The Kerr Scott Reservoir is the main water supply for Winston-Salem, and the greater Wilkesboro / N.Wilkesboro area. The US Army Corps of Engineers manages forestland around the reservoir, and there is abundant timber management being practiced in Wilkes County.

Water Supply Watershed Forests

A few key concepts (assumptions):

1st: Trees are Okay!

- Trees don't suck up all of the water
- Trees help Source Water & Wellhead Protection

2nd: Managing Those Trees is Okay!

- The forest need-not be a preserve or sanctuary
- Managing can prevent stagnation (of trees, not H_2O)

3rd: The public:

- Get input, address concerns, but...
- Manage expectations and stay the course

1st - It is true that trees absorb water from the soil: that is a natural process. If we lived in Arizona or west Texas, or some other really dry, arid region, this might be an issue. But here in the eastern U.S., trees provide a buffering-capacity to mitigate the pulse of stormflow after rains....similar to creating a void in your reservoir ahead of a large rain event. Forested watersheds provide a more reliable, consistent "base flow" -- even during droughty times -- when compared with a watershed that is largely developed, impervious, or agricultural. The research demonstrates that in the Eastern US.

Trees naturally mitigate nonpoint source runoff problems, use nutrients in the soil, and are a vital component to protecting source waters and wellhead areas. This presentation is not intended to give you lots of research facts & figures....but there is ample evidence on how different management regimes of forests can influence stream flows and local surface hydrology. Maybe that's another presentation.

The key to this presentation is item #2: we advocate for some, appropriate level of forest management, instead of thinking that the forest must be a preserve, or a sanctuary, or be left alone with "hands off". Forests can become "stagnant" too,....it doesn't just happen to water.

3rd - Above all, the public, or in your case, your customers and neighbors, deserve some level of input and communication about how your (their) source watershed areas should be managed. Addressing concerns from the start, getting the correct subject matter experts' technical advice, will help. But ultimately, to stay on-target, you will need to manage the expectations of the public, of your constituents, and customers.....perform your due-diligence, and stay the course once an appropriate management pathway is agreed-upon.

- Water Supply Operators have their own language
- Foresters have their own language

Water Systems

Parts:
Motors, Valves, Screens, Pipe

Sub-assemblies or Components:
Pump, Lift Station, Junction Box, Conduit, Tanks/Vessels

Systems or Processes:
Reservoir Intake, Pumping, Lifting, Flocculation, Filtration, Treatment, Storage, Delivery, Transport, Metering

Forestry

Parts:
Soil, Terrain, Aspect, Veg., Shrubs, Trees

Sub-assemblies or Components:
- **Compartment, Management Unit, Stand**
- **Tree Canopy Structure:**
  dominant, co-dominant, suppressed

System (examples):
Even Aged Pine/Conifer.
Two-Aged Upland (Xeric) Mixed Oak/Pine.
Bottomland Riparian Forest.
Even Aged Moist (Mesic) Hardwood Cove.

Each "System" requires a different management strategy, but each strategy often can use the same tools, methods or techniques, just applied or implemented in a slightly different manner.

All professions have their own language, with special terminology... And abbreviations. I'm not going to try to make you into foresters. But what I hope to do is use terms and phrases that I think will be familiar to managing a water system.....And then show how that same term can be applied to managing a forest system.

Let's start with the actual "system".

For a water system, there are Parts.... Those parts can be put together to create Sub-Assemblies or Components.... and then those Components can be linked to create Systems or Processes.

In forestry, the same basic idea applies. Then, when the parts are combined, we create Components. In Forestry, Components can be separated according to spatial area, on the ground: like Compartment, Mgmt. Unit, or Stand. Or...a Component can be considered as the overall tree canopy structure -- in other words, the vertical positioning of the tree-tops in the forest. Some trees are taller than others, and that will influence your management options. So we use words like Dominant, Co-Dominant, or Suppressed to describe vertical structure and relative position of the tree-tops in a forest.

Then, forest systems are made up of different components. Some generic examples of forest systems include: (see list). There are literally hundreds of different forest systems, depending on how you want to categorize a forest. But usually a Forest System is described according to the relative forest age + the type of site + the majority type of tree species.

Ultimately, for both Water Systems and Forest Systems, often we can use the same tools or management practices....but just applied in a different manner.

"Infrastructure"

Water Systems	Forestry
• The reservoir(s)	• The watershed land
• Intake, lifting & pumping stations	• The soil
• Treating & filtration apparatus	• The trees/vegetation
• Storage tanks	• Access roads
• Delivery conduits, pipes, meters	• Stream crossing structures

For the next several slides, I'll show 1 word at the top, and then compare how that term can be applied to both a Water System and for Forestry

For Forestry: it all starts with the land. Then, we have to start with the soil. The type of soil will determine what types of trees are best suited for that site (pines or hardwoods). Then, there are the actual trees and other vegetation on the site. The trees are the most obvious pieces of "infrastructure" that most people think about.

But also important is the infrastructure to access the watershed land: things like access roads; and, chances are, if you have roads....then there will also be the need for stream crossings on those roads. These stream crossings are important to make sure they are correctly designed, installed, and maintained. And a properly-constructed crossing can require a substantial cost investment.

"Inventory Control"

(Knowing What You Have & Where It Is)

Water Systems

- **Overall system capacity to produce/supply water**
- **Number of pumps**
  - ***Make, model, location, capacity, install date***
- **Miles & type of conduit**
  - ***Rolled steel, cast iron, poly, concrete, etc***
- **Types of meters**

Forestry

- **Soil types & inherent growth capabilities:**
  - ***Referred to as "site index"***
- **Forest Inventory:**
  - ***"Timber cruise, or exam"***
- **Forest "stands":**
  - ***Areas of trees which are similar in age & species.***
- **Miles & Types of streams**
- **Miles of roads/trails**
- **Natural Heritage inventory**
- **Cultural Resource inventory**

As noted before, you need to know what types of soils are on the property. The soil type will help determine not only the species of trees to grow, but also will give us a general idea of the maximum, natural growth capacity of that soil to grow certain species of trees. In forestry, that is called the Site Index. It describes an average tree height, for a given tree species, at a specified tree age (usually 25 or 50 years). For example, a Site Index of 120 feet for White Oak at Age 50 is an exceptionally productive site for growing White Oak.

Knowing what type of forest exists on the watershed can be known through a Forest Inventory....sometimes called a "timber cruise". Even if the trees are not going to be cut & sold as "timber".....this is the term that foresters will use sometimes.

Once the forest is inventoried, it can be separated into Components, or "Stands". A stand of trees usually is a lumping together of trees that are similar in relative age, and species of dominant trees.

Some other inventories that can be helpful to know include: < see list >

What tools do you use: GPS, GIS(ESRI)? Guess what, so does forestry. Same tools. Same Terms. Same tools.

"O&M": Operations & Maintenance

Water Systems

- Clearing the intakes
- Renewing treatment chemicals
- Conduit inspections
- Maintain electrical, hydraulic, mechanical components
- Painting storage tanks
- Replace broke meters

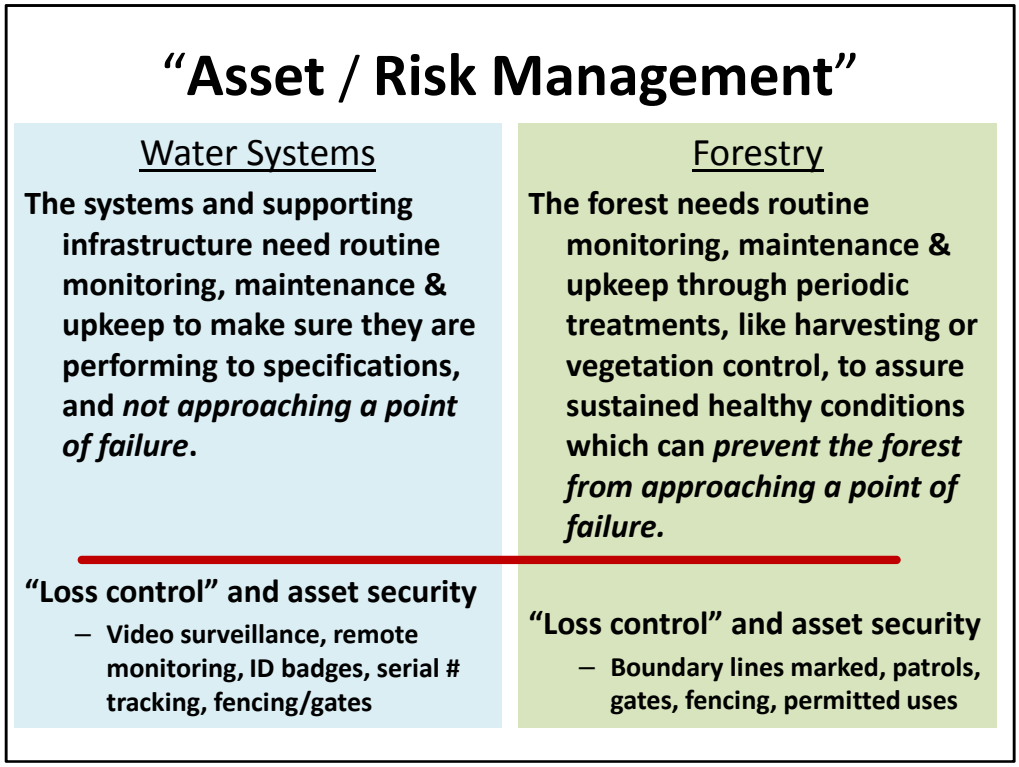
Forestry

- Routine Maintenance
  - Road grading
  - Marking boundary lines
- Managing sunlight & Optimizing soil growth potential
  - **Thinning**
  - **Crop Tree Release**
  - **Prescribed Burning**
  - **Herbicide or mowing**

In Forestry, some routine maintenance includes keeping the roads maintained, fixing erosion problems, cleaning away debris or obstructions on stream crossings, keeping the property boundary lines well-marked to avoid trespassing or encroachment.

But the biggest aspect of "O&M" in forestry is when foresters implement practices to manage sunlight and optimize soil growth potential.....with the goal of focusing these resources onto the most desirable trees in the forest.

This is accomplished by silvicultural treatments like: < see list >



Asset Management, or similarly Risk Management: This term refers to the holistic approach of managing the components in a way to allow the entire system to operate efficiently in a way that minimizes risk.

So, there are similarities between managing these 2 types of systems.

Another aspect of Asset Management is "loss control", or protecting the assets. I would assume that most water system facilities use things like: <see list>

In forestry, we have similar needs to protect the asset. We can post the property lines; patrol the property regularly to look for trespassing, vandalism, or erosion, or insect/disease damage, wind damage to trees, or theft, or encroachment. Gates can be installed on access roads. Fences can be put-up where needed to block unauthorized access. Permits can be issued to allow only certain uses of the property by specific individuals.

"Life Cycle Replacement"

Water Systems	Forestry
• Pumps wear out • Conduits rupture • Valves fail • Motors burn out • Tanks leak	• Trees don't live forever – **Rotation age, (Un-) Even Age, over-mature, declining** • Trees succumb to damaging agents – **insects, storms, disease, old age**
You don't replace the whole system at one time: too much impact (financially & operationally). **But you can conduct an annual cycle of replacing components... in a financially viable way... before they fail... to keep the system operating without disruption.**	**Replacing (harvesting) the entire watershed forest at one time is not appropriate or practical.** **But a periodic cycle of replacing components (stands) can keep the whole system (forest) operating with minimal disruption (from wildfire, insects, disease, excessive mortality).**

In Forestry, one of the hardest things to explain is the fact that trees do not live forever. They will die. In forestry, we use words to describe the relative age of trees when compared with other trees in the same forest. Words like Rotation Age, Even Aged Stands, or Un-Even Aged Stands, or trees that are Over-Mature or may be considered to be Declining, which usually means that more trees are dying than there are new trees regenerating.

Trees will succumb to natural, damaging agents: wind, insects, disease, lightning..... And honestly sometimes we don't really know of 1 specific cause for why a tree has died, other than it got old and finally died. A tree that is 160 years old is less vigorous and more susceptible to damaging agents then a younger tree.

"Capital Improvement, CIP, Cap-Ex"

Water Systems	Forestry
• Extend service into new areas • Replace pumps, force mains, junction boxes • Build new treatment facility, or make upgrades • Install new electronic remote meters	• **Land acquisition** • **Property line survey** • **Site prep & reforestation** • **New road construction** • **Old road close-out** • **Replace, install stream crossings** • **Stream restoration** • **Wildfire control capabilities** – Fire breaks; helicopter landing spots – Dry hydrants – Personnel training – Radios to talk with firefighters – Brush Truck; dozer; pumps; UTV/ATV

When it comes time to make Capital Investments in the system, Forestry is no different. The most obvious, and usually most costly, is to buy more land in the watershed. But another important part of Cap-Ex for forestry is to have a survey of the boundaries of land that you already own. Also, it is vital to make re-investments into properly preparing a site for reforestation, or re-generating a new forest. Making that investment will assure high levels of seedling survival and growth to jump-start the new forest.

Also, there may be a need to build new roads; or improve existing roads; or abandon and close-out old roads that are not needed,...or old roads which were not properly constructed and now are constant erosion headaches and trouble-spots. Going along with road improvements, there will likely be a need to install, or rebuild, or remove stream crossings along roads.

And, if somebody really wants to "think outside of the box", there may be opportunities to conduct stream restoration on the watershed lands. Or if you really want to impress and make friends with the state Forestry people, there are investments that can improve wildfire control capabilities, such as < see list>.

Different Worlds, Same Terms

Parts
Components & Sub-Assemblies
Systems & Processes

- Infrastructure
- Inventory Control
- O&M
- Risk Management
- Life Cycle Replacement
- CIP, Cap-Ex

Foresters and Water Supply Managers work in different worlds, but we can communicate by using the same terms. It's just that those terms mean different things. Remember terms like:

Parts....that's the soil and trees and terrain.
Components & Sub-Assemblies....that's Stands and Management Units; and Dominant Crown or Suppressed Crown
Systems & Processes....that's Even-Aged Upland Conifer System, or Riparian Bottomland Hardwood System

And when it comes time to actually manage the systems, the same words can be applied to both forestry and water supply systems, as I have described.

Examples in N.C.

Mountains (western)

- Asheville: 17,000 acres
- Waynesville: 7,300 ac.
- Wilkesboro & Winston-Salem:

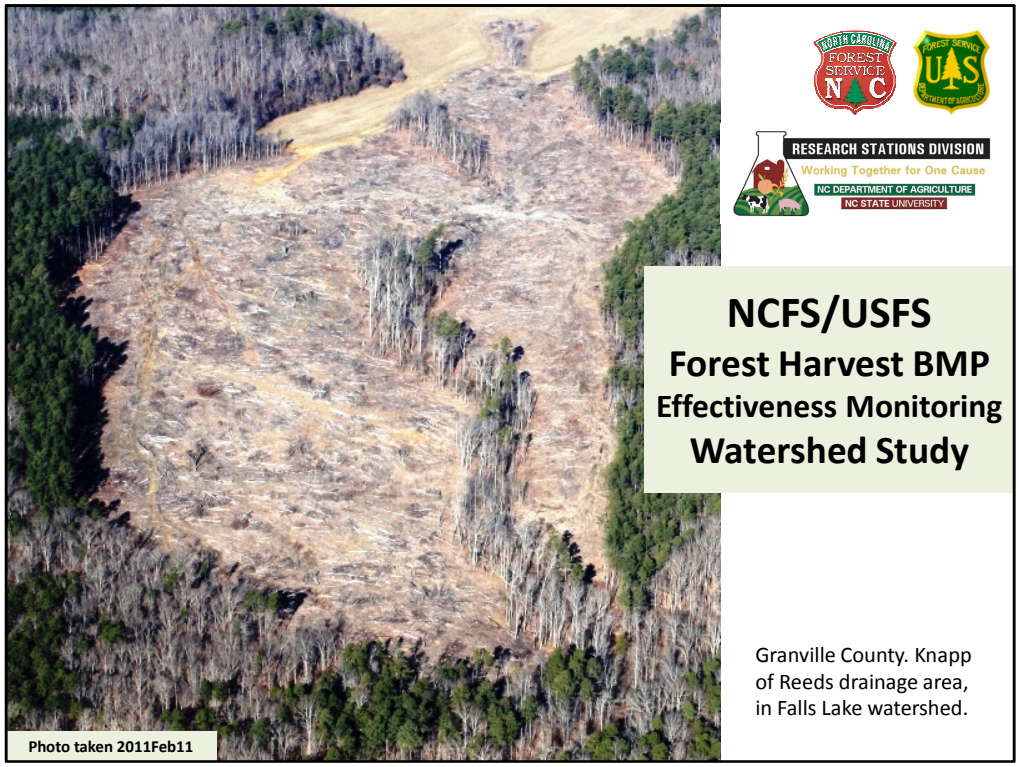
  USACE Kerr Scott Reservoir

Piedmont (central)

- **Watershed Study**
- **Mountain Island Lake Educ. State Forest**
  - Water Supply for Charlotte
- **Jordan Lake Educ. State Forest**
  - Water Supply for Cary, Morrisville, Durham
- Orange Water & Sewer Authority - OWASA
- USACE Kerr Lake

For the 2nd-half of this presentation, I want to show some photos of land being managed within Water Supply watershed properties, and talk in some detail about what you're looking at.

I don't have photos from all of these examples, listed here – only the one highlighted in red font.....but this is a general list of the some of the Water Supply properties that we know about, where some forest management is being done.



Together with the USFS we are doing a long term research study to see what effects -- if any -- a clearcut timber harvest may have, on the quantity of water and quality of water coming from the forest. We are examining the water volume flowing through that stream; and taking regular water samples from each stream to analyze for Nitrogen, Phosphorous, Total Suspended Sediments, Dissolved Organic Carbon, and water temperature. The main objective is to demonstrate that when Best Management Practices (or "BMPs") are used during harvest.....we should see no negative impacts to water quality.

This is 1 of 2 harvest study sites (~47 acres), this one is in Granville Co. on lands managed by the Research Stations Program of the NCDA&CS. Our other harvest study site is about 5 miles away no NCSU forest lands, in the Flat River watershed, which drains to Lake Michie, source of water for Durham. On this study site, you can see the stream buffer, and really see the diversity of pines and hardwoods in the area. This is really typical of the piedmont of North Carolina.

<QUESTION FOR THE AUDIENCE>: How wide do you think these stream buffers are, based on these 3 aerial photos you've just seen? .

The whole stream buffer is about 60-feet across, from side-to-side, on both of these study sites. There is a 30-foot wide buffer of trees on each side of the stream, so the total full width is about 60-ft. Both of these study sites are located in the Neuse River Basin; and there are special Buffer Rules which require that trees be left standing within 30-feet of each side of certain streams. Then, beyond that 30-foot mark, you are allowed to cut all of the trees, but you must retain the natural groundcover and not disturb the soil.

Mountain Island Lake Educational State Forest Gaston/Lincoln counties

~30 year old Planted Loblolly Pine stand: thinned & burned

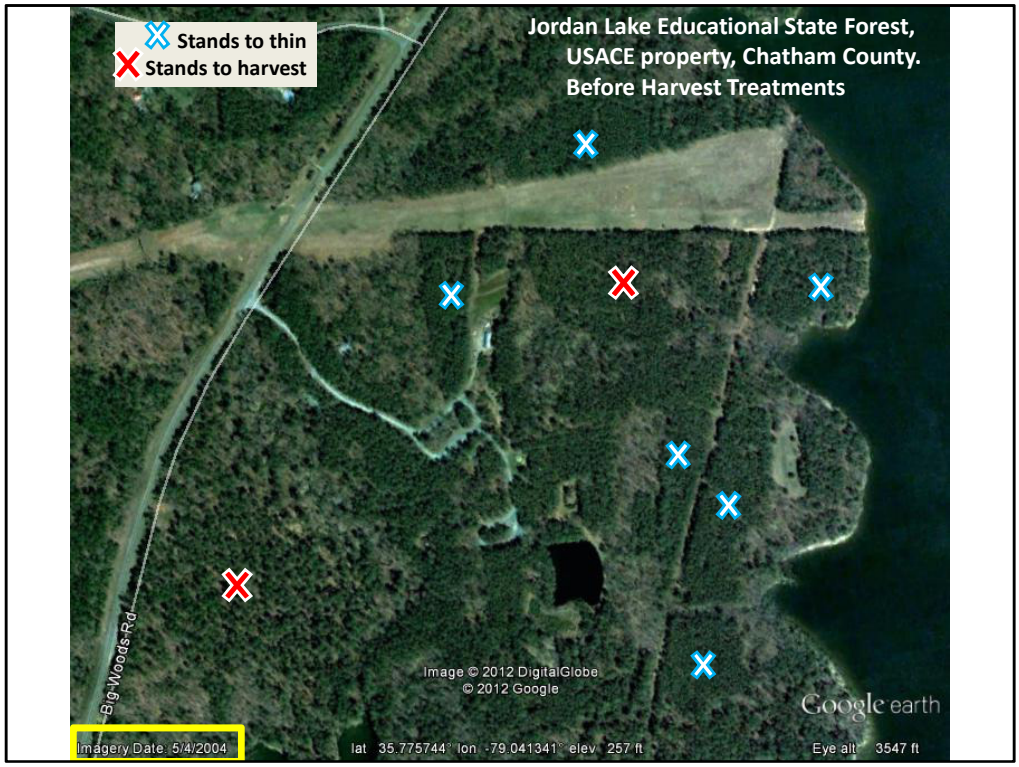
Mountain Island Lake Educational State Forest, located on the western side of Mountain Island Lake, straddling the Gaston / Lincoln county line.....north of Charlotte. This lake is in the Catawba River, and is the primary water supply for the City of Charlotte. The North Carolina Forest Service manages about 2,000 acres at this State Forest.

Photo on the left shows a freshly-improved forest road, with a thick layer of gravel stone applied (this is an example of your "Cap-Ex or CIP" investment work. The road, before this work, was just a muddy trail). The property lines are clearly marked and posted (an example of "O&M"-routine maintenance, and "Asset Management or Loss Control").

Photo on the right shows a stand of planted loblolly pines, about 30 to 35 years old, that have been thinned and had a prescribed burn run through the stand, to reduce competing vegetation and improve the wildlife habitat. Another example of "O&M" (operations and maintenance) of a Forest Stand "Component" to focus the sunlight and natural soil growth capabilities onto the most highly desirable trees in the Stand.

This is Jordan Lake Educational State Forest, along the western side of Jordan Lake. This lake is the water supply for the Town of Cary (population +/-140,000) ; and Town of Morrisville (pop. +/-19,000) and will become a secondary back-up water supply for the City of Durham (pop. +/-225,000). The property is owned by the Corps of Engineers, and the North Carolina Forest Service manages ~1,000 acres of it. That is Jordan Lake in the background.

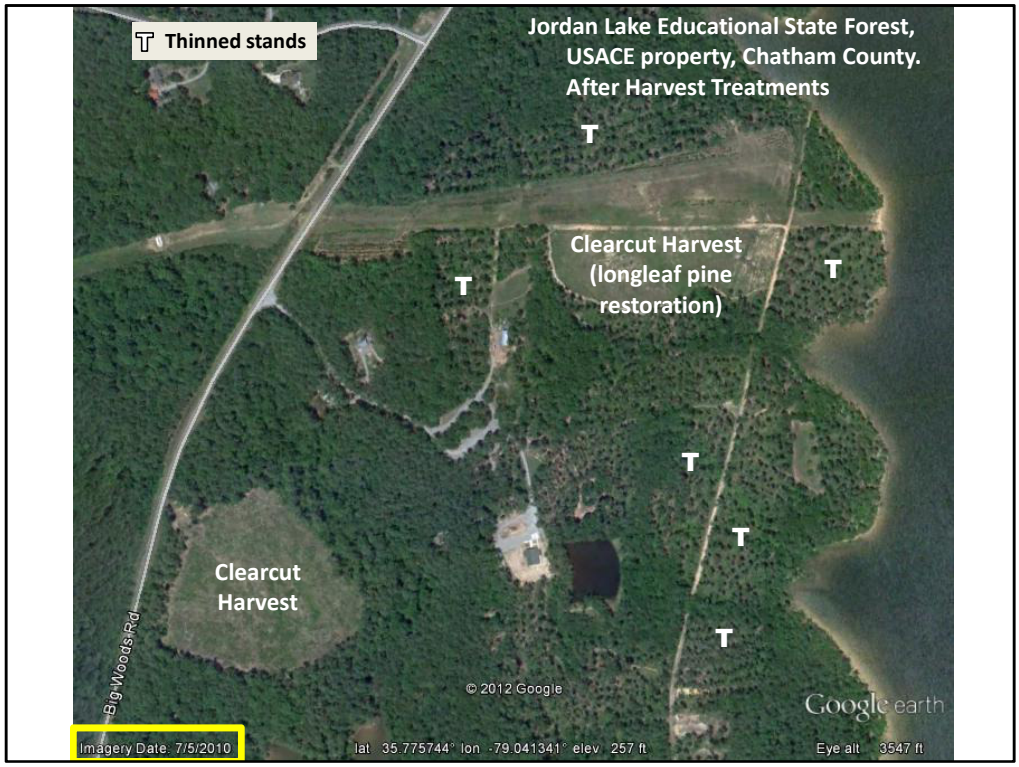
This stand of +/-75 year old Loblolly Pine was selectively thinned with a timber harvest. Then, a prescribed burn was run through the stand to reduce the logging debris and competing vegetation. Opening up the stand greatly improves the wildlife habitat, and increases foraging areas for Bald Eagles, Hawks, Owls, and Osprey. There are many Bald Eagles across Jordan Lake. And this area of the State Forest is over-run with deer. There are lots of wild turkey on the Forest, too. It's difficult to get all of the wildlife to pose in 1 photo, but there is no question that forest management activities can greatly enhance wildlife habitat for a diversity of wildlife.



This is an aerial satellite image of the Jordan Lake State Forest property. Looking at the lower-left corner, this photo was from 2004, before a lot of the harvest treatments were conducted.

Notice all of the dense, green shapes on the photo: these are pine timber Stands. Using aerial photos is a good tool for doing your "Inventory Control" of your forest infrastructure....the photos allow you to see what's out there, before actually going into the woods. This photo was taken in early May 2004, so the hardwood trees had not fully leafed-out yet.....that lets you see the difference between the dense, green pine stands and the open, gray-colored hardwood areas.

The next slide after this shows the aerial photo "after" the harvesting work, and I'll switch back & forth a few times to compare them. You can pay attention to the areas on the photo marked with a small X. Those are the places where you should see the most difference between the 2 aerial photos.



This aerial photo was taken in 2010 (six years later). A lot of harvesting work has been done. The most notable are the 2 clearcut harvest areas. The clearcut area on the North is where you saw those Longleaf Pine restoration photos, just before couple of minutes ago.

The places on the photo that have the letter " T " are where the stand was Thinned, or selectively cut through the standing trees. Let me flip back to the previous photo, to see the difference:

You can see how the Pine areas are not as dense or deep/dark green. The pine stands are more open now, and the trees are spaced-apart to allow more sunlight onto the surface of the ground, stimulating more native grass growth, and allowing the healthier trees to absorb more sunlight and soil nutrients, now that excessive competition has been removed.

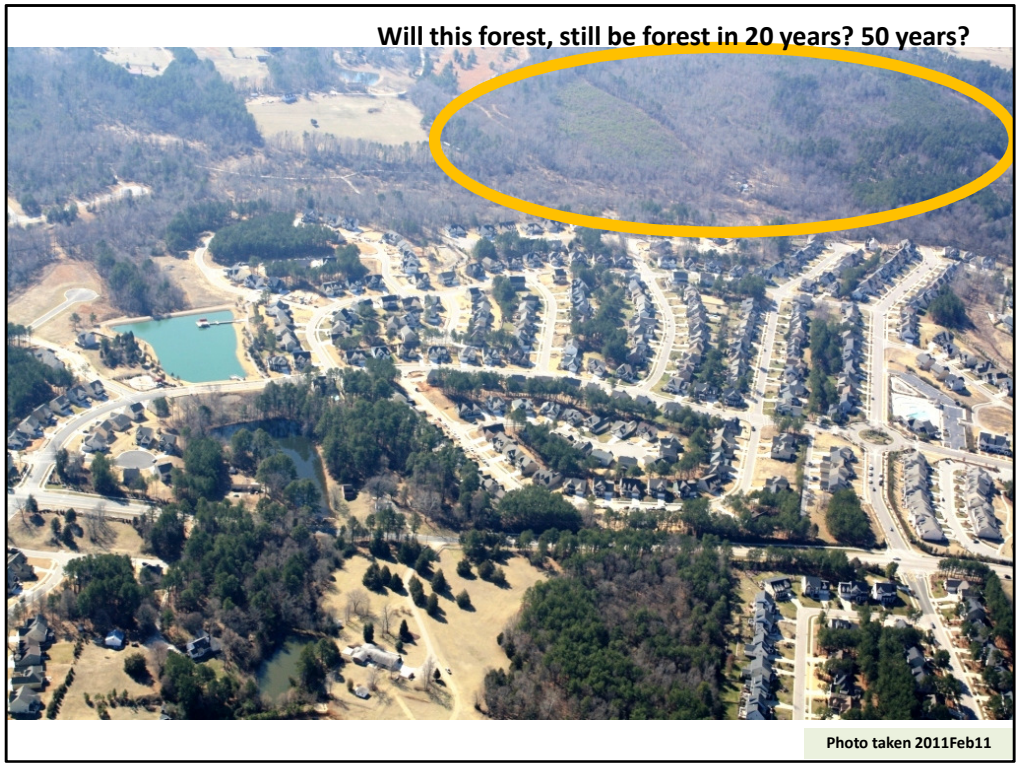
The stand that was Thinned, on the upper/right, along the southern edge of that right/of/way corridor, immediately adjoining Jordan Lake: This is the same stand of trees that I showed back a few slides, when I first started talking about Jordan Lake State Forest:

So, I just wanted to show an example of how some of this harvesting work looks like, looking down from above. I guess my intent was to demonstrate that even when things look pretty harsh, or un-sightly, when standing on the ground -- immediately after a timber harvest -- if you look at the overall landscape, and see how that harvest work fits into the bigger picture of the Forest System, or the whole Watershed.....usually that harvest work is a small alteration which is temporary..... and it can be done in a way that is appropriate for property objectives.

Photo taken 2011Feb11

This is a photo in central North Carolina, I'm not sure where it was taken. But you can see an area that was clearcut, and see the stream buffer along the left-hand edge of the harvest area.

Something that stands-out in this photo: Even after the recent clearcut.....the only visible bare soil that you can see in the harvested cut-over area is where the main skid trail was located. Once this site re-grows with new trees, that temporary impact will be nullified.



Everybody has to live somewhere.....we just hope that we can keep enough areas in North Carolina where growing trees will still be a financially-viable option for land owners.....instead of growing houses.

If you can only remember 1 thing from today: healthy forests = clean water!