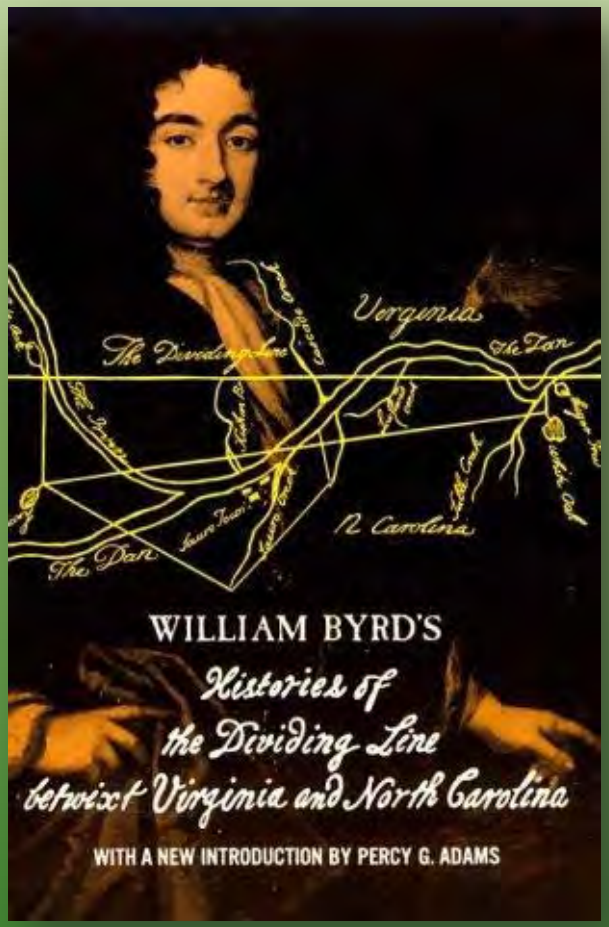
Effects of Recent Fires in the Great Dismal Swamp National Wildlife Refuge 2002-2013

Laura R. Mitchell
Regional Biologist
USFWS

The globally rare, peatland forests of the Great Dismal Swamp NWR, long in decline, face accelerating threats

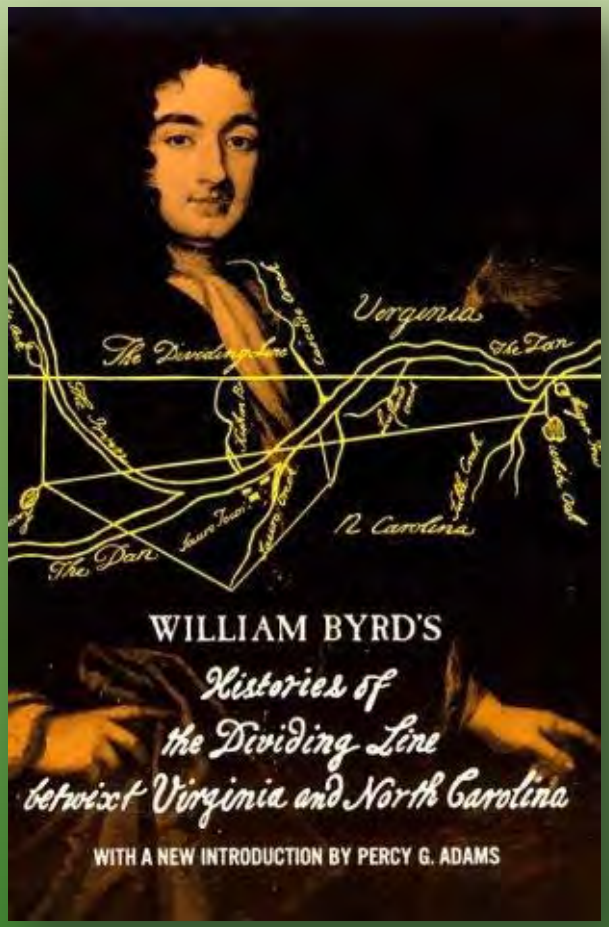
Great Dismal Swamp National Wildlife Refuge, Lateral West Fire, Sept. 2011, looking north from Corapeake Ditch Road (L. Mitchell).

Colonial Period

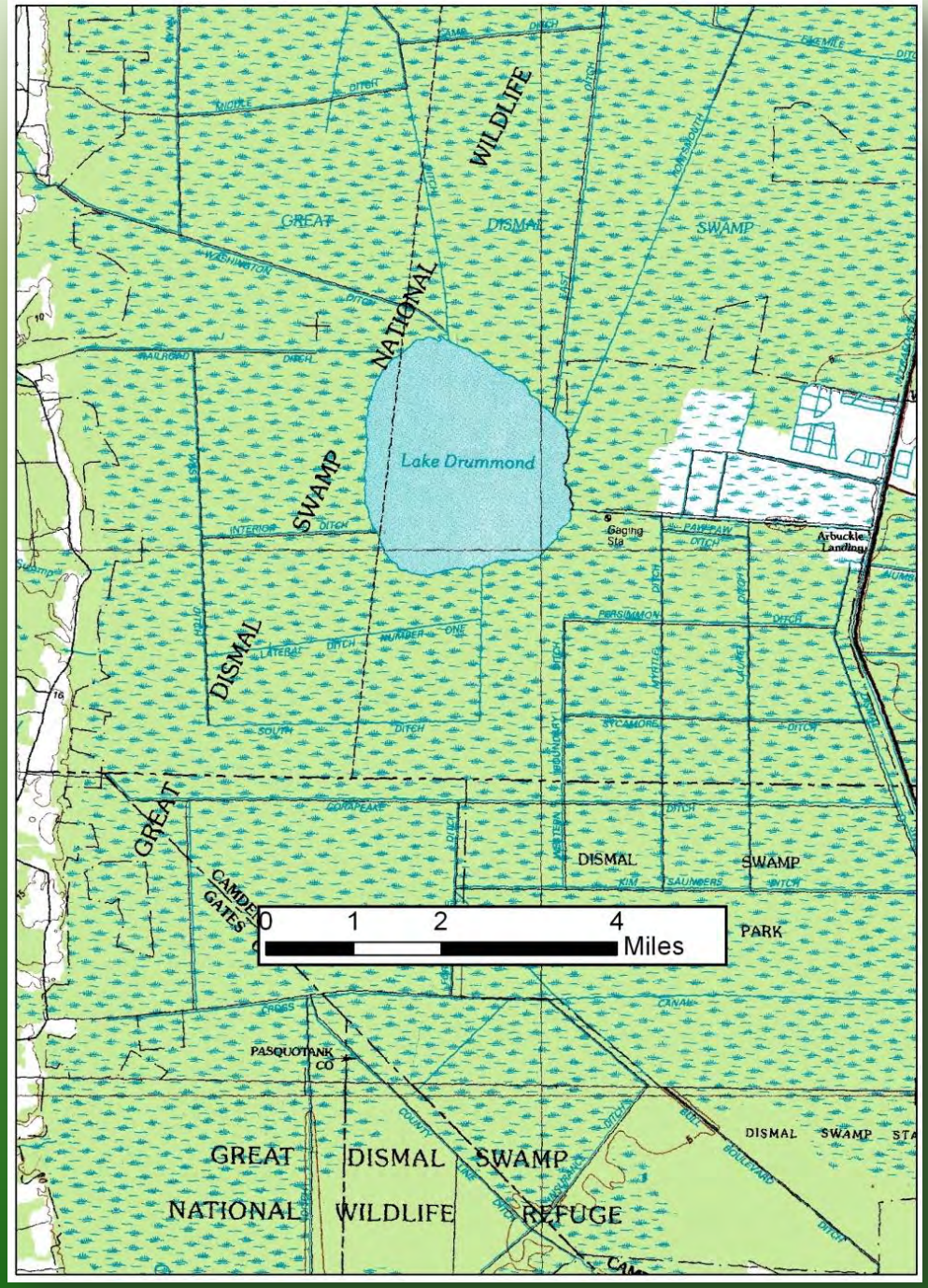


"They marcht from Morning till Night, and Computed their Journey to amount to about 4 miles...It was all along a Cedar-Swamp, so dirty and perplext…. " – William Byrd

Colonial Period



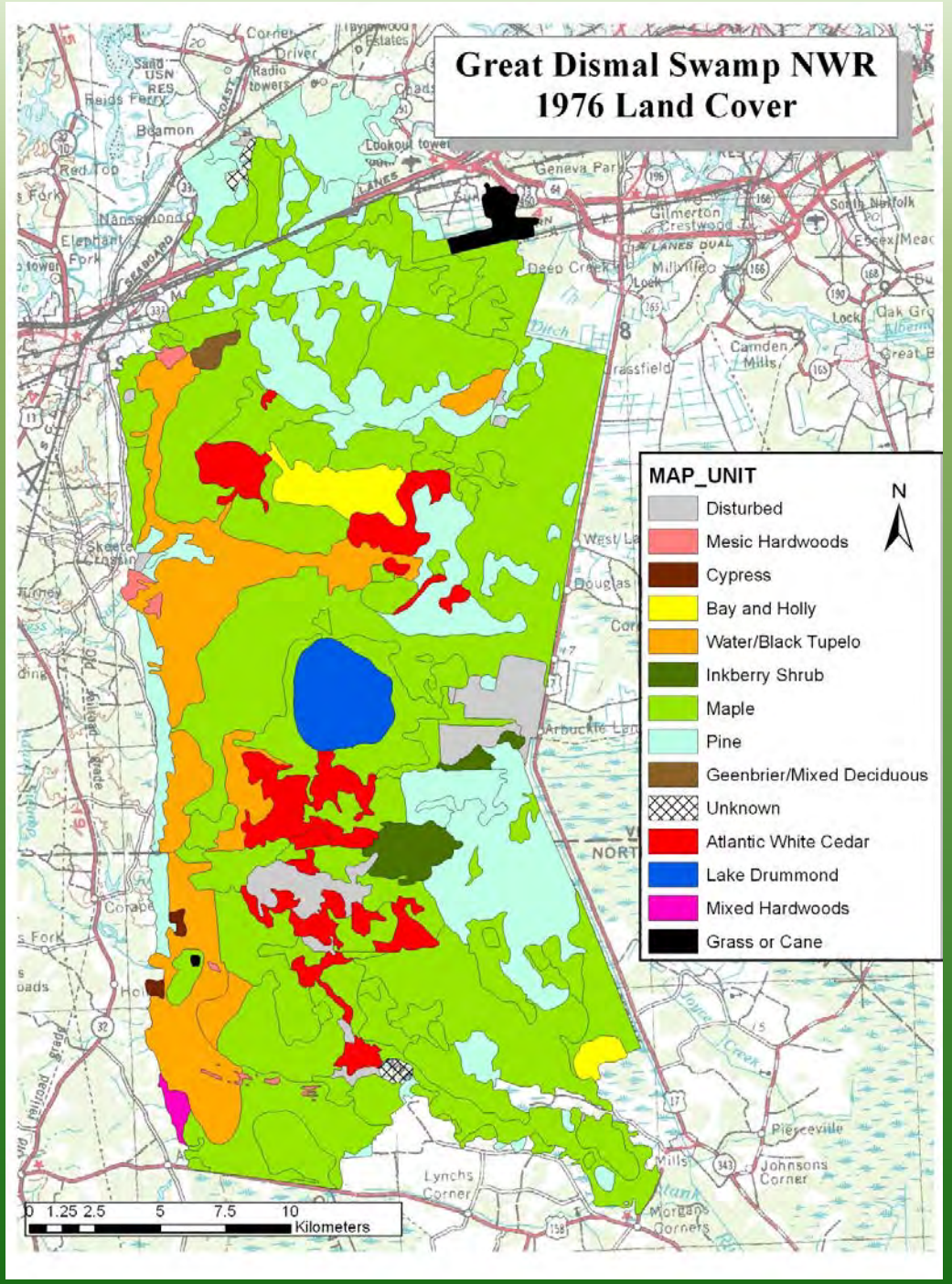
"They marcht from Morning till Night, and Computed their Journey to amount to about 4 miles...It was all along a Cedar-Swamp, so dirty and perplext…. " – William Byrd



Peatland Atlantic White Cedar

Unit 1, west of Forest Line Road, prior to 2003, B. Poovey, GDS NWR.

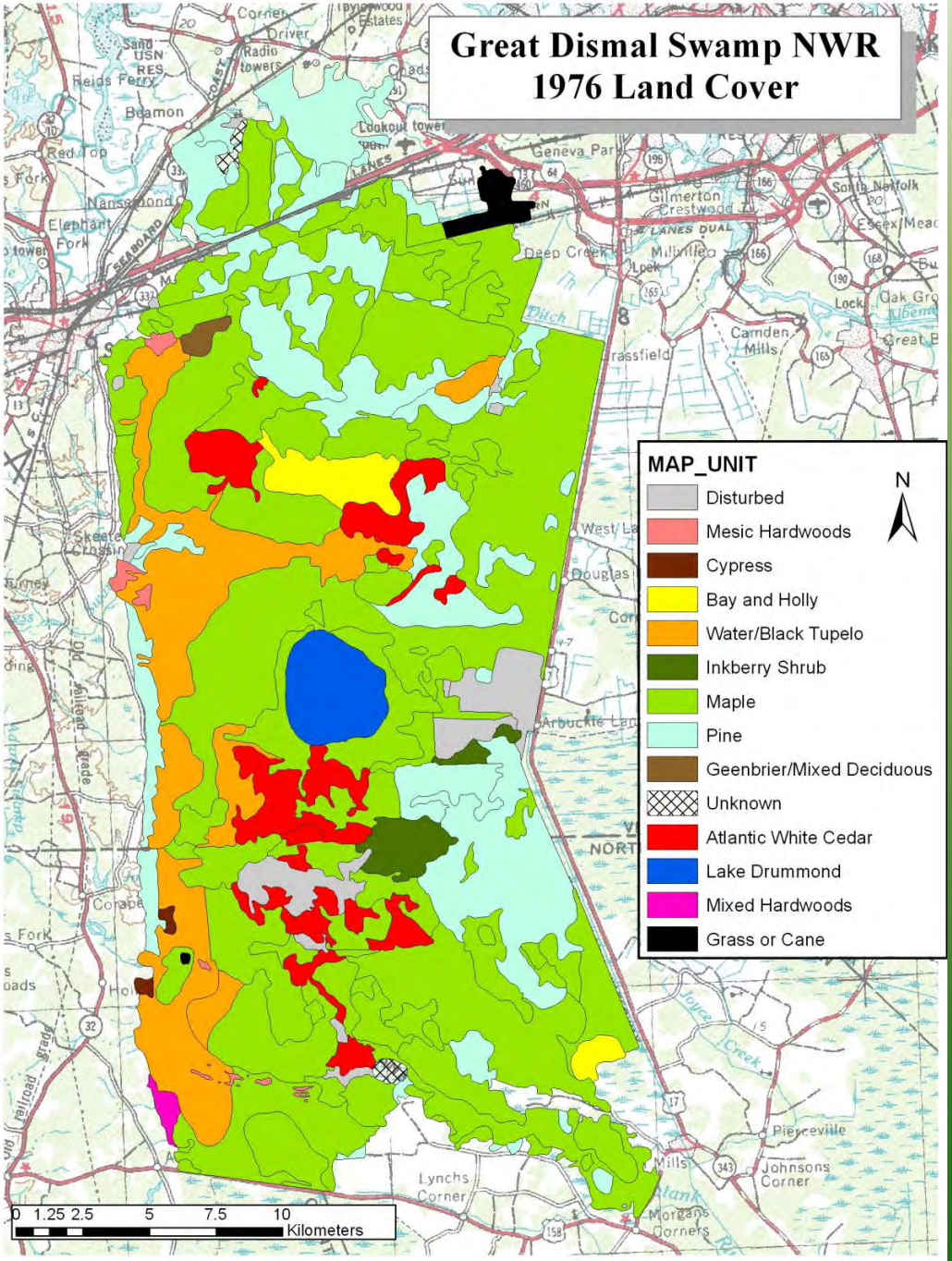
AWC stand at GDS NWR, prior to 2003, B. Poovey, GDS NWR.



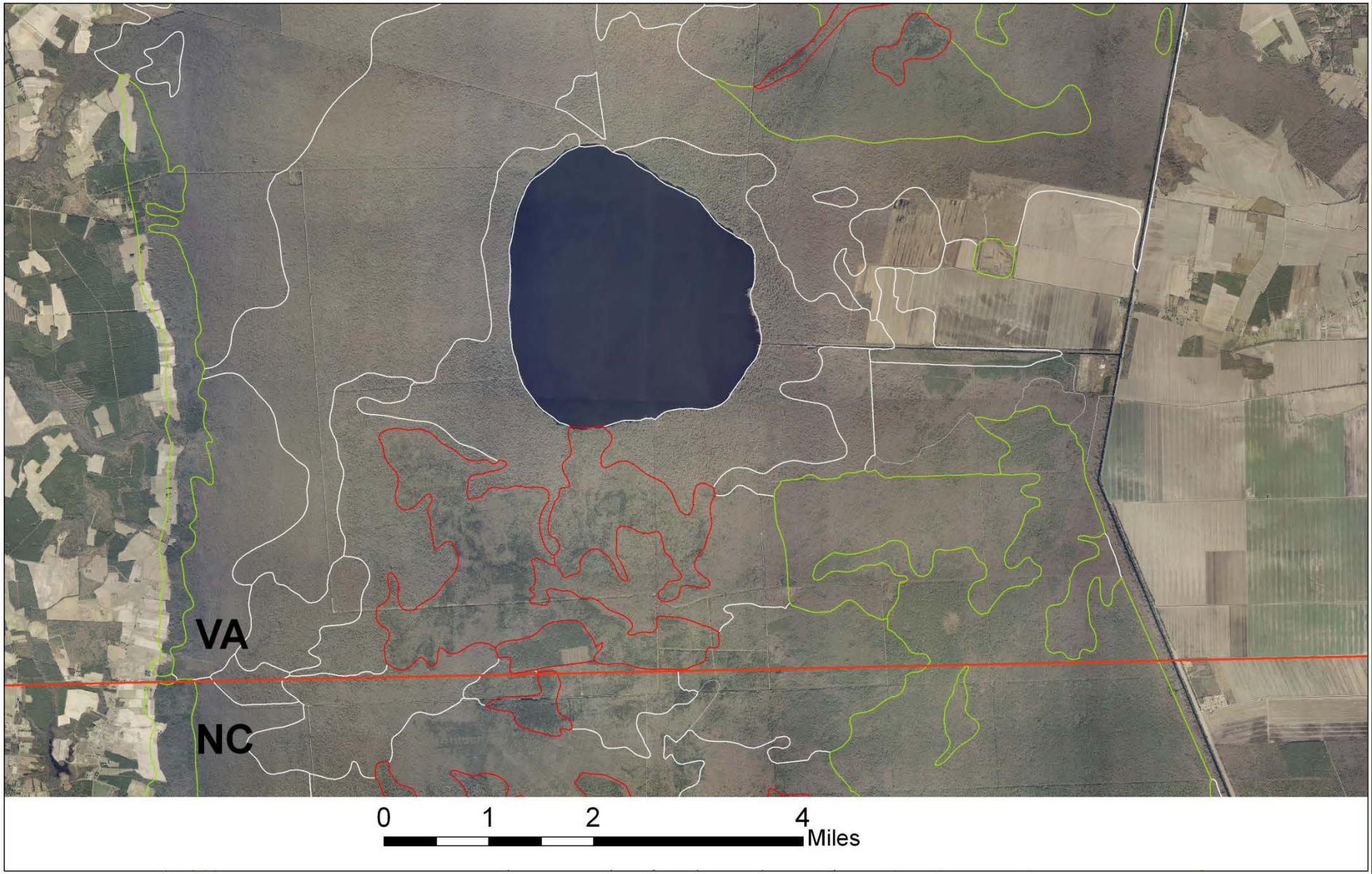
Pond Pine Woodlands and Pocosins

Pond Pine Woodland in Virginia Beach, T. Rawinski, courtesy of VA DCR Natural Heritage Program.

Pine Woodland east of Myrtle Ditch, 1999, B. Poovey. GDS NWR.



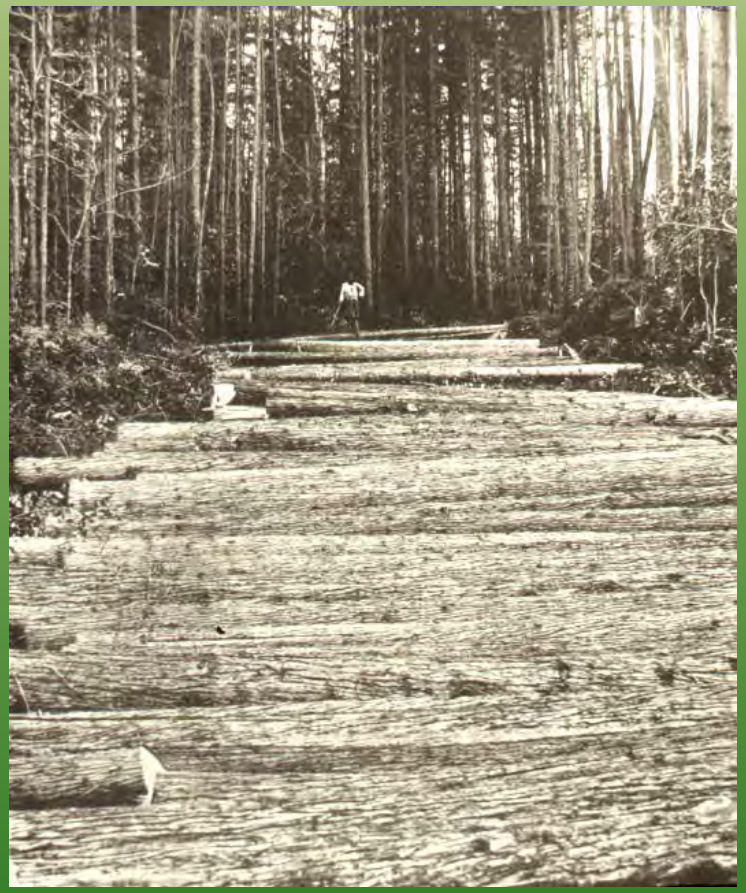
Peatland Forest Changes During USFWS Ownership



Central region of GDS NWR, true color digital orthophoto, leaf-off, Spring, 2002.

Long-term Forces Contributing to Decline of Rare Peatland Forests at GDS NWR

Past timber harvest practices



Historic Atlantic White Cedar harvest in VA/NC, from C. Frost.

Long-term Forces Contributing to Decline of Rare Peatland Forests at GDS NWR

Past timber harvest practices

Altered fire regime

Red Maple dominance at GDS NWR (Courtesy of B. Watts at Center for Conservation Biology)

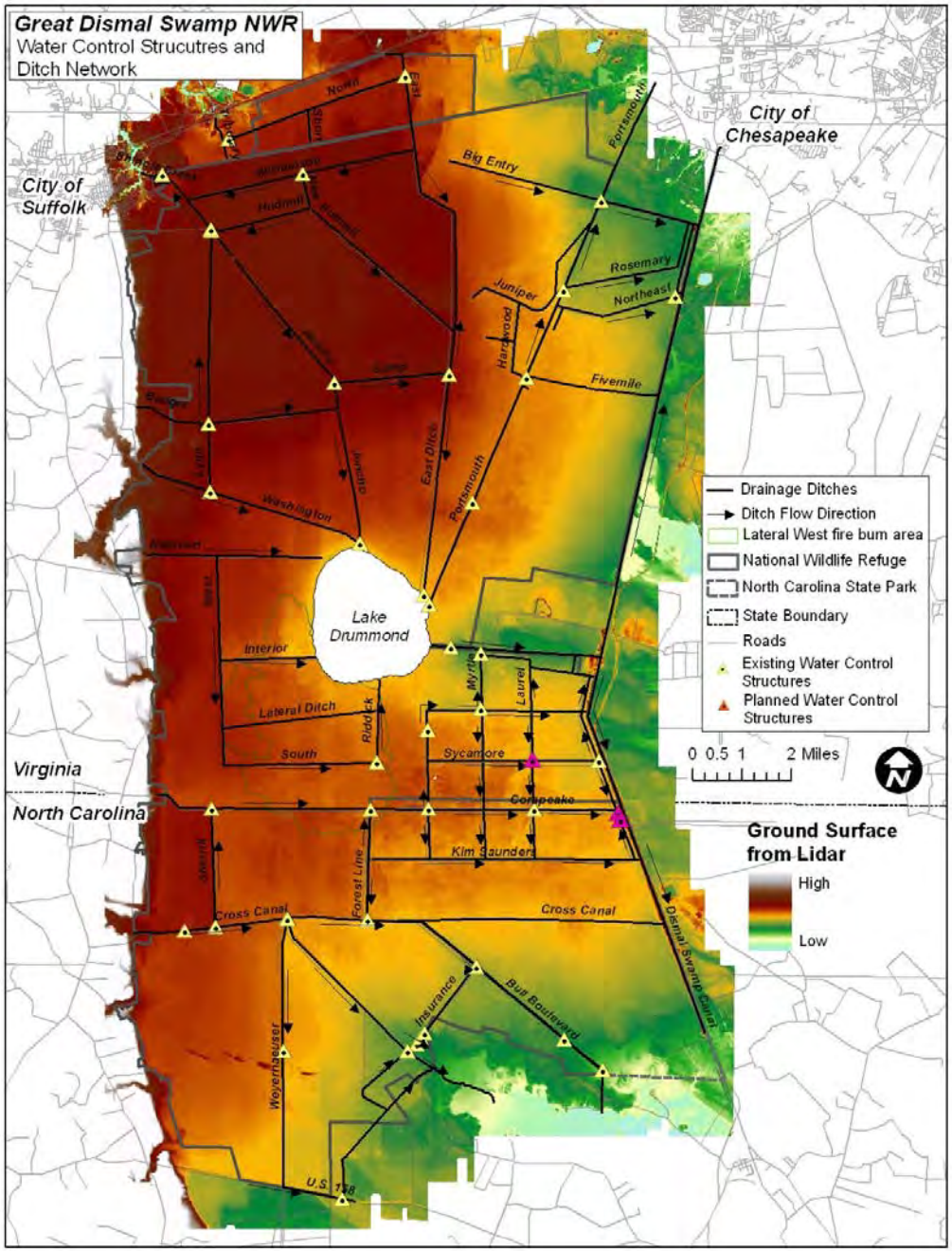
Long-term Forces Contributing to Decline of Rare Peatland Forests at GDS NWR

Past timber harvest practices

Altered fire regime

Drainage network

West Ditch, GDS NWR



Myrtle North Ditch Weir, GDS NWR, by F. Wurster.

Temporary check dam, Interior Ditch, during Lateral West Fire, GDS NWR, by L. Mitchell.

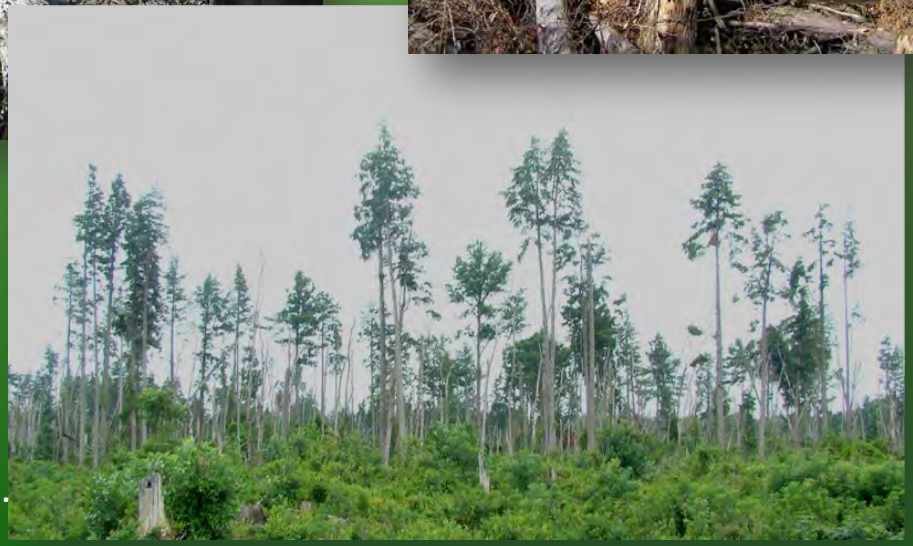
Hurricane Isabel, September, 2003

- Reached Category 5 status; made landfall on the Outer Banks of NC with winds of 105 mph (165 km/h) on September 18
- Most significant storm to hit NE NC and SE VA since Hurricane Hazel (1954) and the Chesapeake-Potomac Hurricane (1933)
- Significant wind throw impacts at GDS NWR and adjacent Dismal Swamp State Park

The eye of Hurricane Isabel approaches North Carolina's Outer Banks in this true-color Moderate Resolution Imaging Spectroradiometer (MODIS) image captured by the Terra satellite on September 18, 2003 at 11:55 am US Eastern time. Jacques Descloitres, MODIS Rapid Response Team, NASA/GSFC.

Refuge staff estimate that 90% or more stems were felled in each of the last AWC stands during the storm.

AWC stands at GDS NWR, after Isabel, by B. Poovey.

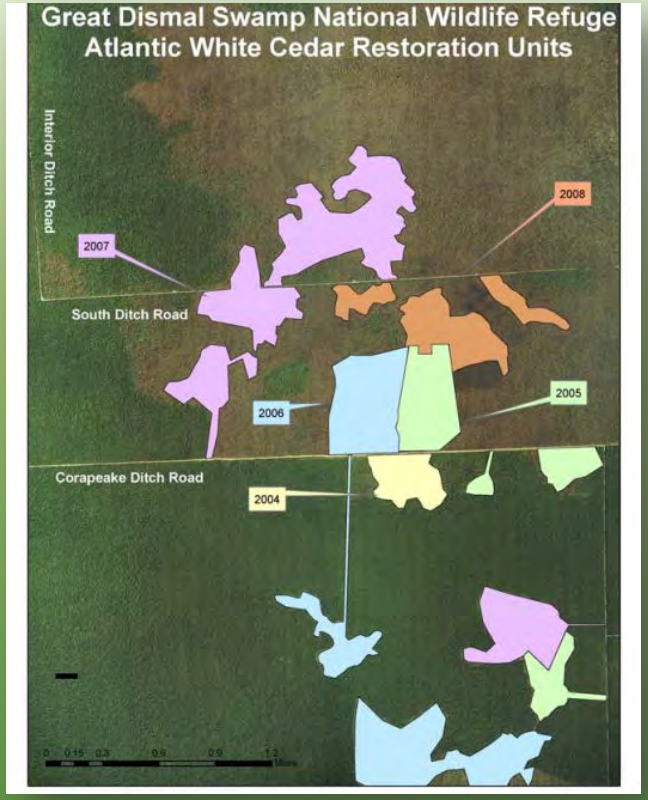


AWC stand, 5 years later, by L. Mitchell.

Maple/Gum/Cypress near Cross Canal inflow blown down by Isabel, by B. Poovey, GDS NWR.

AWC Salvage

- Started with “experimental” 60 acre unit; moved on to large-scale salvage of up to 1,100 acres of AWC
- Contractor removed competing hardwoods
- Contractor used a combination of low ground pressure vehicles and helicopters to minimize ground compaction/disturbance



10,000 pounds per helicopter run (B. Poovey, GDS NWR).

A low ground pressure forwarder (B. Poovey, GDS NWR).

AWC Salvage

- 2004-2008, 1,146 acres salvaged, 6.5 million board-feet AWC removed, reduced 25,000 tons fuel
- Kept surviving trees to provide continuous seed source
- Established monitoring plots for regeneration rates
- Regeneration began immediately after salvage; between 2,500 to 7,000 seedlings/ acre, depending on site conditions

AWC harvest unit, GDS NWR, by B. Poovey.

Regeneration monitoring plot, GDS NWR, by B. Poovey.

Seed trees, GDS NWR, by B. Poovey.

Increasing Restoration Success

The Refuge applied Imazapyr, at low concentrations, by helicopter, to reduce competition by *Acer rubrum*, *Smilax* spp., other shrubs and vines.

These photographs are from 2008.

Unit salvage logged in 2005 (photo by L. Mitchell).

Unit salvage logged in 2004 (photo by B. Poovey).

Unit salvage logged in 2004 (photo by L. Mitchell).

Ecological Timber Harvest: Pond Pine Woodland and Pocosin Restoration at GDS NWR

Objectives – remove hardwoods, restore pine overstory, evergreen shrub understory, cavity trees for RCW habitat, pine regeneration

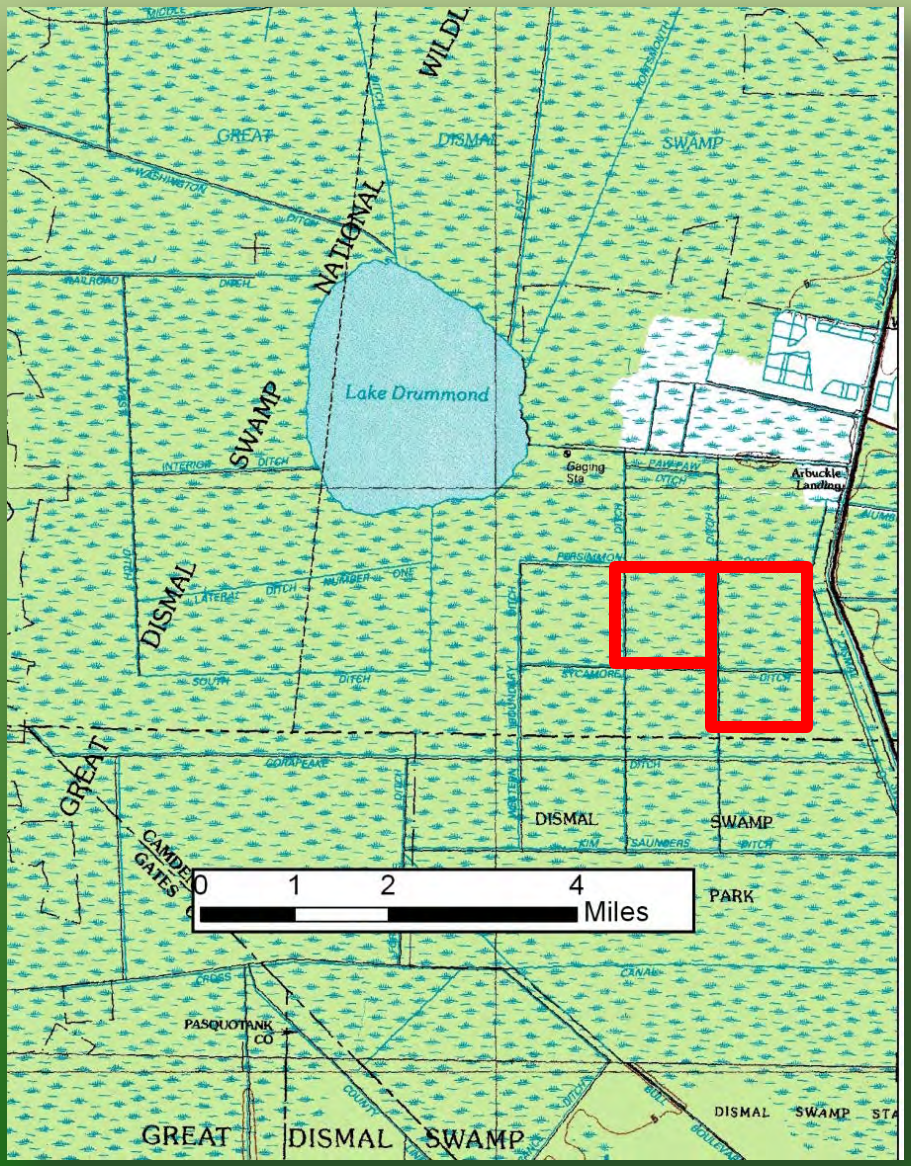
Ilex glabra, G. Fleming, courtesy of VA DCR, Natural Heritage Program.

Pond Pine Woodland restoration unit at GDS NWR, 1-2 years post-harvest (L. Mitchell).

Ecological Timber Harvest: Pond Pine Woodland and Pocosin Restoration at GDS NWR

Objectives – remove hardwoods, restore pine overstory, evergreen shrub understory, cavity trees for RCW habitat, pine regeneration

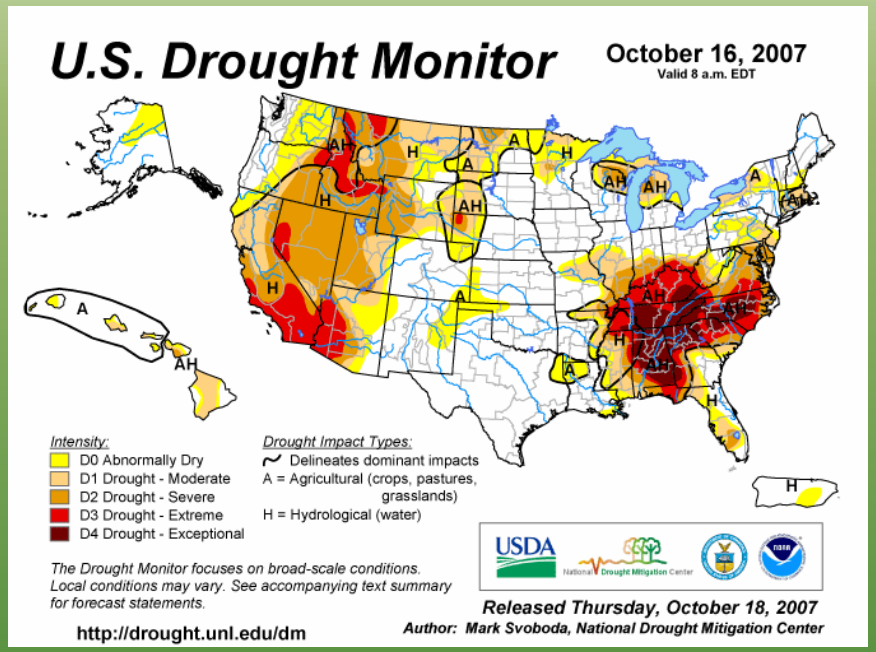
Ilex glabra, G. Fleming, courtesy of VA DCR, Natural Heritage Program.

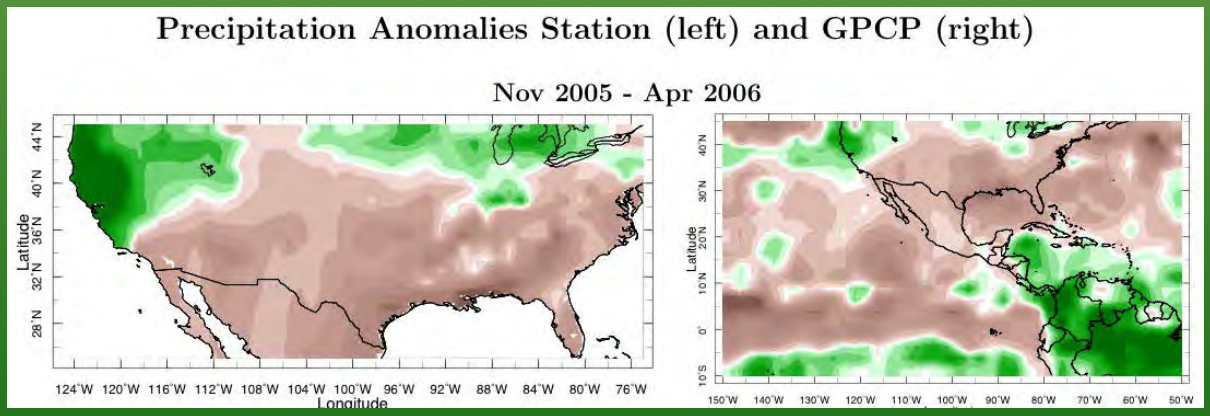


Droughts in the Southeast

Throughout 2000-2011, droughts in the southeastern U.S. lead to longer fire seasons, more intense fires, and more severe fires.

Ground water levels measured adjacent to the refuge have dropped by more than 15 feet since 1985.





Seager, R., A. Tzanova and J. Nakamura, 2009: Drought in the Southeastern United States: Causes, variability over the last millennium and the potential for future hydroclimate change, Journal of Climate, 22, 5021-5045

Refuge Wildfires 2004-2007

- Corapeake Road Fire (May 2004, 280 acres)
- Crosscut Fire (April 2006, 40 acres); lightning strike, AWC salvage unit
- West Drummond Fire (April/2006, 545 acres), north of Interior Ditch
- 2007 – Fifteen lightning starts in one month time frame, including several multi-start days
- McPherson Road Fire (NC) 2,300 acres

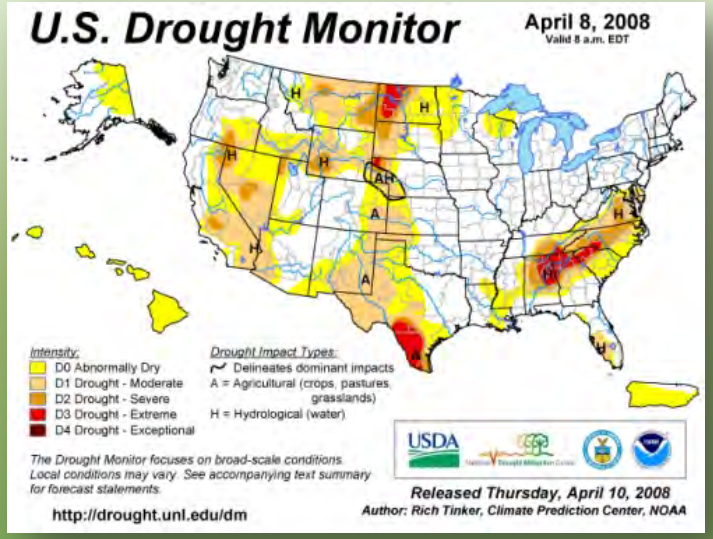
Photographs courtesy of GDS NWR Fire Program.

2008 Fire Season

Close up of burned over equipment, A. Winter.

South One Fire – started June 9, 2008, at GDS NWR; logging equipment caught fire; burned 4,884 acres

Evans Road Peat Fire – started June 1, 2008, affected Pocosin Lakes NWR; lightning caused, contained August 5, 2008; burned 40,000 acres



NASA image created by Jesse Allen, using data provided courtesy of the MODIS Rapid Response team.

SOUTH ONE WILDFIRE, 2008

The South One Wildfire burned rapidly through AWC salvage units, and smoldered for months in the non-riverine swamp forest at GDS NWR, by L. Mitchell.

True color imagery of the central GDS NWR, and the fire perimeter, flown September, 2008, USFWS.

Effects of Burnout Operations

Burnout operation, South One Wildfire, by E. Bader

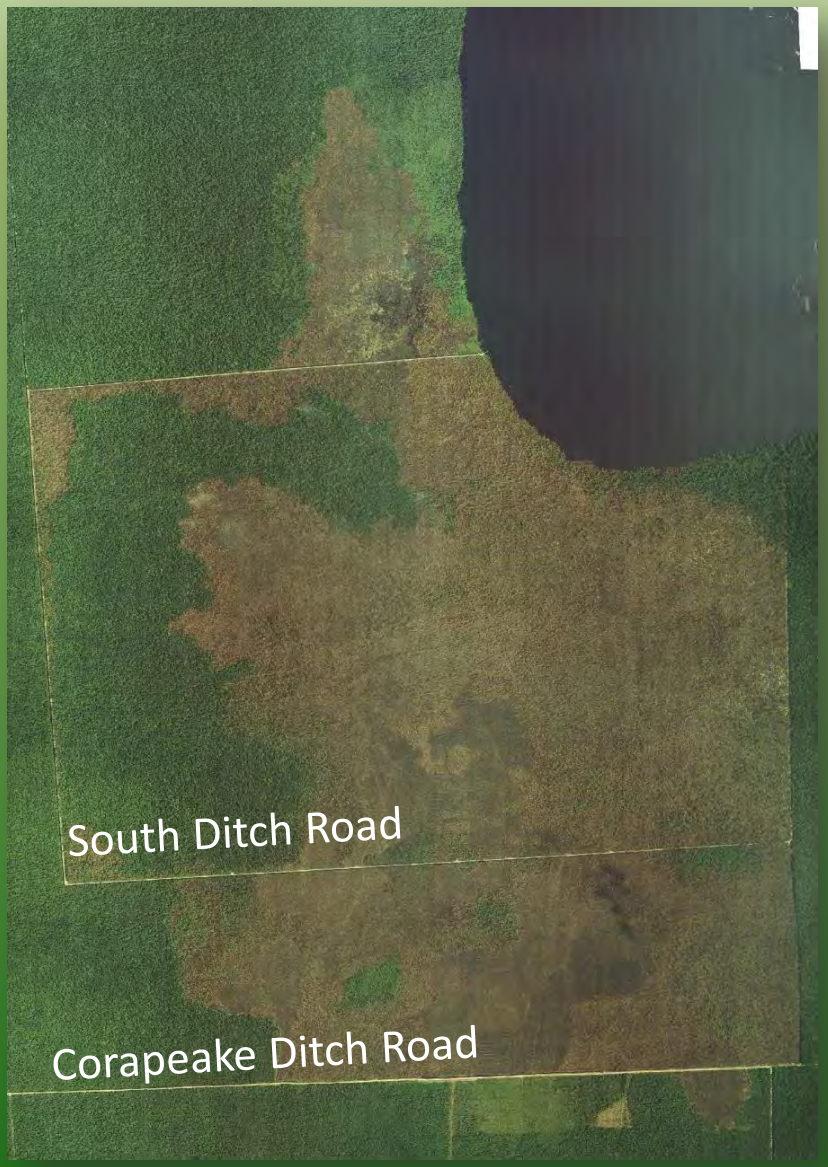
Severe peat loss in burnout along Corapeake Road, , South One Wildfire, by L. Mitchell.

Burned Area Rehabilitation

Refuge consulted a Burned Area Emergency Rehabilitation (BAER) team, and decided to attempt AWC replanting.

Refuge conducted a Severity Assessment within the fire perimeter, focusing on former AWC stands. The purpose was to guide AWC reestablishment efforts, funded by national Burned Area Rehabilitation dollars.

Refuge staff calculating Composite Burn Index (Photo credit: L. Mitchell)



“High Severity” Areas

- Drought led to prolonged combustion; smoldering fire burned away the surface tier and well into the subsurface tier (below 30 cm) of the peat in much of the maple/gum swamp forest
- Also in burnout operations along Corapeake Ditch

Photos by L. Mitchell

“Low to Moderate Severity” Areas

- 781 acres of 1,100 acres AWC harvest/regen. units burned over
- BAER team determined re-planting was feasible in these areas

Photos by L. Mitchell

Photo of burned AWC unit, Courtesy of Christopher Newport University.

Hindsight

- BAER team cautioned that the problem of excessive drainage in swamp had not been addressed

- Report stated “there is tremendous …need to rehydrate the swamp, to stem the desiccation of the AWC forest and other forest types…reduce the fire threat”

- BAER team warned that there was a massive fuel problem– the 3,700 acres of burned, swamp forest posed a future wildfire threat

Hindsight

- BAER team cautioned that the problem of excessive drainage in swamp had not been addressed

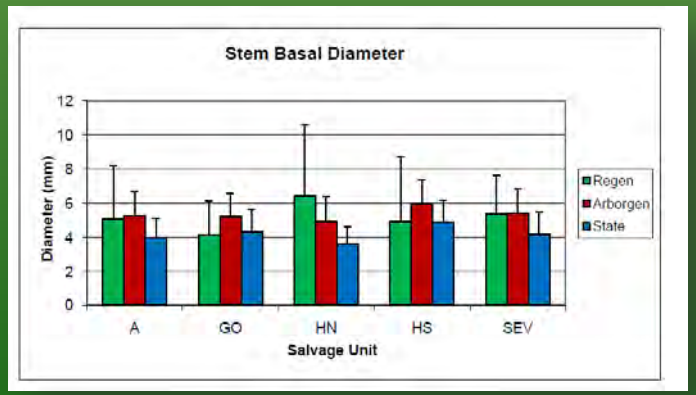
- Report stated “there is tremendous …need to rehydrate the swamp, to stem the desiccation of the AWC forest and other forest types…reduce the fire threat”

- BAER team warned that there was a massive fuel problem– the 3,700 acres of burned, swamp forest posed a future wildfire threat

Burned Area Rehabilitation Great Dismal Swamp NWR

BAR plan accepted December, 2008 ($299,000)

1. Seedling regeneration survey, to prioritize sites and establish planting density
2. Contract grew and planted 234,000 native AWC seedlings over 2008-2011
3. Imazapyr applications, July 2011
4. Research plots: Compare tree health among naturally regenerating AWC, contract- grown AWC grown clonally, and contract-grown AWC grown from seed
5. Factors: percent mortality, seedling regeneration, plant height, canopy diameter, stem basal diameter, water table depth, soil elevation



Figures courtesy of Christopher Newport University.

Meanwhile, the fuel bed in the South One re-grew into a tall grass fuel type….

August 4, 2011: The Lateral West Wildfire

The Lateral West Wildfire burns south toward Corapeake Road, through former AWC planting units (by M.Petruncio/North Carolina Forest Service).

July 2008

Sept. 2011

South One and Lateral West photos by L. Mitchell.

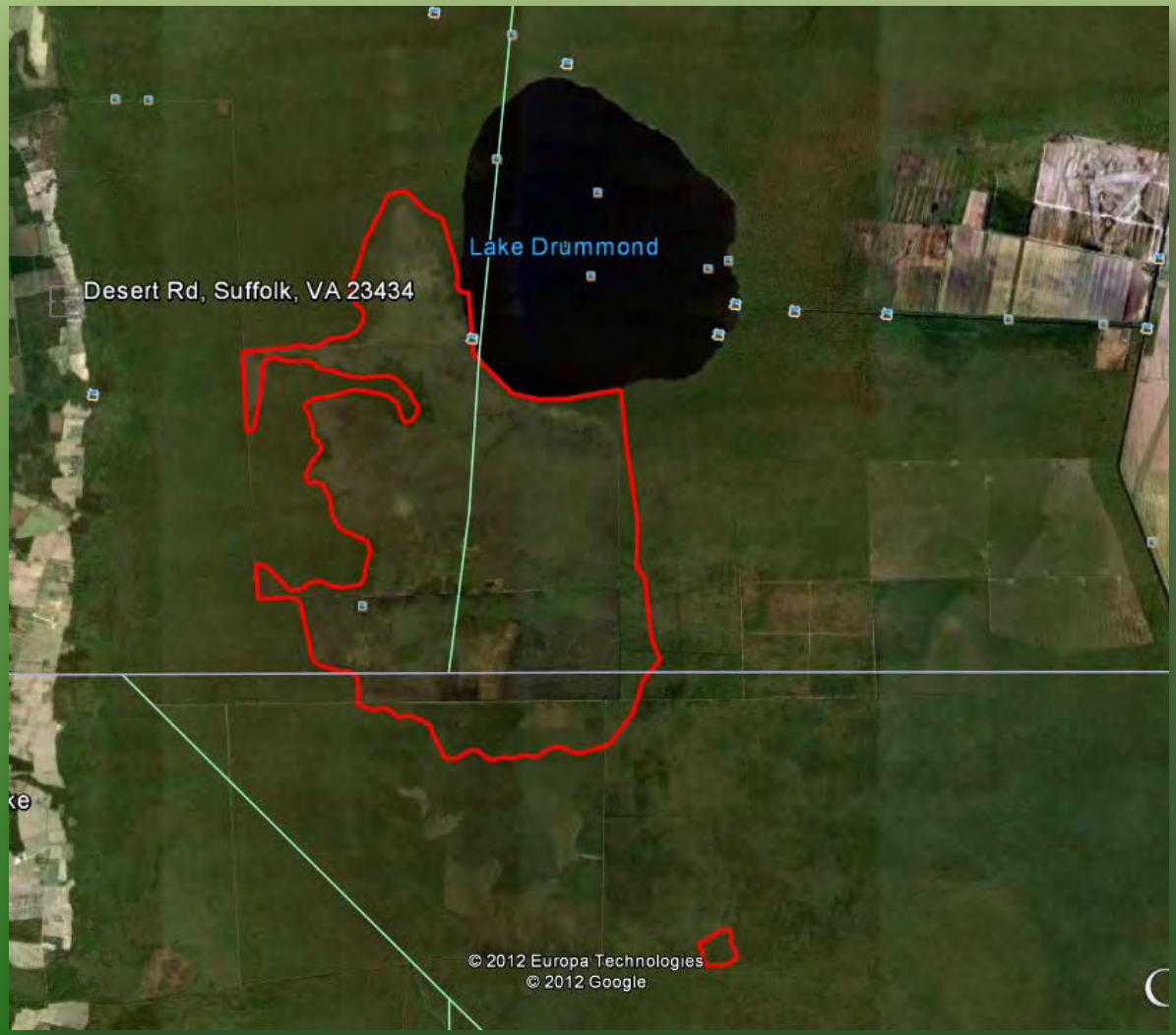
July 2008

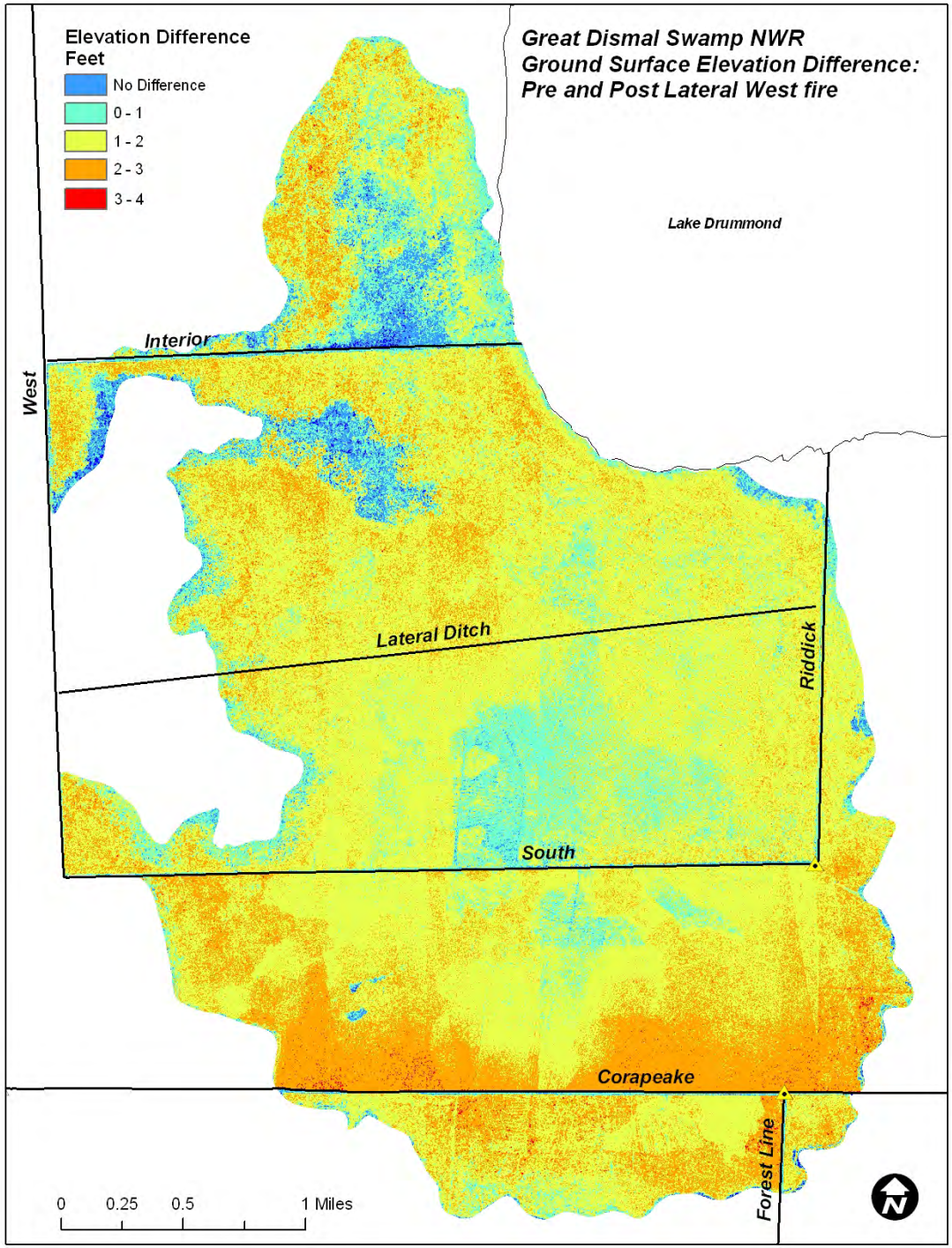
Sept. 2011

South One and Lateral West photos by L. Mitchell.

Impacts

- Completely destroyed BAR restoration units
- Central region of refuge has lost enormous amount of peat and elevation
- Heavy fuel load (downed, burned timber) covers 1,400 acres along south and east perimeter




Elevation Difference
Feet
No Difference
0 - 1
1 - 2
2 - 3
3 - 4
Great Dismal Swamp NWR
Ground Surface Elevation Difference:
Pre and Post Lateral West fire
Lake Drummond
Interior
West
Lateral Ditch
Riddick
South
Corapeake
Forest Line
0
0.25
0.5
1 Miles
N

Impacts

- Complete loss of canopy from VA/NC border to Lake Drummond

- Erosion along Lake Drummond south shore as lakeside forest has been killed, burned twice

Impacts

- Complete loss of canopy from VA/NC border to Lake Drummond

- Erosion along Lake Drummond south shore as lakeside forest has been killed, burned twice

- Invasive *Phragmites australis* has colonized the site

Lessons Learned?

- Harvest units probably too large, exposed, continuous, and too volatile as a fuel type

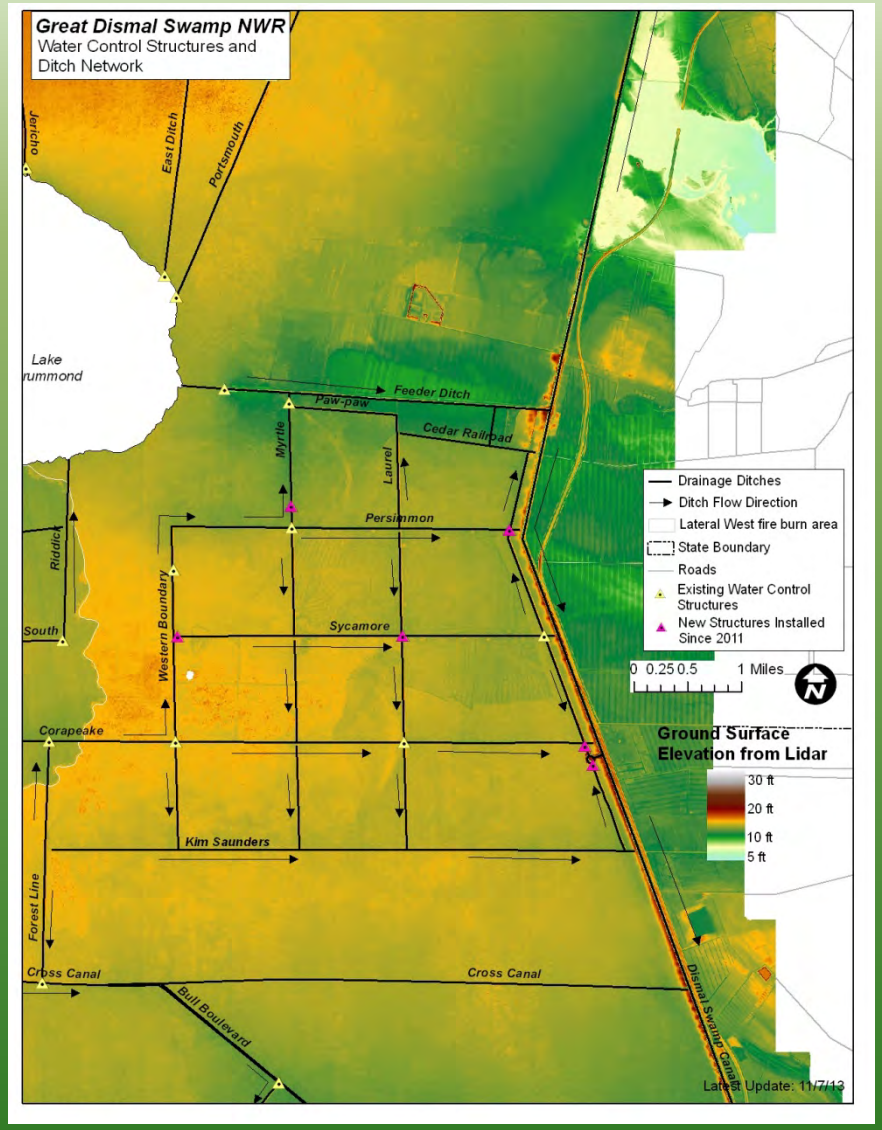
- We focused on restoring trees, without addressing the critical hydrologic/physical problems, and ignored the hazardous fuels in the burned swamp forest

- Salvage approach, in the end, failed to meet objectives – still had large wildfires, smoke, peat/AWC seed bank losses, catastrophic impacts to all peatland forest types

Post-Lateral West

We can't control the weather; we can't afford to treat the post-fire heavy fuels. Refuge is:

1. Increasing capacity to hold as much water as possible, increasing water handling capability. Refuge and partners installed additional Water Control structures to prolong water retention in the central swamp in wet seasons
2. Changing forest management objectives e.g. marsh management, cypress management
3. Conducting emergency *Phragmites* control – helicopter recon./spray/monitoring



The Future

The Refuge forests are facing a change that is beyond our ability to influence: drought + heavy fuels + tall grass fuel type + dry peat + lightning + fire, repeat = conversion to marsh /open water in center of Great Dismal Swamp National Wildlife Refuge.

Area of GDS NWR bounded by West, South, and Riddick Ditches, looking east, September, 2011 (by L. Mitchell)