), however the majority of population is located in Mecklenburg County and to a lesser degree in Lincoln County.

Demographics

In 2000, the population of Mecklenburg County was 695,454 persons, of whom 445,250 (64.0%) were White; 193,838 (27.9%) were Black/African American; and 21,889 (3.1%) were Asian. The median age was 33.1 years, with 66.3% of persons between 18 and 64 years of age. 8.6% of the population was above 65 years of age, 17.8% were between 5 and 17 years of age, and 7.3% were below 5 years of age. The population grew by 184,121 persons or 36.0% between 1990 and 2000 and has remained in the top 50 fastest growing cities in the United States since the early 1980's. The 2006 population was estimated to be at 827,445[1] and could reach one million by 2010. Mecklenburg County and Charlotte have seen the same type of population growth patterns as Wake County and Raleigh during the same time frame. The City of Charlotte accounts for 46% of the land mass and 78% of the population of Mecklenburg County.

Figure 4: Population Growth Comparison -Mecklenburg and Wake Counties



Source: US Census.

Table 2: Population Comparison Mecklenburg and Wake Counties

	Mecklenburg County		Wake County	
Year	Population	% Change	Population	% Change
1970	354,656			
1980	404,270	13.99%	301,429	
1990	511,433	26.51%	423,380	40.46%
2000	695,454	36.0%	627,846	48.29%

Source: US Census.

Mecklenburg County is the most populous county in North Carolina and Charlotte is the most populous city, Wake County and the City of Raleigh are second, respectively. The growth that has and is anticipated to occur in Mecklenburg County almost mirrors that of Wake County. Although slightly more developed at the time the McGuire Plant was built, the Lake Norman area of Mecklenburg County has grown up around the plant.

Land Use

The first unit of the McGuire Nuclear Power Plant began operation in July 1981 and the second unit went online in May 1983. Duke Energy, which owns and operates the plant, owns approximately 568 acres. The bulk of this land is maintained in a natural state. The plant location is north of NC 73 and is generally bounded by Lake Norman on the remaining sides. The plant uses water from Lake Norman to cool the steam that drives the turbines.

The power plant area is zoned Special Purpose District (SP), a zone which was established by the Town of Huntersville to accommodate uses that may constitute health or safety hazards, have greater than average impacts on the environment, or diminish the use and enjoyment of nearby property by generation of noise, smoke, fumes, odors, glare, commercial vehicle traffic, or similar nuisances. Because uses permitted in the SP District vary as to their impacts on the community, they may likewise vary as to effective mitigating conditions. Therefore the SP District exists as a General Zoning District but will frequently benefit from application as a Parallel Conditional Zoning District. The conditional zoning district system allows for special conditions to be imposed when property is rezoned.

The northern part of the Duke Energy property is zoned for and has been developed for office space directly related to the plant. The McGuire fishing area is located at the northern tip of the property. Immediately adjacent to and south of the plant, land zoned as Open Space is designated as the Cowans Ford Wildlife Reserve. While the Town of Huntersville has no official future land use map, the NC 73 Land Use Corridor Plan designates the Wildlife Refuge to remain park/open space.

Along the lakefront to the east, the land is zoned General Residential and is utilized for residential uses. As described in the Huntersville code of ordinances, the General Residential zone permits the completion and conformity of conventional residential subdivisions already existing or approved prior to the development regulations adopted June 2007. Density in the General Residential District is determined by the latest approved subdivision. Within this zoning district, three subdivisions, each with between 20 and 50 lots, have been approved approximately one mile east of the plant, between NC 73 and Lake Norman. Within a two- mile radius of the plant, there are over 600 single-family subdivision lots located east along the shores of Lake Norman and to the south of the plant.

Properties located southeast of the plant are generally zoned Rural Residential which was established to encourage the development of neighborhoods and rural compounds that set aside significant natural vistas and landscape features for permanent conservation. Rural Residential density is regulated on a sliding scale; permitted densities rise with increased open space preservation. Development typologies associated with the Rural Residential District are farms, the single family house, the conservation subdivision, the farmhouse cluster, and the residential neighborhood. Rural residential lots must average at least 2 acres while no lot can be less than 1.5 acres. Adjacent property to the west in Lincoln County is similarly zoned.

Rural residential seems to be a more appropriate zoning classification for the area directly around McGuire as opposed to General Residential which is located along the shores of Lake Norman. Rural residential is more likely to retain rural character, minimize population densities and limit commercial growth which will help preserve environmental resources and ease potential emergency situations. However, high demand for

residential uses along the shores of Lake Norman has led to the advent of higher density subdivisions.

Across Lake Norman to the north a large peninsula juts out from the Town of Cornelius. These properties are built out as low density single family residential properties. Overall, low density residential is permitted adjacent to the Special Purpose District, although zoning does not appear to have been directly influenced by the proximity of the McGuire Plant.

Environmental Resources

Rapid growth in the Charlotte-Mecklenburg County region and in areas around Lake Norman has threatened to compromise the rural character that has protected environmental resources. In recent years, the region has taken numerous measures to protect these resources. Lake Norman and Mountain Island Lake, the Catawba River (damned by Duke Power to form the lakes), along with the many tributaries to the river are the major environmental features in the region. Lake Norman is one of eleven lakes that compromise the Catawba River System. The Cowans Ford Dam that forms Lake Norman is located at the headwaters of Mountain Island Lake, which supplies drinking water to residents of Mecklenburg and Gaston counties.

The Catawba Rivershed area around Lake Norman and Huntersville is part of the Mountain Island Lake Watershed Protection Area (WPA) which is the area within Mecklenburg County that contributes surface drainage to Mountain Island Lake. The intent of the Mountain Island Lake Watershed Overlay District (WOD) is to protect public drinking water supplies as required by the N.C. Water Supply Watershed Classification and Protection Act (G.S. 143-214.5). The Mountain Island Lake WOD supplements the regulations of the underlying zoning district to ensure protection of public drinking water supplies. All regulations for the underlying zoning district continue to remain in effect for properties within the WOD.

The Charlotte-Mecklenburg County area and other area counties and municipalities have engaged Duke Energy as a community partner. Duke Energy, which is responsible for the Cowan Hydroelectric Plant and both the McGuire and Catawba (South Carolina) Nuclear Power Plants, has played an active role in environmental resource protection. Duke Energy

provides land for open space and parks including Norman Lake State Park and maintains a Shoreline Management Plan for the Catawba River shed that includes Lake Norman. The Shoreline Management Plan, updated in 2006, includes present and future uses of project lands and waters, shoreline management guidelines, and maps of the reservoirs, which among other data locate environmentally sensitive (and protected) shoreline areas.

Recognizing that energy facilities can have major impacts on communities and their environments, it is important that communities engage energy companies as community partners. Large corporations have the capability to contribute through planning, civic leadership, community outreach, and education. As a willing partner, utility leadership can foster a relationship that provides residents with a transparent view of operations and realistic awareness of potential problems.

Governance

In the 1980s, the City of Charlotte and Mecklenburg County consolidated a number of public services, including planning and building services to form the Charlotte-Mecklenburg Department of Planning and Zoning. Planning services were consolidated to improve coordination and service delivery efficiencies. The Charlotte-Mecklenburg Planning Commission serves a major role in setting policy and approving land use development in Charlotte and unincorporated areas within Mecklenburg County.

Mecklenburg County, along with nine other counties, is a member of the Centralina Council of Governments (COG), the state designated lead regional organization for the area in and around Charlotte. The Centralina COG serves as a conduit for grants, a staff resource for members, and a forum for local governments to address current problems and future needs. The Centralina Board of Delegates is comprised of elected officials from the municipalities within the nine-county region. The COG serves as a resource for land use, zoning, water, and community development and serves as a regional clearinghouse for related demographic information. The McGuire Nuclear Power Plant is part of the Charlotte-Mecklenburg metropolitan region which has been experiencing well documented suburban sprawl and growth pressures particularly over the past twenty years.

Historically, annexation has accounted for most of the population growth in Charlotte as it has in the smaller municipalities of Mecklenburg County. From 1950 to 1995, Charlotte grew sevenfold from 30 square miles to 212 square miles. Most of the remaining undeveloped land soon will have been annexed and this growth pattern will not be able to continue.

In 1959, the North Carolina State Legislature revised laws that govern how cities may annex adjacent areas, allowing municipalities to annex unincorporated lands without permission of the residents of those areas. In the ensuing decades, North Carolina cities have greatly expanded their borders. The original fifteen townships within Mecklenburg County, although still recognized by the census, are either within extraterritorial jurisdictions (ETJ) or have been annexed into Charlotte or other municipalities within the County. The annexation process in Charlotte is described by the Charlotte-Mecklenburg Planning Department as the methodical extension of a city's boundaries into adjacent unincorporated areas and the corresponding extension of that city's services to the areas encompassed in the new boundaries. The City of Charlotte, which systematically performs involuntary annexations on a 2-year cycle, has used annexation to double the size of the city since 1980. In order to qualify for involuntary annexation, an area must meet strict state criteria for annexation including requirements regarding density, boundary of the area, and provision of public services.

Growth Management

Unprecedented growth over an extended period of time has led to a number of growth management and "smart growth" initiatives within Mecklenburg County, its towns and cities, and through regional cooperatives. Generally, however, growth initiatives do not take into account the McGuire Plant.

According to the Charlotte-Mecklenburg Planning Department, the overall population density decreased from 6.98 persons per acre in 1950 to 3.60 in 2000. Since 1980, Mecklenburg County has been losing open space at the rate of five acres per day. To address this issue, Charlotte-Mecklenburg planning has implemented TOD zoning districts and enacted a framework of growth centers and corridors. These planning steps are intended to focus growth in centers and corridors while

maximizing the use of the transportation system and existing infrastructure. The current vision is to achieve more compact growth while maintaining high quality urban design within livable neighborhoods.

There are six other incorporated cities and towns in Mecklenburg County of which Huntersville, Davidson, and Cornelius are located within the 10-mile emergency planning zone for the McGuire Plant. In 1996, the Town of Huntersville adopted a new zoning ordinance modeled along the principles of traditional town planning. The towns of Cornelius and Davidson have adopted similar policies, all intending to avoid the low density sprawl type growth seen in Charlotte.

During the period 1990 – 2000, Huntersville, just 12 miles north of Charlotte, had a population increase of 728%. Located along I-77 and Lake Norman, Huntersville initiated a strategic land planning effort in 1995 in an effort to preserve the small town quality of life. The Town enacted a one-year moratorium on development until a new code could be adopted. The new development code is performance based, with stringent urban design requirements. The code seeks to establish pedestrian-oriented public streets and is supportive of an integrated transit service with the City of Charlotte and other North Mecklenburg towns. Huntersville, approximately 64 square miles, combined with Davidson and Cornelius, govern approximately 100 square miles in the Lake Norman area.

Property Ownership

The majority of property around the McGuire Plant consists of privately-owned residential properties along Lake Norman and NC 73. Duke Energy owns the McGuire Plant property, the Cowans Ford Dam and hydroelectric plant, and associated utility transmission easements. Mecklenburg County and the State of North Carolina own large areas of open space and recreational land including the Cowans Ford Wildlife Preserve, Lake Norman State Park, and scattered recreational and open space facilities that cover 6,000 acres within the County.

Infrastructure

North Carolina Highway 73, owned and maintained by the State of North Carolina, is the primary roadway in the vicinity of the McGuire Plant. NC 73 is generally the only major east-west route within 10 miles of the

McGuire plant and is the primary link to other major roadways. Within Mecklenburg County, other major roadways include Interstate 77, parts of the planned I-485 corridor, US Highway 21, and NC Highway 115. Most of these highway run north-south with few major east-west numbered roadways within 10 miles of the McGuire Station.

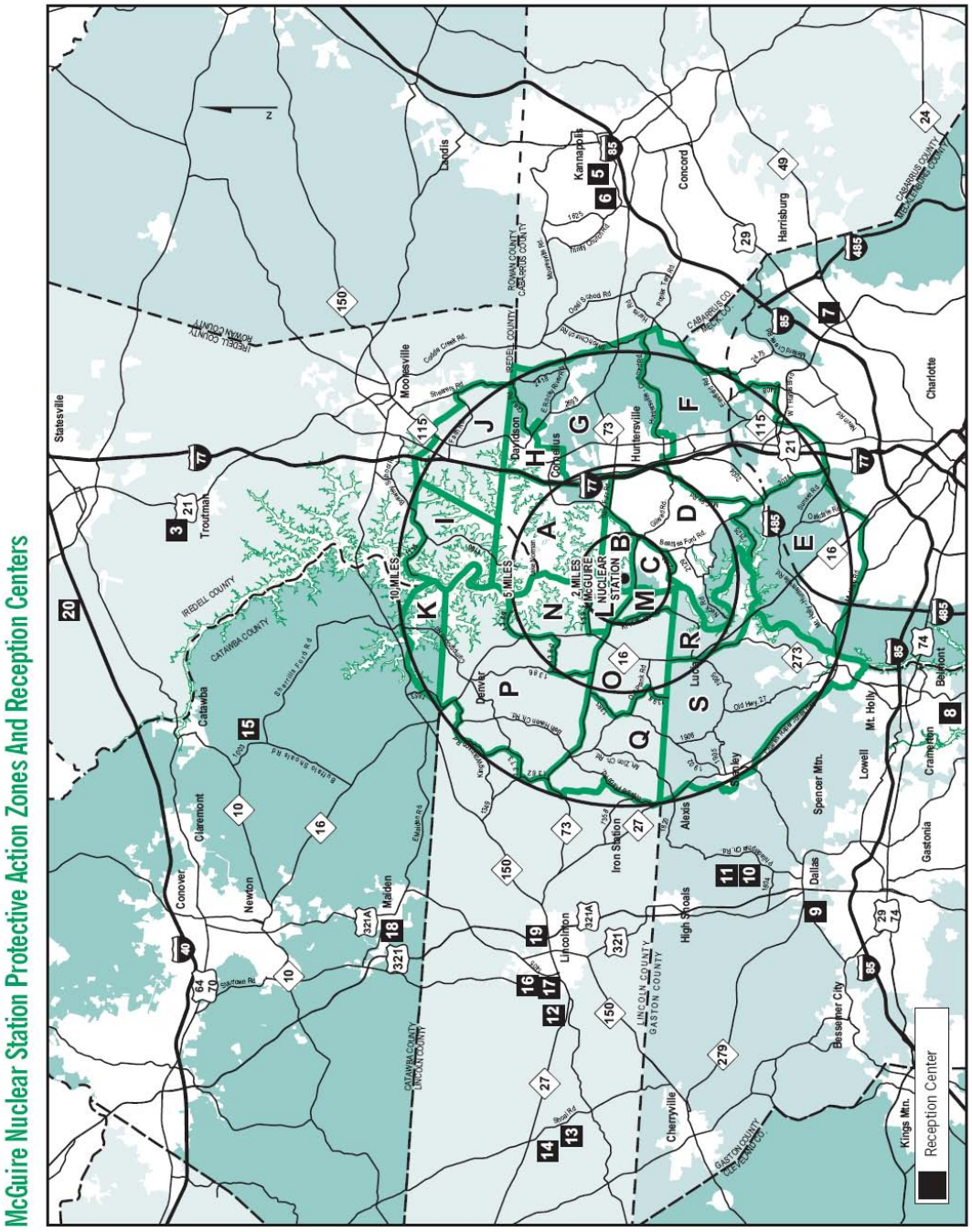
Transit service within the County is provided by the Charlotte Area Transportation System (CATS) which is managed by the Public Transit Department of the City of Charlotte. CAT routes 48X, 77X, and 83X provide service to parts of Huntersville and are the closest transit routes to the McGuire plant.

The wastewater system within Mecklenburg is primarily maintained and operated by the Charlotte-Mecklenburg Utilities District (CMUD) and serves Charlotte, Cornelius, Davidson, Huntersville, and unincorporated areas of the County. CMUD draws water primarily from Lake Norman and Mountain Island Lake.

Emergency Preparedness

Mecklenburg County and each of the municipalities within the County provide a link to the Duke Power website which contains step by step instructions for an emergency situation. Charlotte-Mecklenburg operates a broad-based, highly-trained emergency planning organization that is responsible for planning for and responding to an emergency event.

Figure 5: McGuire Emergency Management Plan



Lessons Learned

- **Multi faceted approach to growth management**. There is no one solution for effectively managing the enormous population growth and the impact that low density growth patterns have had on the Charlotte-Mecklenburg region. Surrounding communities have implemented a number of growth management techniques that will help maintain a high quality of life and curb suburban sprawl. Specific implementation activities include:
    - Strict rezoning process
    - Transit-oriented development
    - Focus on growth centers
    - Urban design requirements
- **Regional Cooperation**. Local governments near the McGuire Plant have recognized the importance of shared resources and the effects of poor policy on neighboring communities. Organizations such as the Centralina Council of Governments and the Lake Norman Region Economic Council have been successful at a regional level.
- **Rural/open space preservation.** During a period of unprecedented growth, the region has been somewhat successful in maintaining rural character through clear zoning policies and focusing development on "growth centers".
- **Streamlined government**. Annexation has led to land within Mecklenburg County falling under the jurisdiction of only a few governmental units. This accompanied with the merger of the City of Charlotte with Mecklenburg County to form a consolidated planning entity has made cooperation easier, allowed for "one stop shopping" of services, and provided consistency of policy.
- **Utilize energy corporation as a community partner**. While energy providers are sometimes characterized as faceless corporations their presence in the community is undeniable. It would be beneficial for communities to engage power corporations as Duke Energy has been engaged in Charlotte-Mecklenburg. Duke Energy has played a significant role in the preservation of open space and maintenance of the environment within the region.
- **Annexation.** Annexation policies have allowed the City of Charlotte and the Town of Huntersville to systematically grow while providing a high level of public services.

- **Source water protection.** While water quality has remained high, the region recognizes potential threats. A number of plans have been enacted to ensure this important resource remains protected.
- **No clear links between emergency management and land use.** While the comprehensive plans of some of the communities address the nuclear power plants as an industrial use, the plants are not addressed in depth in any of the community plans. Emergency planning for all the facilities was handled in a separate document making it difficult for most people to correlate the two issues. As the comprehensive plan is the framework for community growth, it would make sense to incorporate the findings of evacuation plans into planning policies.
- **Buffering.** Development will encroach close to nuclear power plants. Before this happens, it may make sense to purchase surrounding lands or restrict activities to minimize the impact of development immediately adjacent to plants. Doing this may ease evacuation planning as fewer people will need to be evacuated in case of an event and the adverse impacts of an incident at a plant would be minimized.
- **Remote may not be remote in 10 years.** In two of the case studies, Calvert County and Mecklenburg County, the plants were originally located in what were then considered remote areas. However, development caused by nearby employment centers generated residential growth. This growth will come and it is better to be proactive as it takes time to implement growth plans.
- **Details in evacuation planning.** All the plants studied had evacuation plans that detailed routes for residents to take in the event of an incident. The more detailed the plans are the easier it will be to steer residents effectively to shelters.
- **Advanced technology has a role.** As communities grow, the use of GIS and the internet can provide localized information to residents. Residents can be apprised of land use changes and obtain customized evacuation routes based on specific locations. This can be a great tool in areas that are highly built up or experiencing rapid change.
- **Proactive Land Use.** Where growth is anticipated, clustering and town center concepts should be incorporated well in advance of growth. Implementation of this type of planned growth requires

adherence to clearly defined planning policies to achieve the desired vision.

- **County and Municipal.** It is important to have established working relationships among county and municipal governments. If procedures are clearly spelled out and each party has distinct roles and responsibilities in planning efforts, potential future conflicts can be minimized.

Harris Lake Drainage Basin
Case Studies

Wake County, North Carolina

Limerick Generating Station
Montgomery County, PA

Case Study – McGuire, Mecklenburg County, NC

Case Study – Limerick, Montgomery County, PA

General Overview

The Limerick Generating Station is located in Limerick Township, Montgomery County, Pennsylvania, 20 miles northwest of Philadelphia. The 600-acre facility is located on the Schuylkill River from which it draws cooling water for the plant. Three counties and 42 municipalities fall within a 10-mile radius of the plant.

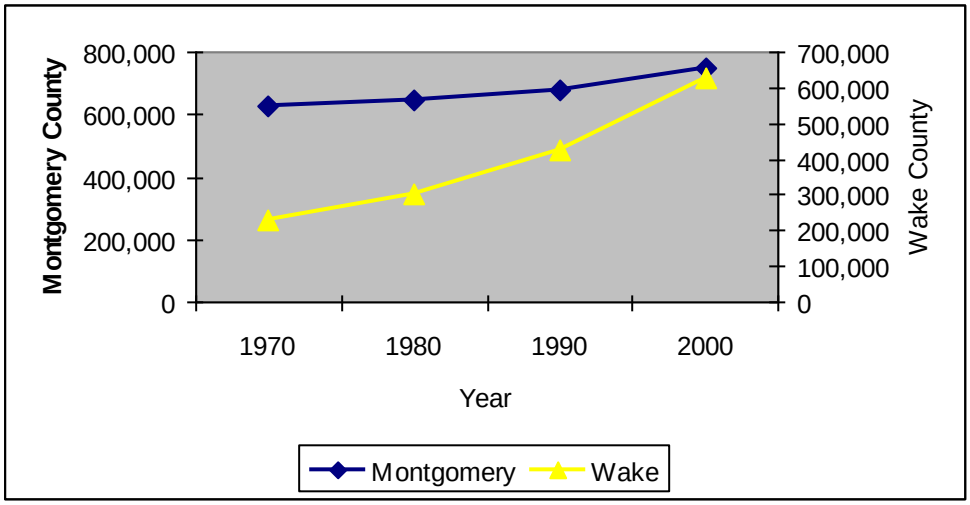
The first unit of the Limerick Generating Station began operation in February 1986 and the second unit went online in January 1990. Exelon Energy owns and operates the plant on an approximately 600-acre site. The bulk of the land surrounding the station has been maintained in a natural state. The station lies south of US Highway 422 and west of Limerick Center Road and is generally bounded by these roads and the Schuylkill River. There are still some scattered residential parcels within the area.

Limerick Generating Station
(photo: Berks County)

Demographics

In 2000, Montgomery County had a population of 750,097 persons, of whom 648,510 (86.5%) were White; 55,969 (7.5%) were Black/African-American; and 30,191 (4.0%) were Asian. The median household age was 35.9 years, with 58.8% of persons between 20 and 64 years of age. 14.9% of the population was above 65 years of age, 19.9% were between 5 and 19 years of age and 6.3% were below 5 years of age. The population of Montgomery County grew by 120,017 persons (20.2%) between 1970 and 2000. The fastest 10-year period of growth during this time was from 1990 to 2000 when the population grew by 71,986 persons (10.6%).

Figure 6: Population Growth Comparison of Montgomery and Wake Counties



Source: US Census.

Although Montgomery County currently has a slightly larger population than Wake County, the growth that has and is anticipated to occur in Wake County will eventually result in Wake being the more populous of the two counties.

While the population of Montgomery County has not grown as fast, the most significant 10-year period of growth for the County was between 1950 and 1960 when population grew by 46.3%. Montgomery County has experienced growth levels similar to Wake County, though for not as long a period of time. Montgomery County was in many ways a more mature rural and suburban area with well established roads when the Limerick Station was constructed.

Table 3: Population Comparison Montgomery and Wake Counties

	Montgomery County		Wake County	
Year	Population	% Change	Population	% Change
1970	624,080		229,006	
1980	643,621	3.13%	301,429	31.62%
1990	678,111	5.36%	423,380	40.46%
2000	750,097	10.62%	627,846	48.29%

Source: US Census.

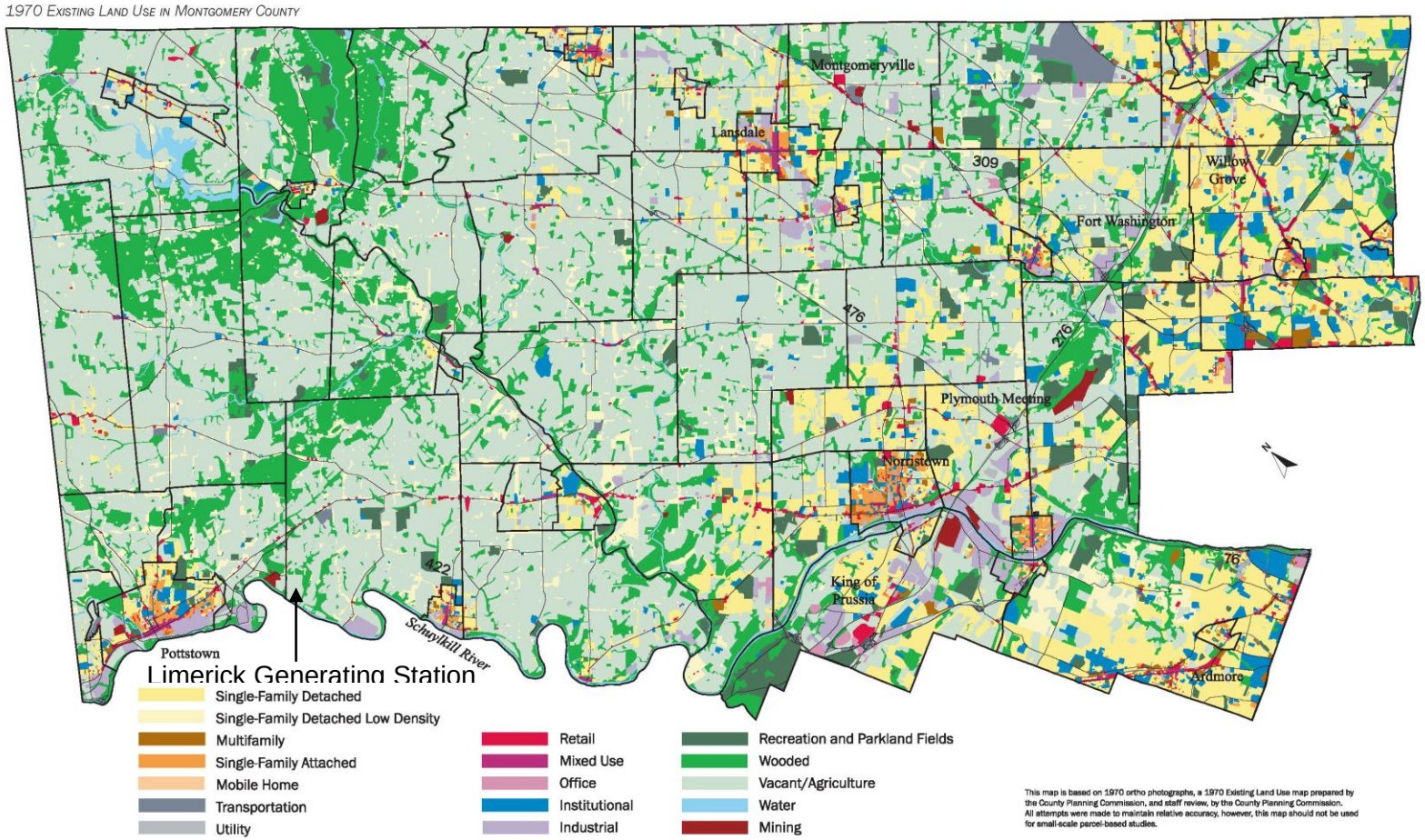
Land Use

Although each of the three counties within a 10-mile radius of the Limerick Station has a planning department or commission, these county agencies are primarily advisory in nature with few regulatory powers. Each county in Pennsylvania is divided into townships, boroughs, or municipalities with responsibility for planning and zoning which has resulted in 43 separate municipalities within the 10-mile radius of Limerick Station. Recent changes in Pennsylvania State Law have encouraged inter-jurisdictional planning efforts by giving funding priority to those projects that affect more than one municipality.

The region near the Limerick Generating Station is at the outer edges of the Philadelphia metropolitan region and has only recently been experiencing suburban development pressures. The area has remained largely rural in character with farm fields and forest tracts surrounding scattered small towns and villages. Recently, development has started to fill in the areas between many of these historic town centers. As this has happened, many of the more rural municipalities have begun initial efforts at cooperative multi-jurisdictional planning, which is geared towards better coordination of planning activities among participants. However, these efforts still leave ultimate land use planning and zoning authority in the hands of the individual municipalities.

Although the population of the City of Philadelphia is in decline, counties adjacent to the City are still experiencing population growth. As satellite employment centers have grown, workers have moved out of the City to be closer to higher paying jobs in the service and financial industries. The King of Prussia, Plymouth Meeting, Fort Washington, and Willow Grove areas of Montgomery County are all about 12 miles outside the City of Philadelphia along a stretch of I-276 which serves as the Pennsylvania Turnpike. These towns and the Limerick Generating Station are all located within Montgomery County. Overall since 1970, the number of jobs in the County has more than doubled.

Figure 7: Land Use in Montgomery County, Pennsylvania - 1970



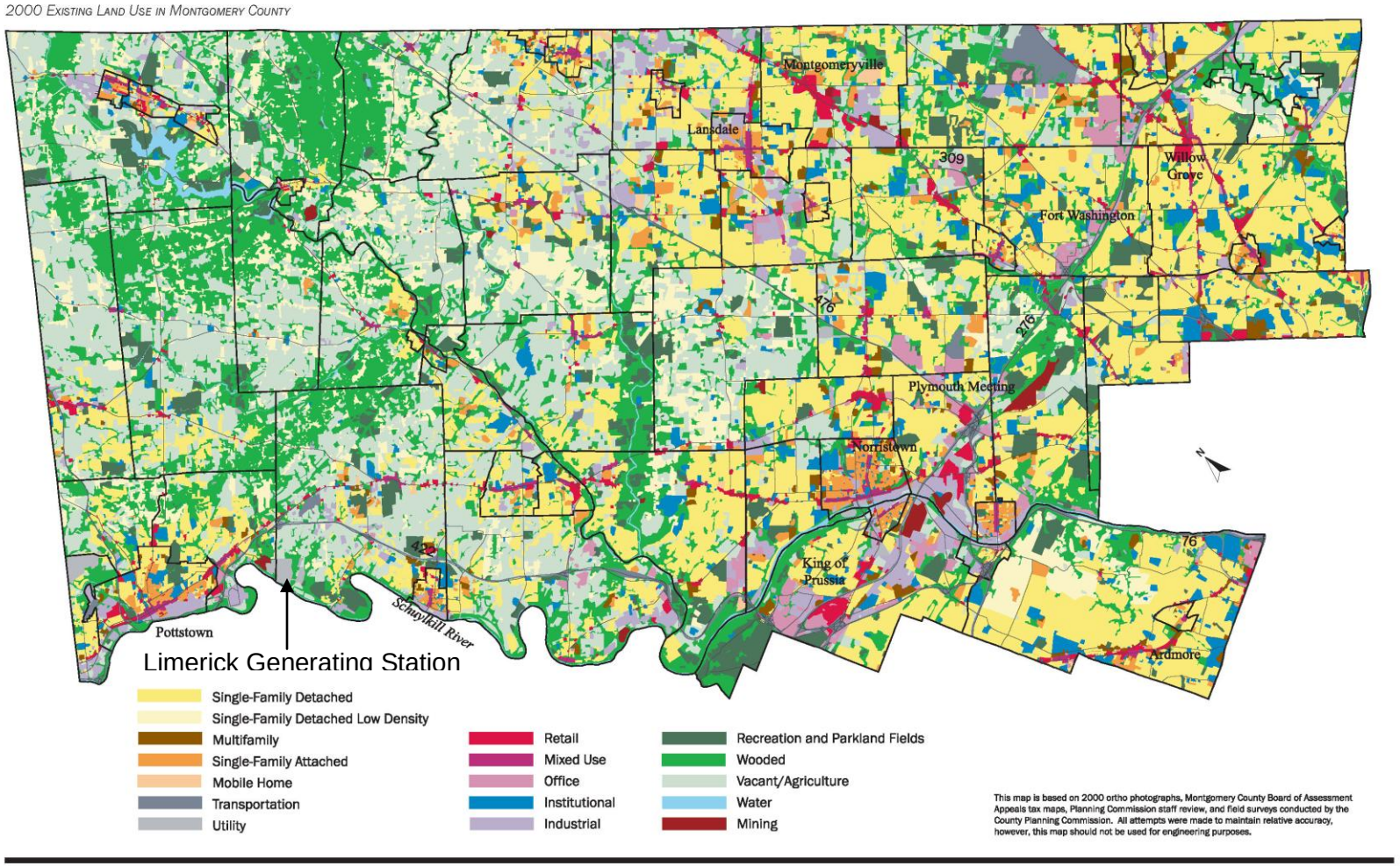
Similar growth patterns are occurring in Wake County where population growth is fastest farther away from the Research Triangle Park within suburban office areas in outlying towns which are located approximately the same distance away from Raleigh. However, Raleigh itself, unlike Philadelphia, is still continuing to grow in population.

The Collegeville area, which is within 10 miles of the Limerick Generating Station, is also a growing center due to the headquarters of Wyeth Pharmaceuticals (at the intersection of US Highway 422 and PA Highway 29) and Ursinus College. The Borough of Pottstown, located north of the generating station, also serves as a regional destination. Despite no central planning authority in the region, the municipalities surrounding the Limerick Generating Station have zoned to maintain the predominant rural land use patterns.

According to the Montgomery County Comprehensive Plan, the bulk of the population lies in the eastern portion of the County, closer to Philadelphia while the western edges of the County, including the Limerick area, are more rural. Overall approximately 54% of the County has been developed, though large areas of open space, farmland, and undeveloped land remain in the west. Although there are some residential subdivisions located among these land resources, for the most part housing tends to be clustered in small village centers located at main crossroads within the area. As development occurs, the County is concerned about sprawling patterns of development.

Although the area around the plant is largely rural, the Limerick Station is located within three miles of both Royersford and Pottstown Boroughs. These two boroughs are historic centers of population in western Montgomery County and are both located on the Schuylkill River which historically provided water and power for mills and other industries. In fact, the areas immediately surrounding the Limerick Generating Station are not zoned for residential use. Both Limerick and Lower Pottsgrove Townships zone the areas between Highway 422 and the Schuylkill River primarily for heavy and light industrial uses.

Figure 8: Land Use in Montgomery County, Pennsylvania - 2000



A brief description of zoning in the three municipalities immediately adjacent to the Limerick Generating Station follows.

Limerick Township

The Limerick Generating Station is located within the Limerick Township Heavy Industrial (HI) Zoning District Zoning in this district places buffering requirements on "private utility facilities" and "private electrical utility uses". The Station is considered to be a "private utility facility". It should be noted that although the facility is not mentioned by name in the zoning ordinance, utility facilities are mentioned and assessed numerous impact fees. Two such fees are assessed for decommissioning and unforeseeable impacts to address potential changes in the status of the Station. This makes it unlikely that other generating facilities will locate within this district, though industrial uses are allowed.

The HI district is surrounded by Limited Light Industrial (LLI) zoning which allows for light office, research, and industrial uses and does not preclude the construction of residences. About one mile from the Station, Limerick Township has zoned areas for high and low density residential use and office developments. Areas zoned for R-3 residential use have a maximum density of 0.85 dwelling units an acre with a minimum lot area of 40,000 square feet (without public water and sewer) or up to 1.80 units per acre with a minimum lot size of 15,000 square feet if water and sewer are provided. Two family and multi-family units are permitted in this district. The areas zoned for R-1 have a density of 0.5 dwelling units per acre (or 2 acres per unit) with a minimum lot size of 40,000 feet. This is the lowest density residential zone. The Highway 422 corridor is zoned for commercial and industrial uses while mid-density development is allowed beyond this corridor with R-1 zoning in place beyond that.

Lower Pottsgrove Township

Near the Limerick Station, Lower Pottsgrove Township zoning allows quarry and industrial uses and also provides for a small area of interchange zoning which permits commercial uses such as shopping centers south of Highway 422. Interchange zoning is located further away from the Station than the quarry zoning. Immediately north of

Highway 422, Lower Pottsgrove Township is zoned primarily for higher density residential uses with some local commercial areas.

East Coventry Township
East Coventry Township is located in Chester County across the Schuylkill River from the Limerick Generating Station. Land bordering the river is zoned for commercial, farm, residential, and limited industrial use. Further south are residential zoning districts and a small business campus.

According to the Montgomery County Comprehensive Plan, while the population grew by roughly 20% from 1970 to 2000, the amount of developed land increased by 69%. The County has also determined that for each additional person added to the County from 1970 – 2000, an average of 0.540 acres of land was consumed by development during the same time period. To address this issue, the Comprehensive Plan recommends that municipalities adopt clustering provisions in rural areas and keep overall housing density low at one home per two acres or less.

Environmental Resources

As the municipalities near the Limerick Generating Station have only recently begun to feel development pressure, these areas have largely maintained their rural character and as a result many environmental resources remain intact. The Schuylkill River is the major environmental feature in the region and both the Generating Station and the Borough of Pottstown, a regional population center, lie along the river. The Schuylkill River, Perkiomen Creek, and other large creeks associated with the river also serve as public drinking water supplies.

The area surrounding the Limerick Generating Station contains many working tracts of farmland. These farms are generally small family operations which not only provide residents with fresh produce but also provide habitat for animals in the area. Such agricultural uses, along with timber management, abound in the Harris Lake Drainage Basin in Wake County.

Governance

Each of the three counties within 10 miles of the Limerick Generating Station is governed by a board of supervisors. In Montgomery County,

commissioners are elected every 3 years and one of the three commissioners must represent the minority party. Montgomery County established a planning commission (MCPC) in 1950 as an advisory body to the County and the municipalities on matters of land use, transportation, the environment, water and sewer service, parks and open space, farmland preservation, storm water management, site design, housing, zoning, development patterns, and demographic trends. The MCPC is made up of a nine-member appointed board supported by 47 professionals. The MCPC prepares county plans, model ordinances, and informational publications and provides technical assistance to municipalities within the County.

Unlike Wake County, Montgomery County is completely divided into municipalities such that the MCPC does not have direct zoning and land use control over any land within the County. Land use control lies within each municipality which has its own zoning ordinance and subdivision and land development ordinance (SALDO). Some municipalities have in-house planning staff others have outside consultants or the county planning commission performs planning activities. Having 43 municipalities within 10 miles of the nuclear power generating station is a serious challenge to coordinating planning activities.

Growth Management

The Montgomery County Comprehensive Plan, which serves as an advisory document for the municipalities within the County, embraces "smart growth" planning concepts. However, municipalities must adopt their own comprehensive plans and enact the zoning required to implement their plans. Montgomery County has facilitated implementation of the Comprehensive Plan in the western portion of the County (within 10 miles of the Limerick Station) by establishing four regional planning commissions.

The four areas covered by regional plans include the Pottstown Metropolitan Region, the Central Perkiomen Valley Region, the Upper Perkiomen Valley Region, and the Indian Valley Region. Each region has developed and adopted a comprehensive plan which has also been adopted by the municipalities within each region. The Limerick Generating Station is mentioned in some of the plans as a regional

employment center or as a significant land use, but specific land use and emergency planning policies are not included in the plans.

When each municipality adopted the respective regional plan, that plan became the municipality's comprehensive plan. Once the regional plan was adopted, each municipality was required to amend the local zoning ordinance to comply with the plan. As a result most rural areas are zoned for densities of one home per two acres or less within 10 miles of the Limerick Generating Station. The regional comprehensive plans also designate portions of townships for various types of land use patterns. These land use categories help define whether an area will be zoned for higher density mixed use development (growth area) or targeted for preservation (rural area). Montgomery County also has a farmland preservation program which many municipalities are using to preserve farmland and open spaces. In addition the County is encouraging infill development in older municipalities and revitalization of existing downtown shopping areas as opposed to construction of new retail.

The regional planning efforts would be somewhat similar to the efforts that are currently underway in Wake County to improve communication between the County and the municipalities. However the Urban Services Area process in Wake County provides the County with additional power in these negotiations.

Property Ownership

Privately-owned property within the Limerick Station area of Montgomery County is largely residential or farmland. The general pattern of ownership is somewhat similar to that in Wake County, although proportionally there is less land owned by the County and the nuclear power utility than in Wake County.

Infrastructure

Lesser State highways are also present in the Limerick area with most of these being two lane roads. Pennsylvania Highways 23, 29, 63, 73, 100, 113, 562, 663, and 724 are located within 10 miles of the Limerick Generating Station. Ridge Pike and Germantown Pike are two other major roads in the area. These routes serve as primary evacuation routes in the case of emergency (and will serve to keep residents off of Highway 422) and provide access to evacuation reception centers

beyond 10 miles of the Station. The roads generally radiate throughout the project area which means that traffic can be routed throughout the municipalities to prevent any one municipality from being overwhelmed by traffic during an evacuation.

In Pennsylvania individual school districts operate and maintain public schools. These districts may be composed of one or more municipalities and may cross county lines. There are 13 public school districts and approximately 69 schools within 10 miles of the Limerick Generating Station. Limerick Township permits schools and other educational facilities within all residential zoning districts by conditional use. Therefore, while there are no zoning standards that explicitly exclude schools from the area immediately surrounding the Generating Station, there is the potential that certain conditions could be imposed on future school development relating to proximity to the Generating Station. The existing schools are identified in the publicly available "Emergency Planning for the Limerick Area" guide published by Exelon Energy. Of these, 7 districts with a total of 45 schools are located within Montgomery County. The Emergency Plan specifies which schools will be evacuated together and where children will be routed to outside the 10 mile radius.

Act 537 is the Pennsylvania State Law that requires each municipality to prepare and update sewer facility plans. Each municipality is required to prepare a plan that indicates where sewer service is anticipated to be provided. While Montgomery County strongly advises its municipalities to coordinate Act 537 Plans with comprehensive plans there is no requirement to do so. Most municipalities have updated, or are in the process of updating, Act 537 plans to comply with the regional comprehensive plan; however, each municipality has independent authority with regards to sewer services.

Based on the Act 537 plans, it appears that about half of the area in Montgomery County within 10 miles of the Plant either has or is anticipated to have public water and sewer services. Most of these areas are located near the Schuylkill River and the Limerick Generating Station, indicating the potential for higher density development closer to the Station. The Station itself is located within an area served by public water and sewer but zoning restricts development to residential uses immediately adjacent to the Station. Areas without sewer service rely on

on-site septic tanks, which are often difficult to locate due to soils with high clay content. Public water service generally follows the same patterns as sewer service. Areas that are not served by public water use water from groundwater aquifers.

Emergency Preparedness

As mentioned earlier the evacuation plans for the Limerick Generating Station identify State highways as the primary means of evacuation. In the emergency plan prepared by Exelon Energy, each municipality is provided with directions to a specific reception center. In addition, for major population centers such as Boyertown, Phoenixville, and Pottstown, the plan lists designated pick-up points for those who are not able to drive; smaller municipalities are provided with a contact number to call for transportation assistance. The plan lists all public schools that are at risk during an incident and provides information on which schools would host students during an evacuation event. The plan also provides information on sirens, emergency alerts, and materials that should be brought during an evacuation. Most information concerning an evacuation event due to an incident at the Station is available on the Exelon Energy website - www.exeloncorp.com/ourcompanies/powergen/nuclear/limerick_generating_station.htm

Figure 9: Limerick Generating Station Emergency Plan

Lessons Learned

- **Regionalism helps**. It is hard to establish regional organizations when municipalities have established policies, procedures, and institutions. It is essential to develop inter-jurisdictional coordination early, as Wake County is doing.
- **Cooperation**. The municipalities near Limerick show that it is possible to work together regionally in a way that does not impinge on local authority. Within the last twenty years, the long-established municipalities within the Harris Lake Basin have begun to annex land aggressively. Wake County should continue to strengthen inter-jurisdictional planning efforts to ensure development in the area occurs in a coordinated fashion.
- **Buffer with industry**. The communities near the Limerick Generating Station did not zone land for residential development immediately adjacent to the plant. Although pockets of residential use are found near the station, for the most part land uses surrounding the facility are industrial. For the most part, communities around the Limerick Station have decided to locate residential populations away from the station.
- **Small scale emergency planning.** The number of municipalities within a 10-mile radius of the Limerick Generating Station show that small geographies can assist with advance planning for evacuations. Each small area can be provided more specific evacuation instructions and be directed to different reception centers to help distribute traffic.
- **Many routes for evacuation.** There are numerous State Roads radiating out from the area around the Limerick Generating Station. These roads provide more options for evacuation routes to prevent major traffic backups. Wake County needs to expand the existing road network to ensure better traffic distribution in case of an evacuation.
- **Identify alternate routes.** US Highway 422 is one of many roads designated as an evacuation route in official emergency management plans. Designating other evacuation routes helps reduce traffic congestion on this primary US highway.

- **Water and sewer impact development.** Water and sewer help dictate development density. If a community desires to buffer nuclear power plants from surrounding development, it may be advisable to restrict public water and sewer service near plants. In the case of Limerick, the station was sited near water and sewer facilities but zoning does not allow residential development.
- **Non-residential buffers.** Although residential uses are permitted within one mile of the Limerick Station, the station itself is in an area of industrial use which generally does not permit residential uses or high density development. This zoning helps minimize the number of people who may be impacted by an incident at the station.
- **Consistency in zoning.** Although the municipalities around the Limerick Generating Station have taken steps at coordination, individual municipalities maintain separate zoning ordinances. As a result, zoning classifications across municipal lines may look generally consistent though specific regulations vary. As regional efforts accelerate, the municipalities may work towards common zoning definitions and density requirements.
- **Plant changes.** Limerick Township has considered the possibility of decommissioning or other unforeseen activities at the Station. Although the Township has not planned for these events, the Township has created impact fees to provide resources that can be utilized to plan after the Station is no longer in use.


LIMERICK GENERATING STATION
10 Miles
Berks County
Bucks County
Montgomery County
Chester County
OLEY VALLEY HIGH SCHOOL
EMMAUS HIGH SCHOOL
Southern Lehigh High School
BOSCOV'S OUTLET CENTER
ROBESON BLDG.
COUNTY LINE PLAZA
MONTGOMERY MALL
PLYMOUTH MEETING COMPLEX
NESHAMINY MALL
MORGANTOWN INDUSTRIAL PARK
DOWNINGTOWN HIGH SCHOOL
WEST WHITELAND BLDG.
STETSON MIDDLE SCHOOL
Schuylkill River
Ridge Pike
Germantown Pike
BECHTELSVILLE
WASHINGTON
COLEBROOKDALE
BOYERTOWN
DOUGLASS
EARL
AMITY
UNION
WEST POTTS GROVE
UPPER POTTS GROVE
NEW HANOVER
LOWER POTTS GROVE
LIMERICK
UPPER FREDERICK
LOWER FREDERICK
MARLBOROUGH
GREEN LANE TOWNSHIP
UPPER SALFORD
LOWER SALFORD
SCHWENKSVILLE
PERKIOMEN
SKIPPACK
TRAPPE
COLLEGEVILLE
WORCESTER
NORTH COVENTRY
EAST COVENTRY
SOUTH COVENTRY
WARWICK
SPRING CITY
ROYERSFORD
UPPER PROVIDENCE
LOWER PROVIDENCE
EAST VINCENT
EAST NANTMEAL
WEST VINCENT
EAST PIKELAND
WEST PIKELAND
PHOENIXVILLE
SCHUYLKILL
UPPER UWCHLAN
CHARLESTOWN
NORTH
W
E
S
EMERGENCY EVACUATION ROUTE
TOWNSHIP DIVISION
RECEPTION COMMUNITY

Harris Lake Drainage Basin
Case Studies

Wake County, North Carolina

Indian Point Energy Center

Westchester County, NY

Case Study – Indian Point, Westchester County, NY

General Overview

The Indian Point Energy Center (IPEC) is located in the Town of Buchanan, Westchester County, New York, on the east bank of the Hudson River, 24 miles north of New York City. The Center is located on 239 acres owned by Entergy Nuclear Northeast, a subsidiary of the Entergy Corporation based in New Orleans, LA. IPEC consists of three Westinghouse pressurized water reactors, two of which are currently operational. Unit one, built in 1962, was shut down in 1974. Unit 2 (1974) and Unit 3 (1976) combined generate 1,955 megawatts of electricity. By comparison, the Shearon Harris Plant operates one Westinghouse pressurized water reactor with an output of 900 megawatts.

Since its completion, the IPEC has been controversial and at the center of discussions regarding nuclear power. Special interest in the IPEC can be attributed to its proximity to New York City. While the population within the 10-mile EPZ is estimated at 288,000, the population within the 50-mile radius is almost 20 million. Heavy media coverage and opposition to the plant has spurred a number of studies prepared by various groups with different interests. The 1979 Three Mile Island incident heightened awareness in terms of nuclear accidents across the country which led to safety upgrades and a number of calls for shutting down IPEC. The terrorist attacks of 9/11 brought to the forefront the potential for intentional terrorist attacks on nuclear power plants.

An organized campaign for the shutdown of IPEC has been headed by such groups as Riverkeeper, Indian Point Safe Energy Coalition, and Close Indian Point Now. The aggressive efforts of opposition groups, a mainly internet based forum, has led to the creation of www.safesecurevital.org, a website developed by Entergy. This website was specifically developed to publicize the safety features, emergency planning, and vital energy that IPEC provides to the region (30% of NYC electricity). In May of 2007, Entergy filed for a 20-year extension for the operation of the two IPEC reactors. Currently the reactors are licensed to expire in 2013 and 2015. During the public comment period, On Wednesday July 25, 2007 a 60-day period of public review began. During this period the public is able to raise and substantiate environmental and safety concerns regarding the plant. The application renewal process will then follow a three year course similar to a NEPA

Environmental Impact Process. Although none of the 48 renewal processes for nuclear power plants in the U.S. has been denied, this process should bring out some particularly interesting facts concerning nuclear power.

As the IPEC is located within a highly developed area, this case study shows how development near nuclear power plants can lead to community tensions and how these tensions can be mitigated. Given the large population near Indian Point, public outreach and evacuation planning are quite substantial and may serve as guides to Wake County as the areas near the Harris Plant continue to experience population growth.

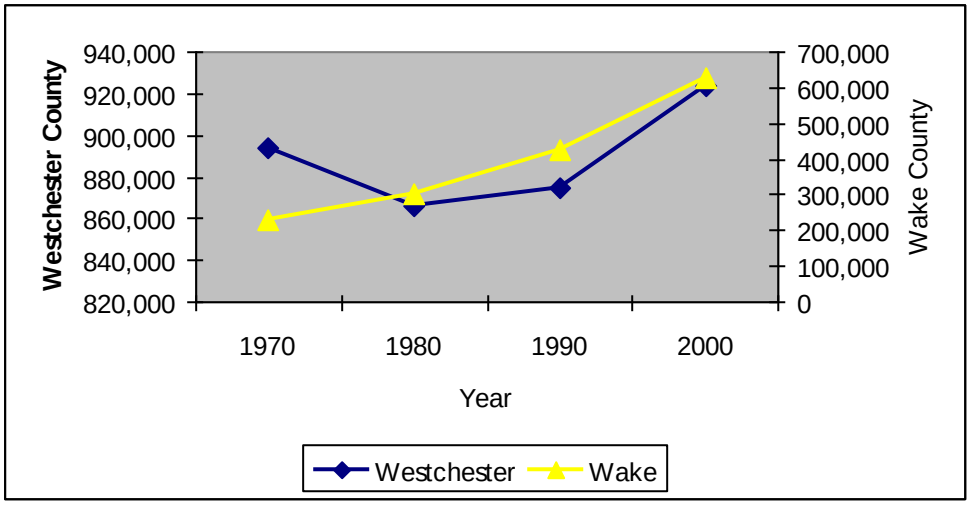
Demographics

In 2000, the population of Westchester County was 923,459 persons, of whom 718,451 (77.8%) were White; 137,595 (14.9%) were Black/African-American; and 50,790 (5.5%) were Asian. The median age was 33.1 years, with 61.3% of persons between 18 and 64 years of age. 13.9% of the population was above 65 years of age, while 24.8% were between 5 and 17 years of age and 7.3% were below 5 years of age. After a period of slight population decline, Westchester County population leveled off and again grew at a modest 5.5% from 1990-2000. Westchester is a first tier suburb of New York City and has been traditionally been considered a wealthy community. According to the Bureau of Economic Analysis, in 2004 Westchester County had a reported per capita income of $58,592 - 8th highest per capita income in the United States.

Table 4: Population Comparison Westchester and Wake Counties

	Westchester County		Wake County	
Year	Population	% Change	Population	% Change
1970	894,104		229,006	
1980	866,509	-3.1%	301,429	31.62%
1990	874,866	.96%	423,380	40.46%
2000	923,459	5.5%	627,846	48.29%

Figure 10: Population Growth Comparison between Westchester and Wake Counties



Source: US Census.

Land Use

Since Westchester County is entirely divided into towns and villages, the County has no authority to establish zoning districts or development standards. Land use in the area surrounding the Indian Point Energy Center is controlled by the Village of Buchanan, which is within the Town of Cortlandt.

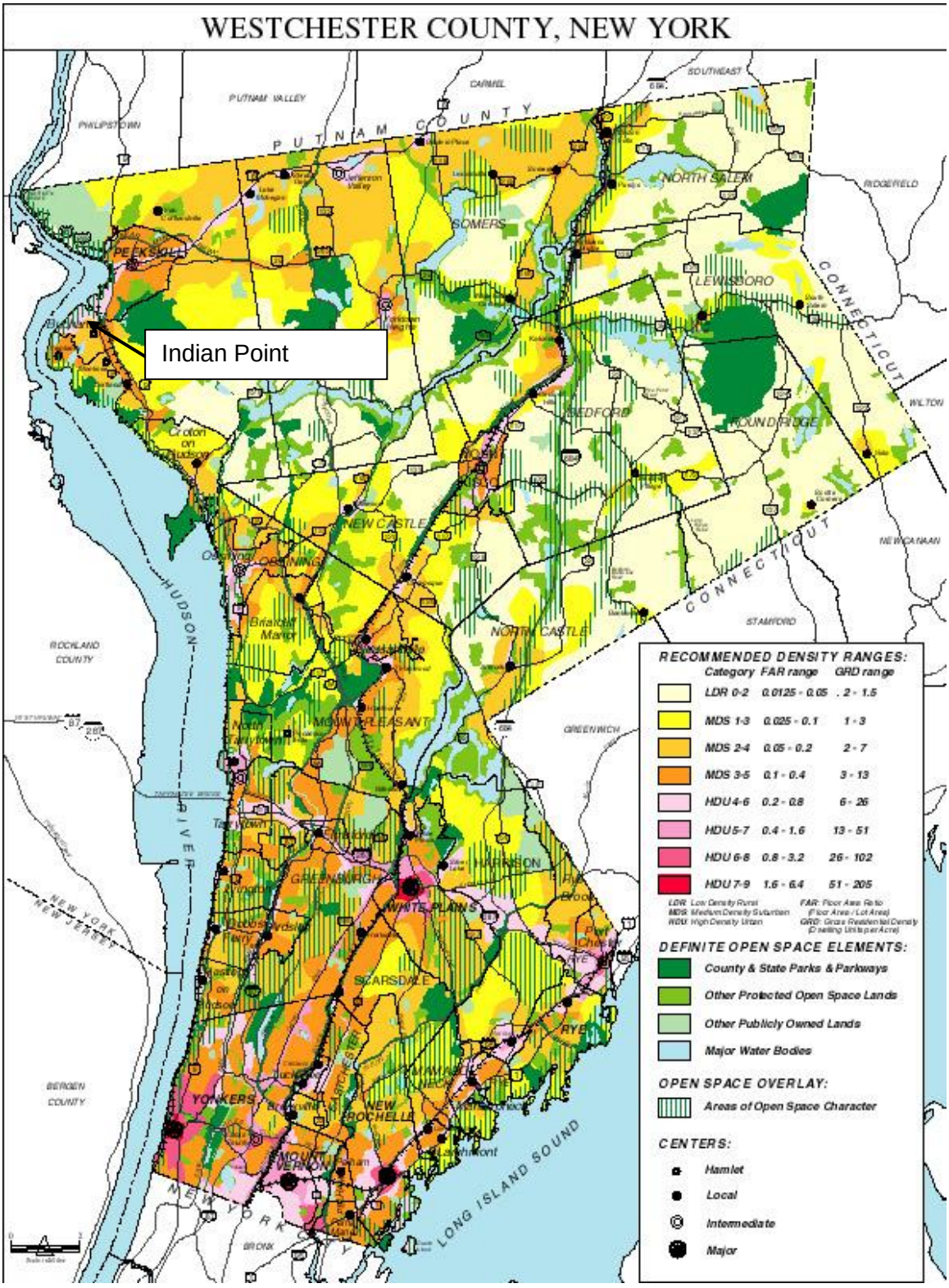
The Village of Buchanan is significantly built out. The zoning of the power plant property and the immediately adjacent properties is M-2, which is a heavy industry classification. Adjacent to the M-2 Zoning District are low-density residential lands, some of which host a local elementary school and a public pool and community center. Residential neighborhoods are located within 0.75 miles of the power plant reactors. These neighborhoods are zoned residential with a density ranging from 0.2-1.5 dwelling units per acre. Light industrial lands are also located adjacent to the power plant property. The last remaining large undeveloped area within the village is close to IPEC.

Westchester County is responsible for emergency services for the entire county, which leads local municipalities to defer to the County for guidance on emergency planning. Since emergency planning is not incorporated into planning policies at the county level, local municipalities

have not incorporated them into local planning given the potential multi-municipal impact.

Figure 11: Land Use Plan for Westchester County

Case Study – Indian Point, Westchester County, NY



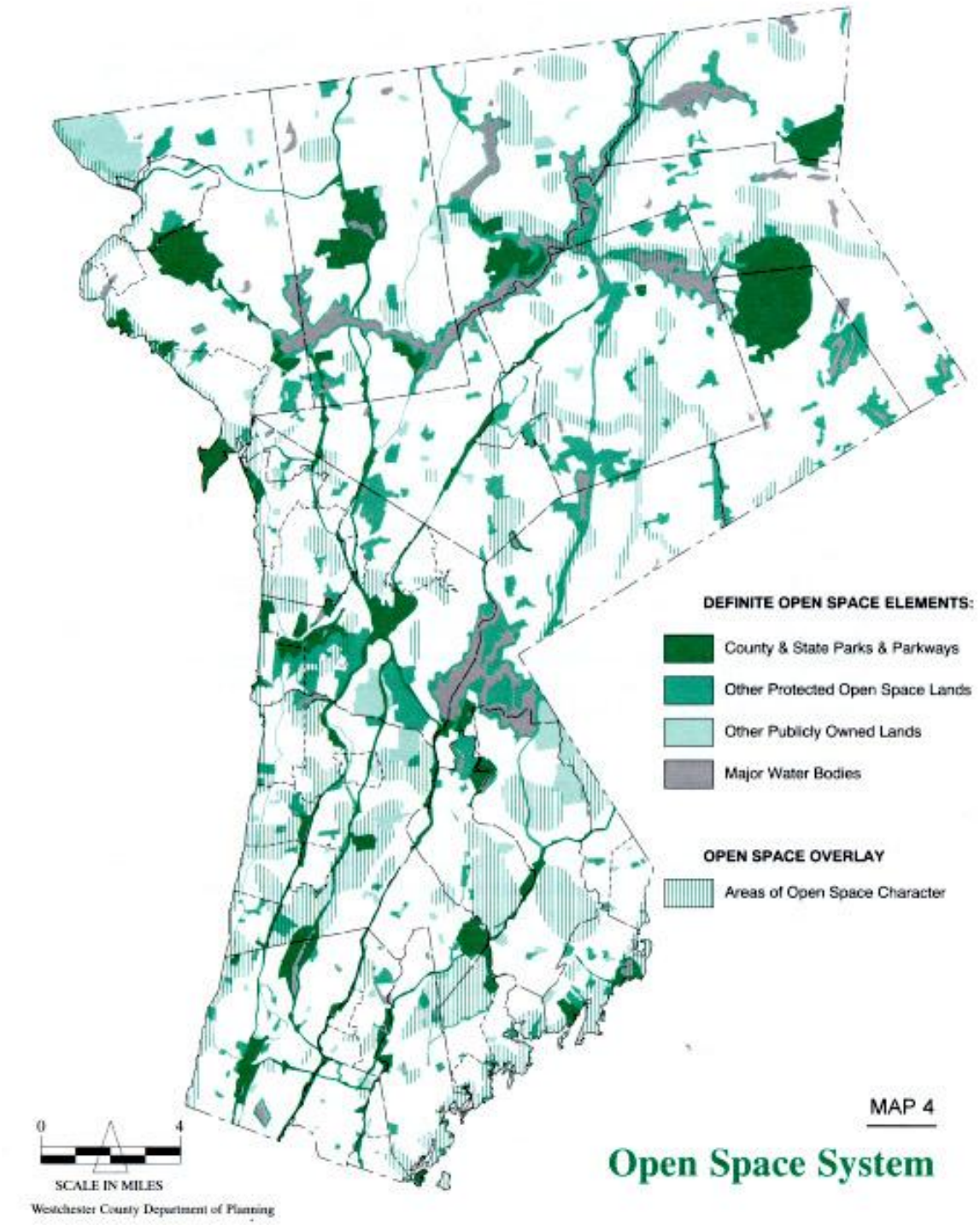
Environmental Resources

Westchester County can generally be described as a built-out first-tier suburb of New York City. The Hudson River, where Indian Point Energy Center is located, and its tributaries serve as the greatest environmental resource to the region. The Hudson River is tidal at Indian Point and flows into New York City and then into the Atlantic Ocean. Prior to the development of railroads and highways, the Hudson River was the historic transportation spine for the State of New York as it connects New York City to Albany. From Albany, the Erie Canal connects Albany to Buffalo and the Great Lakes beyond. The Hudson River and the Erie Canal are often mentioned as catalysts that turned New York City into the nation's trade capital.

The Hudson River is bounded by steep cliffs and mountains on either side and small historic towns line the river banks. As a main transportation route, the river hosted manufacturing centers that have left a legacy of high levels of PCBs in river sediment. Public funds are being spent now to clean up this high value environmental resource.

Much of the steep topography within the Hudson Valley that is not suitable for development has been preserved within State or county parks. In addition, New York City owns thousands of acres of land that surround drinking water reservoirs that the city maintains as part of the public drinking water system. These reservoir watersheds impact twelve of the jurisdictions within Westchester County and provide drinking water for approximately 800,000 people within the County.

Figure 12: Open Space Network in Westchester County



Governance

Westchester County is governed by an elected county executive and an elected County legislature. The legislature serves as the policy making branch of county government and is comprised of 17 members that each represent a specific district within the County. Among the four case studies, Westchester County is the only county not governed by an elected board of commissioners and operates with a clear division between executive and legislative duties of government.

Growth Management

Westchester County is a relatively urbanized county with significant development within the 10-mile radius of the Indian Point Energy Center. The Village of Buchanan is entirely located within 1.5 miles of the plant.

Westchester County has six cities, 16 towns, and 23 villages, each of which has home rule authority on all matters relating to planning and zoning. Westchester County has no direct control over the planning and zoning prepared for the individual municipalities. The County serves in an advisory capacity to local municipalities.

According to the Westchester County website (http://www.westchestergov.com/index.htm), the county planning department and planning board respond to the challenge of working within this multi-jurisdictional and sophisticated environment by promoting intergovernmental cooperation and urging participation of the municipalities in regional and sub-regional planning efforts. County goals include:

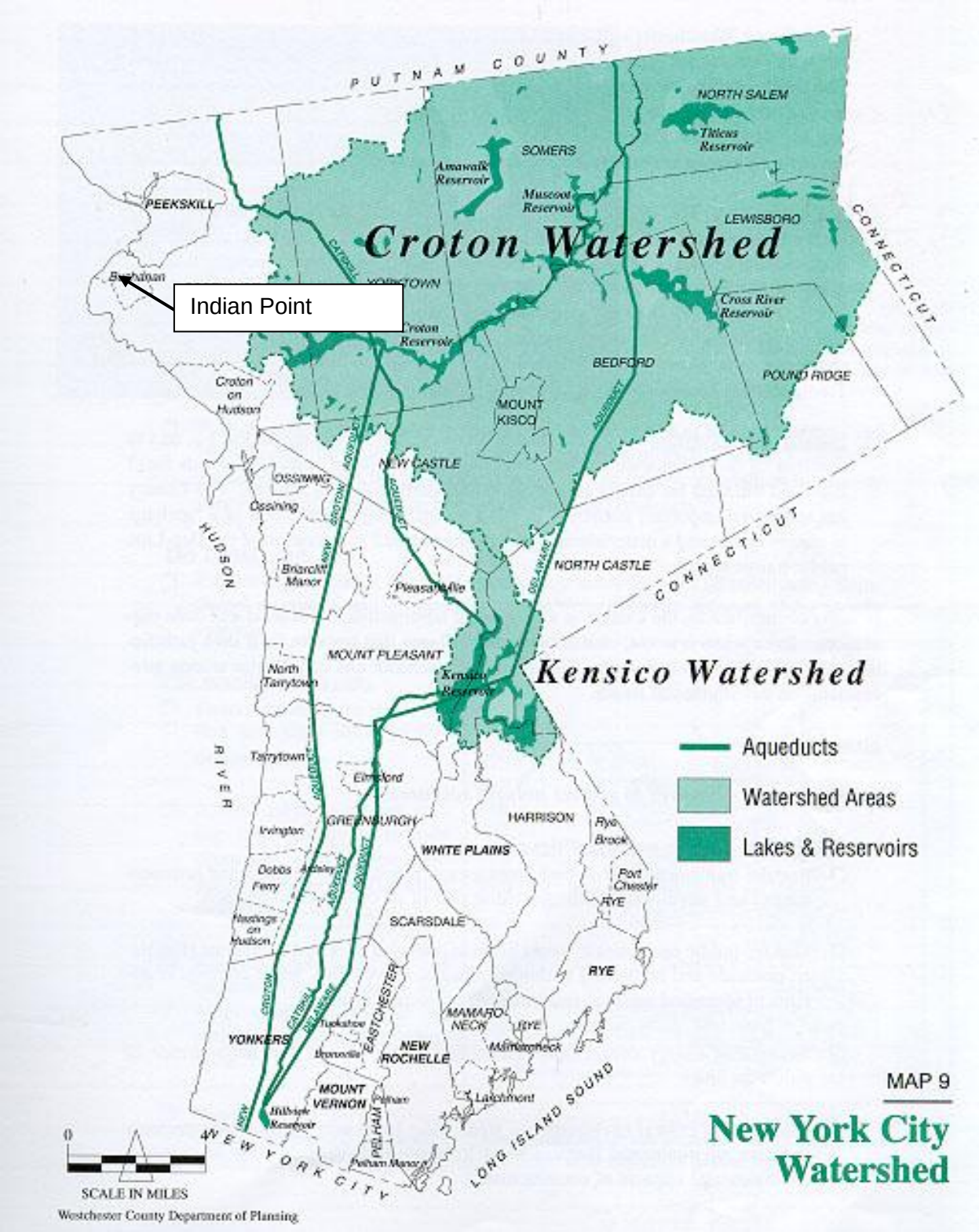
- Provide a regional perspective and offer critical guidance on land use, development and zoning actions being considered by local governments.
- Promote appropriate and sustainable development of land in coordination with transportation and infrastructure, guided by the goals, policies and strategies of "Patterns".
- Initiate studies on inter-municipal topics that assist local land use and zoning decision-making by municipalities.
- Provide essential technical assistance on planning and zoning actions to municipal officials and county departments.

Patterns, the Westchester County comprehensive plan, sets policies that seek to coordinate planning activities and ease tension among the various municipalities. Patterns contains policies relating to the overall development of the County, but does not have policies relating specifically to the Indian Point Energy Center. Westchester County maintains a separate emergency services department, which provides emergency information and planning regarding the power plant.

Within the Buchanan Comprehensive Master Plan, adopted in 2005, Indian Point is simply referred to as a utility with no other consideration given to the use of the power plant property. This is likely due to the fact that the power plant is such an integral part of community. According to the Buchanan Master Plan, a portion of the Indian Point Energy Center property is available for development and portions of the property are analyzed for development capacity. Areas with development potential are identified for rezoning to heavy industry and low-density residential uses. The Master Plan treats the power plant as a typical industrial use and no special buffers are required.

The City of New York also plays a role in growth management in Westchester County as 40% of the land area is within watersheds associated with the City's drinking water system. As part of ongoing efforts to protect the water supply, the City, Westchester County, and nearly 80 other environmental groups and governmental agencies have signed a Memorandum of Agreement (MOA) to protect the water supply. The memorandum outlines steps that the City, County, and other municipalities can take to better protect drinking water supplies. Activities include revisiting and strengthening stormwater ordinances, purchasing development rights and properties to limit further development, and improved coordination between governments to manage the watershed. In 2007, the Comprehensive Croton Watershed Water Quality Protection Plan was in the process of being approved by the County and watershed municipalities to guide the implementation of these policies.

Figure 13: New York City Watershed



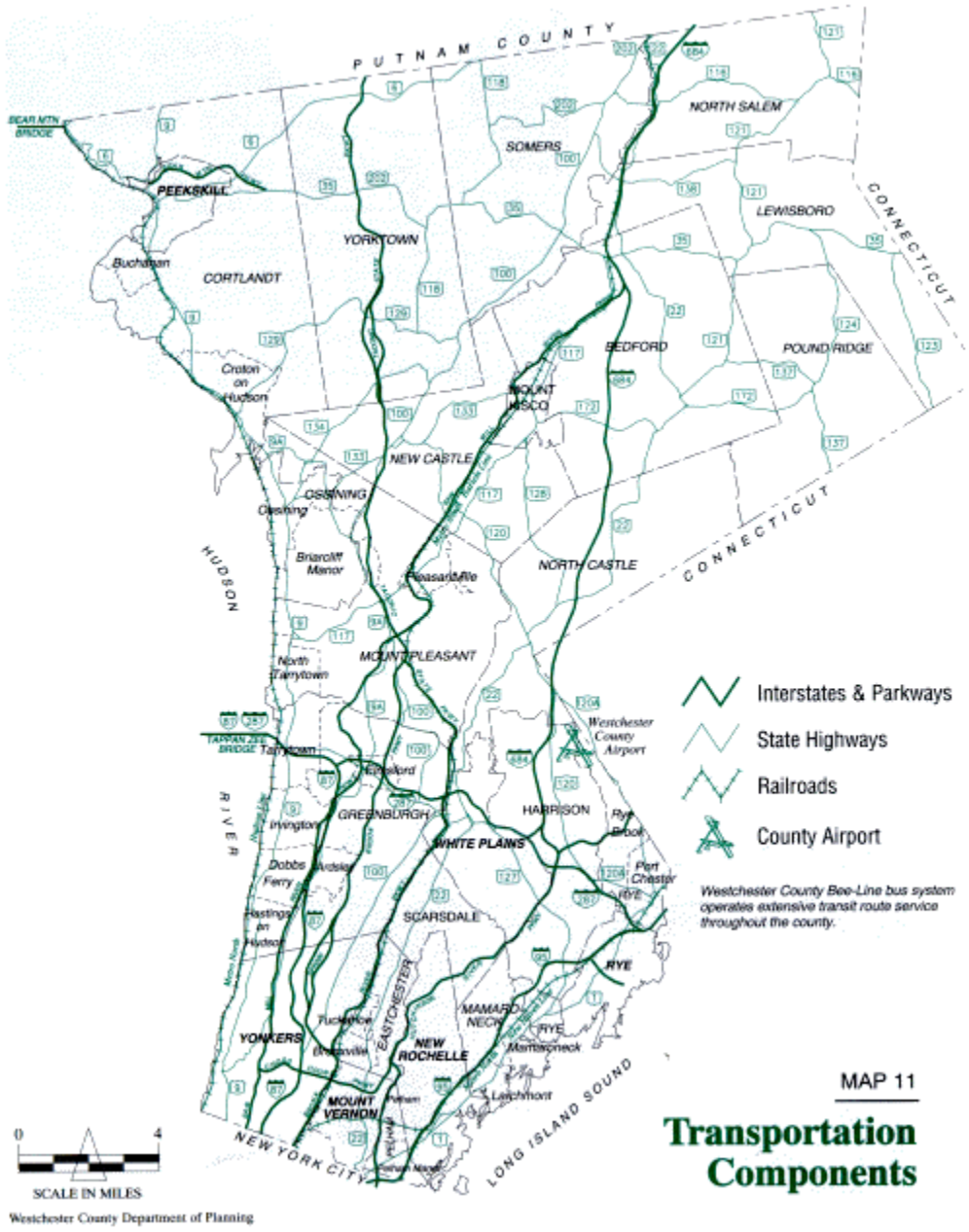
Property Ownership

The majority of property within 10 miles of Indian Point is privately owned. As a heavily developed first tier suburb of New York City, most land has been developed for residential use with portions of land maintained for open space and natural resources protection.

Infrastructure

The southern boundary of Westchester County is Bronx County, New York which is the northernmost borough of the City of New York. Numerous highways and major routes run through Westchester County connecting New York City to Upstate New York and the regional transportation system. Interstate 87 (NY State Thruway) and Interstate 684 are the major north-south traffic corridors. These two interstates are supplemented by State parkways including Saw Mill River Parkway, Taconic River Parkway, Sprain Brook Parkway, Cross County Parkway, Hutchinson Parkway and Bronx River Parkway which prohibits commercial trucking. Interstate 95 runs along the southern tier of the County along Long Island Sound and connects New York City to Connecticut. Interstate 287 (Cross County Expressway) is an east-west interstate that connects Interstate 95 to the Tappan Zee Bridge which carries Interstates 87 and 287 across the Hudson River.

Figure 14: Transportation in Westchester County



Westchester County has a public airport and the Metropolitan Transportation Authority (MTA) also runs 3 branches of the Metro-North Commuter Railroad within the County. The New Haven rail line provides service to the southern portions of the County along Long Island Sound and continues to New Haven, Connecticut. The Hudson rail line runs along the Hudson River ending in Poughkeepsie, New York with the Cortlandt and Peekskill stations each roughly 2 miles from Indian Point. The Harlem rail line runs north-south through the center of the County and roughly parallels the route of I-684 with service extending north to Wassaic, New York. Westchester County maintains and operates its own bus network, the Bee Line, which provides bus service to the Village of Buchanan and the Metro-North stations in Cortlandt and Peekskill. NY highways 14, 16, and 18 also run through Buchanan.

Approximately 85% of the residents of Westchester County get drinking water from the New York City water supply system. The remaining residents are provided water from groundwater supplies from private, community, or municipal wells, mostly within the northern portion of the County. The County maintains seven wastewater treatment plants along the Hudson River and Long Island Sound that serve approximately 90% of the population. Approximately one-third of Westchester County depends on these systems and most of the area served is within the Croton Watershed. The watershed also contains 28 privately and municipally-owned and operated wastewater collection, treatment and disposal systems. Buchanan receives water from the reservoir system but does not tie into the County wastewater treatment system.

Electric Power is provided and transmitted by Consolidated Edison and New York State Electric and Gas.

Emergency Preparedness

The emergency preparedness for the Indian Point Energy Center is based upon the 10-mile Emergency Planning Zone (EPZ) around the plant. This, however, has remained a point of contention due to the population that lives within a larger radius of the plant. The Entergy website – www.safesecurevital.org - offers an emergency brochure updated in 2006, for each of the four counties that fall into the 10-mile EPZ. The brochure is mailed to all residents who fall within the EPZ and

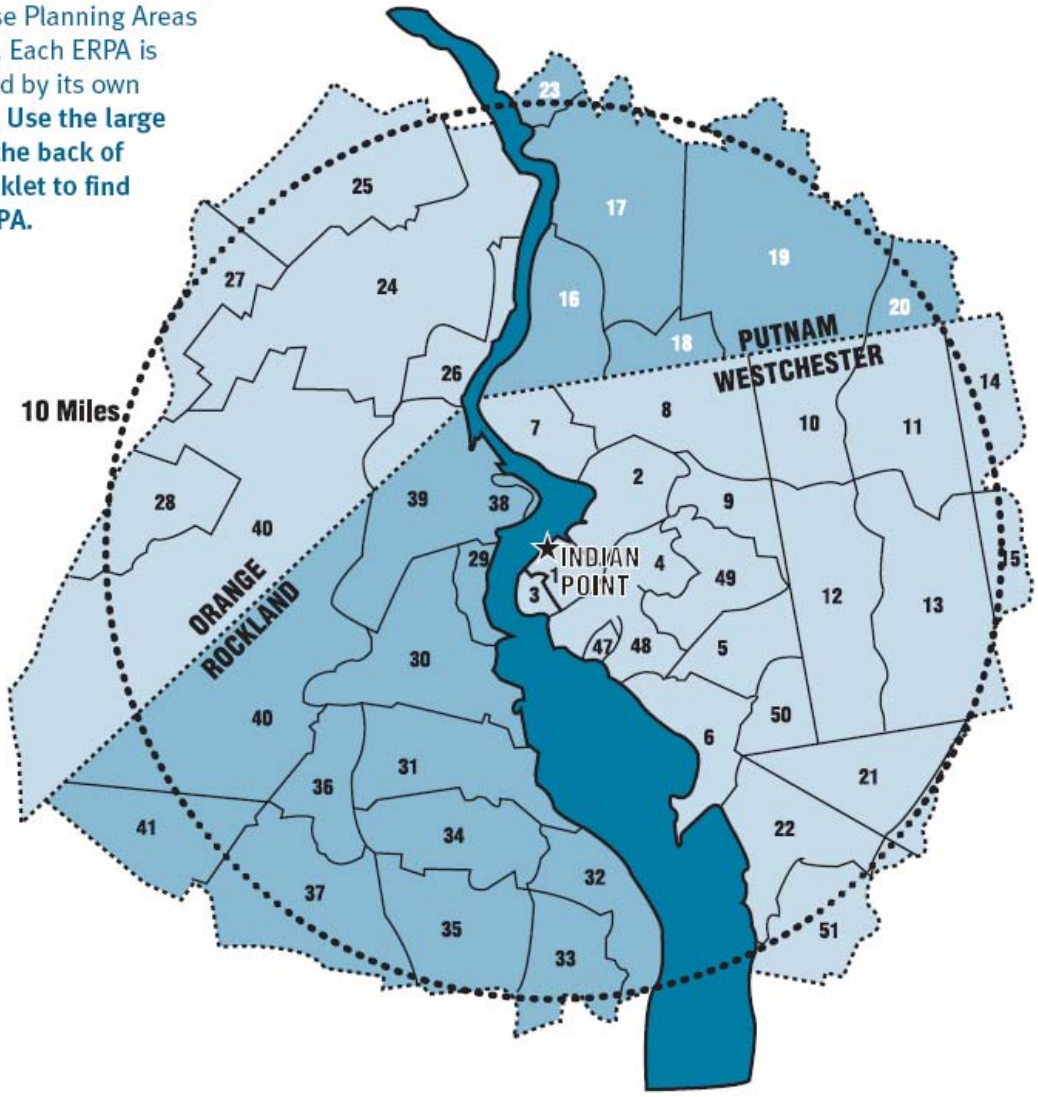
provided in Spanish for Rockland and Westchester Counties. A system of 156 sirens, located throughout the EPZ, is tested regularly. Westchester County offers an interactive GIS based program on the County website which allows residents to locate their address to see if they are within the EPZ. If they are, the site provides evacuation information and links to the emergency evacuation brochure.

A more detailed evacuation information system has been developed by Rockland County, where approximately 40% of County residents live within 10 miles of Indian Point. The Indian Point Interactive GIS Mapping System (IPIGMS), unveiled in August 2002, provides detailed evacuation information for residents. A user of the system can type in an address to identify the emergency response planning area (ERPA), review evacuation routes, reception centers, and emergency alert system broadcast stations within the area. The system also allows residents to generate specific directions to school reception centers and to view other GIS data maintained by the County.

There is, however, no accepted plan for areas outside of the 10-mile EPZ. This has brought to the forefront the argument that there may not be a feasible evacuation plan for an area so heavily populated. While the likelihood of an event that would require such large scale evacuation is low, and has not occurred during the nuclear era of this country, it cannot be ignored. In 2003, New York State released a report performed by a private consultant that took a comprehensive look at the ways local and state officials would respond to a disaster. The report pointed out that emergency plans would be unlikely to protect people from an unacceptable dose of radiation in the event of a release from IPEC. The report stated that the events of 9/11 changed what was once sufficient in regards to nuclear facilities and that emergency plans for each plant need to be tailored to their surroundings. The report also recognized that while it is necessary to take into account the effects of major population centers, large scale evacuation of places like New York City is unlikely to occur in a timely matter during any event. New York City offers a public health emergency preparedness site through the city's department of health and mental hygiene.

Case Study – Indian Point, Westchester County, NY

This map shows the Emergency Planning Zone divided into 51 Emergency Response Planning Areas (ERPAs). Each ERPA is identified by its own number. **Use the large map in the back of this booklet to find your ERPA.**



Lessons Learned

- **Adaptability**. The 9/11 terrorist attacks altered the atmosphere and risks associated with all facilities that could be potentially vulnerable to a terrorist attack. It is important that energy suppliers are able to adapt to changing needs and climates surrounding nuclear plants.
- **Planning outside of 10-mile EPZ**. While the effectiveness of plans outside the 10-mile EPZ have been debated, attention to the subject has allowed for important information regarding potential scenarios outside of the EPZ. Large population centers should maintain some level of emergency planning if they fall within a 50-mile radius.
- **Ease of obtaining information.** Both Westchester and Rockland Counties have web pages devoted to evacuation procedures in case of an incident at Indian Point. Web pages can be accessed from the main county websites.
- **Detailed information.** The use of GIS allows residents to access information geared specifically towards them to assist in evacuation.
- **Responding to media coverage and opposition.** Nuclear power will continue to be a controversial topic. Governments surrounding a nuclear power plant should work to ensure that residents receive specific and accurate information regarding emergency preparedness.
- **Clear regional planning.** Establishing clear planning policies at a regional level will help guide local communities in coordinating planning efforts.

Summary - Overall Lessons Learned

The case studies show how four different community situations have handled growth around sensitive facilities. The case studies demonstrate how development has occurred near nuclear power plants after construction and how established communities have adapted to the presence of a nuclear facility. Although all the case studies do not have the same land use characteristics or governmental structure as in Wake County, each case offers insight into the issues facing land use planning and emergency preparedness around nuclear power facilities. When viewed as a whole, the case study exercise demonstrates:

- **Fewer governmental units provide for more coordinated development controls.** Although all the case studies emphasize regional planning efforts, where there are fewer governmental units within the 10-mile EPZ radius, coordinating land use policies is much easier.

- **No clear links between land use and emergency management planning.** While the comprehensive plans of some of the communities address the nuclear power plants as an industrial use, none of the community plans address the power plants in depth. In all cases, emergency planning was handled in a separate document making it difficult for most people to correlate the two issues. As the comprehensive plan is the framework for community growth, it makes sense to more closely coordinate the two planning issues.

- **Buffering.** Development will encroach close to nuclear power plants. Before this happens, it makes sense to purchase surrounding lands or restrict activities to minimize the impact of development immediately adjacent to plants. Doing this may ease evacuation planning as fewer people will need to be evacuated in case of an event and the adverse impacts of an incident at a plant would be minimized.

- **Remote may not be remote in 10 years.** In two of the case studies, Calvert County and Mecklenburg County, nuclear power plants were originally located in what were rural areas. However, development attracted by nearby employment centers subsequently generated

residential growth close to the plants. Proactively planning for future growth should not be delayed.

- **Details in evacuation planning.** All the plants studied had evacuation plans that detailed routes for residents to take in the event of an incident. The more detailed the plans, the easier it will be to effectively and efficiently direct residents to evacuation routes and shelters.

- **Advanced technology has a role.** Governments can use the internet and GIS (geographic information systems) to provide up to date, locally specific, and easily accessible information. Residents can be apprised of land use changes and obtain customized evacuation routes. These are excellent tools particularly in urban situations or in areas experiencing rapid growth.

- **Proactive Land Use.** Where growth is anticipated, clustering and town center concepts and development standards should be put in place well in advance of growth. Successful implementation requires regional adherence to clearly defined planning policies to achieve desired development patterns.

- **County and Municipal.** It is important to have established working relationships among county and municipal governments. If procedures are clearly spelled out and each party has distinct roles and responsibilities in planning efforts, potential future conflicts can be minimized.