Helping Nature Help Itself: Restoring the Land Using Natural Processes

A Presentation for the

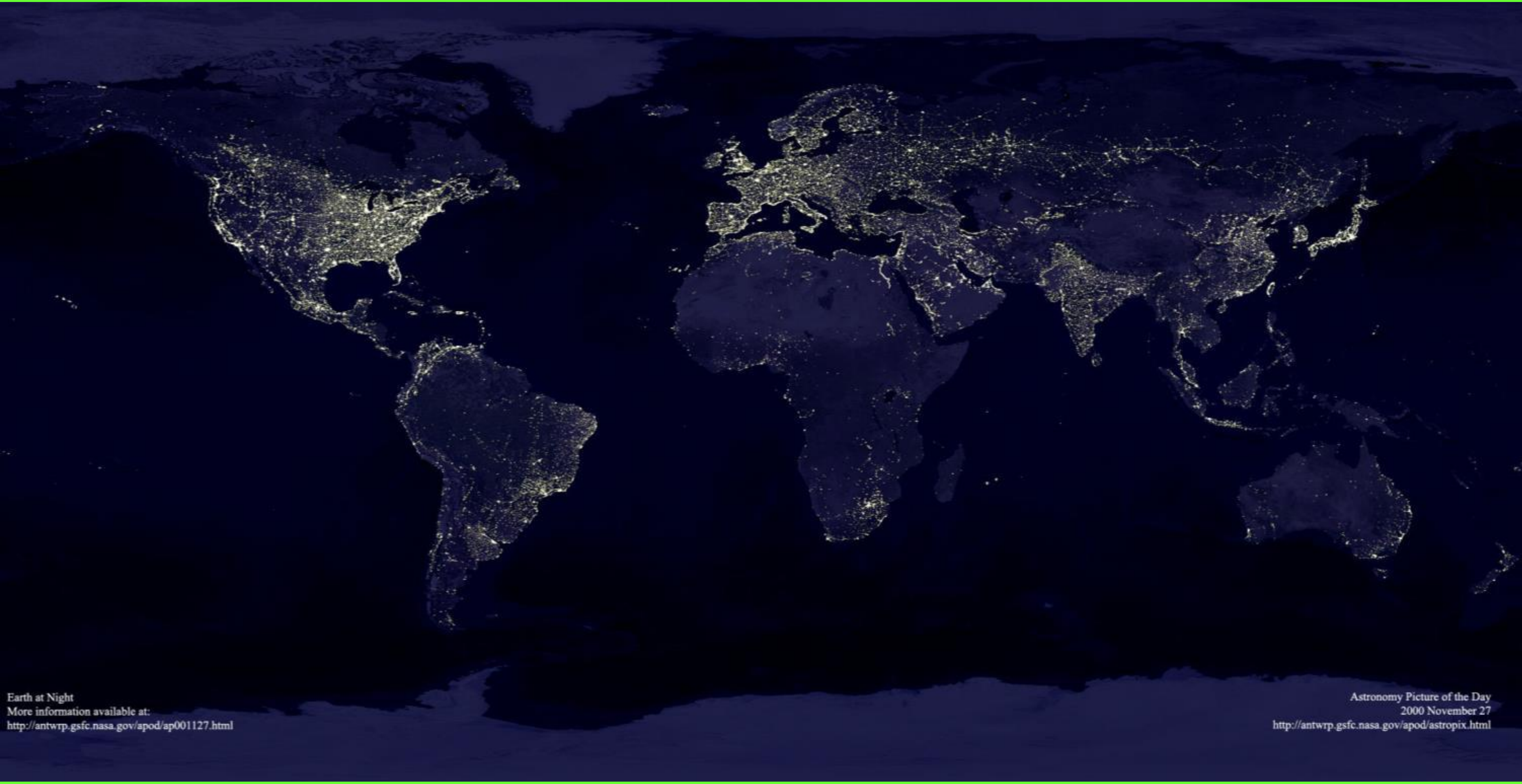
Maryland Native Plant Society

August 28, 2018

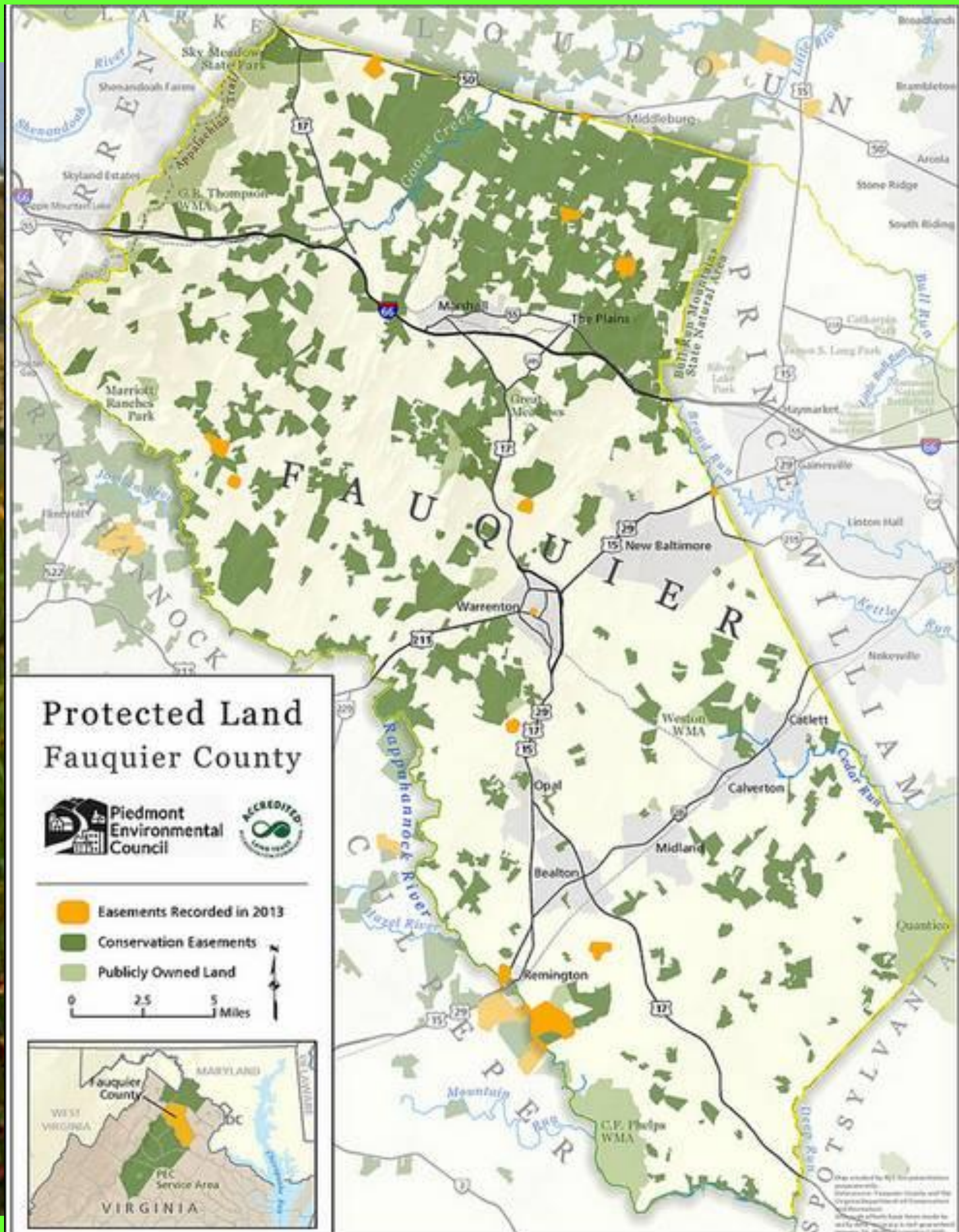
By: Charles Smith

The remainder of the century will be a bottleneck of growing human impact on the environment and diminishing biodiversity. We bear all of the responsibility of bringing ourselves and as much as possible of the rest of life through this into a sustainable Edenic existence.

-Edward O. Wilson, Nov 2013



Earth at Night - NASA



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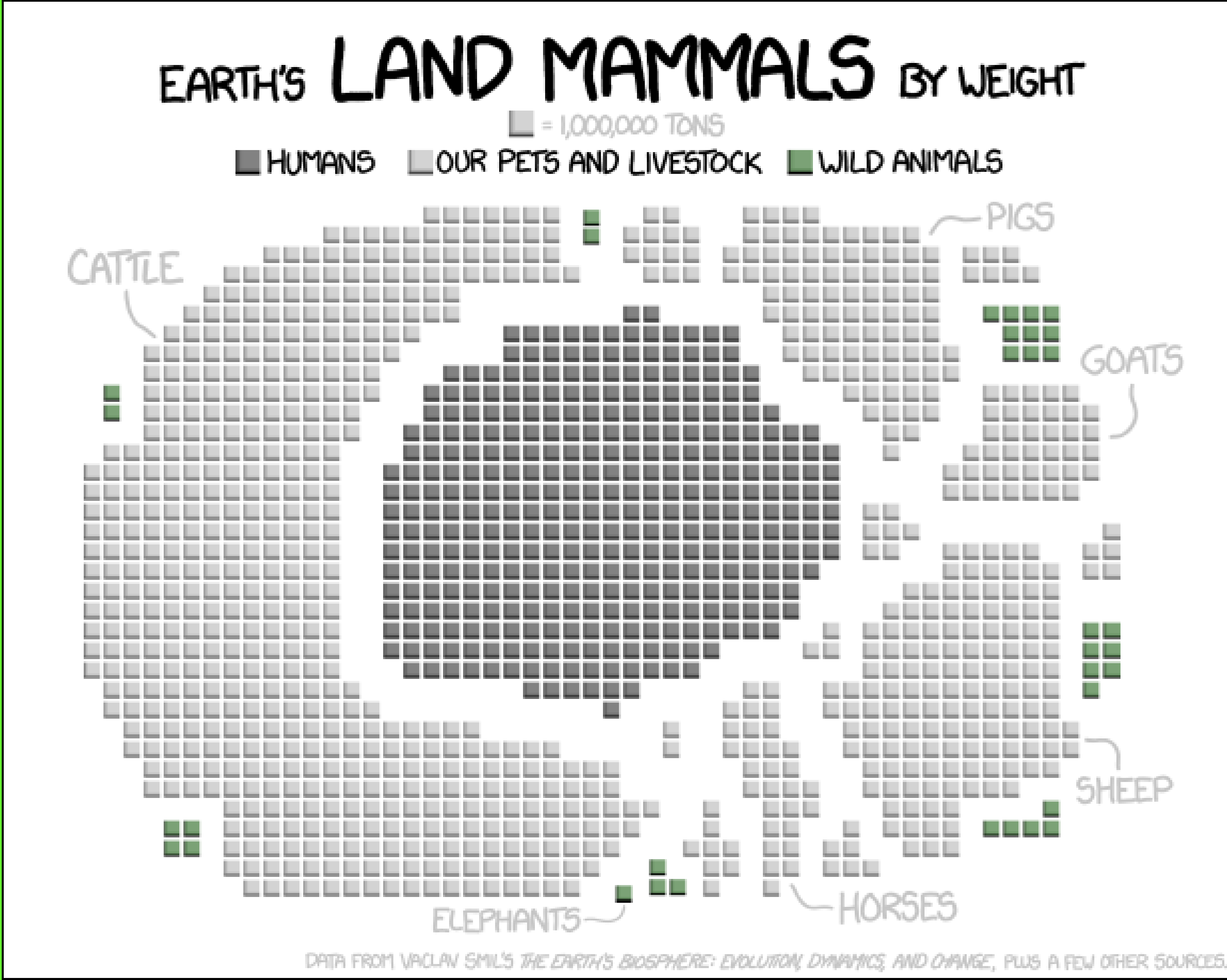

EARTH'S LAND MAMMALS BY WEIGHT
= 1,000,000 TONS
HUMANS
OUR PETS AND LIVESTOCK
WILD ANIMALS
CATTLE
PIGS
GOATS
SHEEP
HORSES
ELEPHANTS
DATA FROM VACLAV SMIL'S THE EARTH'S BIOSPHERE: EVOLUTION, DYNAMICS, AND CHANGE, PLUS A FEW OTHER SOURCES.

Free-Ranging Cats

- Listed by the International Union for Conservation of Nature as one of the 100 worst invasive species in the world
- Have caused or contributed to 33 (14%) of the modern bird, mammal and reptile extinctions recorded on islands world wide.
- Across the contiguous United States (all states excluding Alaska and Hawaii) free-ranging domestic cats kill annually*:
  - 1.3–4.0 billion birds (median=2.4 billion, with ~69% of this mortality caused by un-owned cats)
  - 6.3–22.3 billion mammals (median=12.3 billion, with 89% of this mortality caused by un-owned cats)
  - 228 and 871 million reptiles (median=478 million)
  - 86 and 320 million amphibians (median=173 million)
- This magnitude of mortality may exceed all other sources of anthropogenic mortality of US birds and mammals.

*Source: Scott R. Loss, Tom Will & Peter P. Marra; The impact of free-ranging domestic cats on wildlife of the United States; Nature Communications: 29 January 2013 - https://www.nature.com/articles/ncomms2380

Ecological Carrying Capacity

The maximum number of Organisms an ecosystem can support without deterioration.

Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview

Thomas J. Rawinski
Northeastern Area State and Private Forestry
Forest Service, U.S. Department of Agriculture
Newtown Square, PA
www.na.fs.fed.us
June 2008

Introduction

The white-tailed deer (*Odocoileus virginianus*) occupies a prominent position in the fabric of the American experience. The past, present, and future importance of this magnificent animal is immeasurable.

Seeing a deer in the forest (or in the headlights) is no longer a rare event in much of the country (Figure 1). Despite record harvests in recent years, deer populations are at or near all-time highs in many States. Why have deer become so numerous? How are they affecting forest ecosystems? Why should landowners, forest managers, and the general public be concerned?

This document will address these questions and attempt to focus attention on the issue of white-tailed deer overabundance in the context of the forest resource.

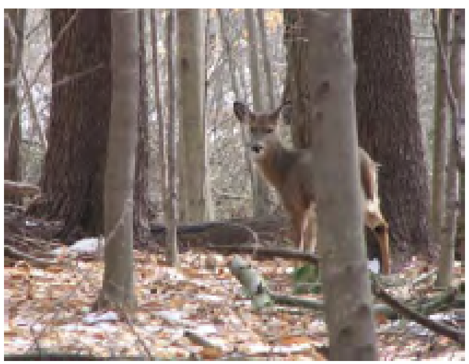


FIGURE 1.—White-tailed deer are frequently seen in this Massachusetts forest.

The Deer Population Explosion

White-tailed deer are adaptable and prolific animals equipped with keen survival instincts (Halls 1984). Major predators such as the gray wolf (*Canis lupus*) and cougar (*Puma concolor*) have been extirpated from much of the deer's range (Cote and others 2004; Rooney and Waller 2003). Because of human intervention, the range of the whitetail has actually expanded to include offshore islands, such as Block Island, RI, where seven deer introduced in 1967 grew to a herd of 700 deer by 1994 (Rhode Island Department of Environmental Management, Division of Fish and Wildlife 2007). In addition to the food sources available to them in forests, deer have successfully exploited the human-altered environment, feeding in agricultural fields, orchards, roadsides, lawns, and gardens.

State wildlife management agencies and hosts of cooperators have achieved broad successes in managing deer populations at ecologically and socially acceptable levels, primarily through regulated hunting (McDonald and others 2007; Winchcombe 1992). But in certain regions, deer populations remain higher than many people desire. In Wisconsin, for example, the 2005 post-hunt deer population was more than 50 percent above the goal established for 60 of the State's 120 deer management units (Rolley 2006). At high population densities, deer can reach nuisance levels, posing hazards to human health and safety, inflicting economic hardships, and degrading forest ecosystems (Drake and others 2005; Horsley and others 2003; Latham and others 2005; McShea and others 1997; Rooney 2001; Rooney and others 2004).

Latham and others (2005, p. 45) provide important insights into this complex issue:

> There is a widespread impulse to blame recent policies and management actions, or inaction, for the current deer situation, but the ultimate causes run much deeper and have been around for a very long time. Profound changes to the landscape and to interactions among wildlife species brought about by humans are responsible for the current high densities of white-tailed deer and their pervasive effects on the rest of the ecosystem.

Exceeding Ecosystem Carrying Capacity

- Deer were largely extirpated by 1900
- Deer were reintroduced for recreational hunting beginning in the 1930s.
- Initial evidence of deer impacts in some regions by the 1940s.
- Studies on deer browse impacts by 1979.

Invasive Species Harm Ecosystems

Virginia Department of Conservation and Recreation – Natural Heritage Program

Invasive Alien Plant Species of Virginia

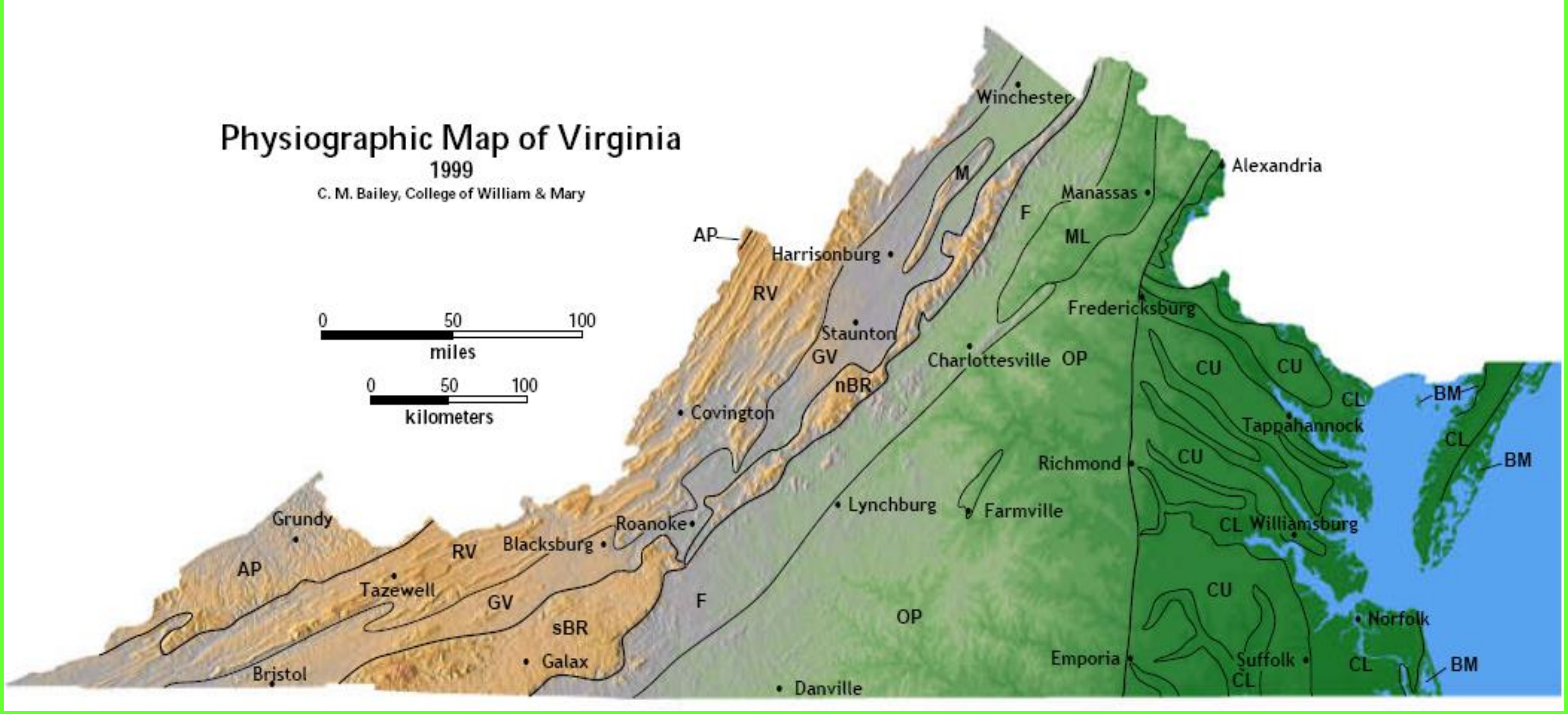
http://www.dcr.virginia.gov/natural_heritage/documents/invlist.pdf

Avoid and Eliminate Invasives

Celastrus orbiculatus Thunb.
Asian bittersweet, Asiatic bittersweet

Virginia Plants

- Approximately 3,200 species of plants in Virginia
- Approximately 750 plant species are introduced
- Of the native species 609 considered rare, 229 are “decidedly uncommon,” and 46 non-vascular plants are rare as of 2009.
- Of the native species 621 considered rare, 229 are “decidedly uncommon,” and 87 non-vascular plants are rare as of 2016.



Threats to Flora and Communities

- Human land conversion & fragmentation
- Frequent disturbance – human or natural
- Over-simplification
- Invasives (EAB, plants, fungal, worms, etc.)
- Deer herbivory
- Human ignorance and attitudes
- Other (climate change, natural catastrophic events, acid rain/air quality, etc.)
- Compound effects

Definition of Ecological Restoration

The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

-Society for Ecological Restoration, *The SER International Primer o n Ecological Restoration, 2004*

Shenandoah National Park

Progression of Plant Communities Over Time

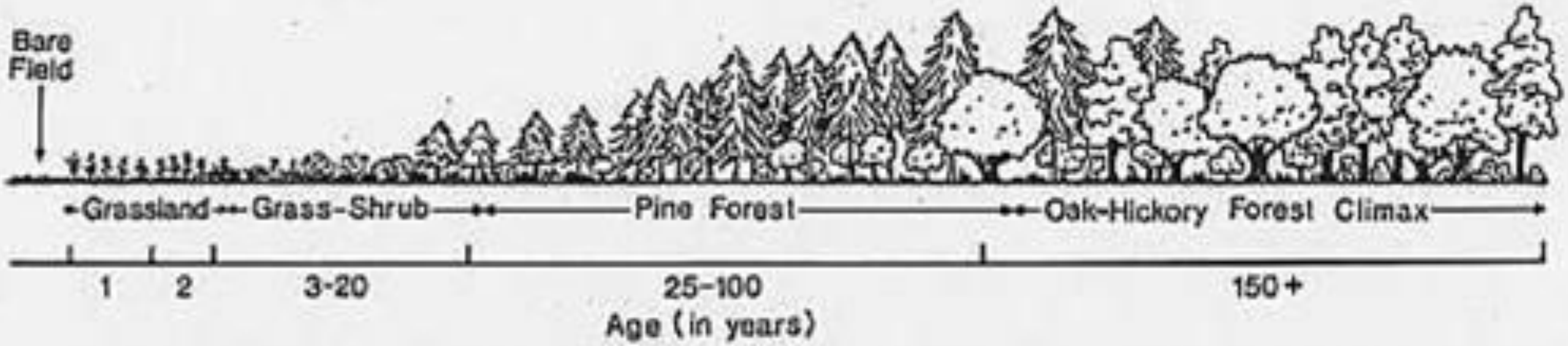
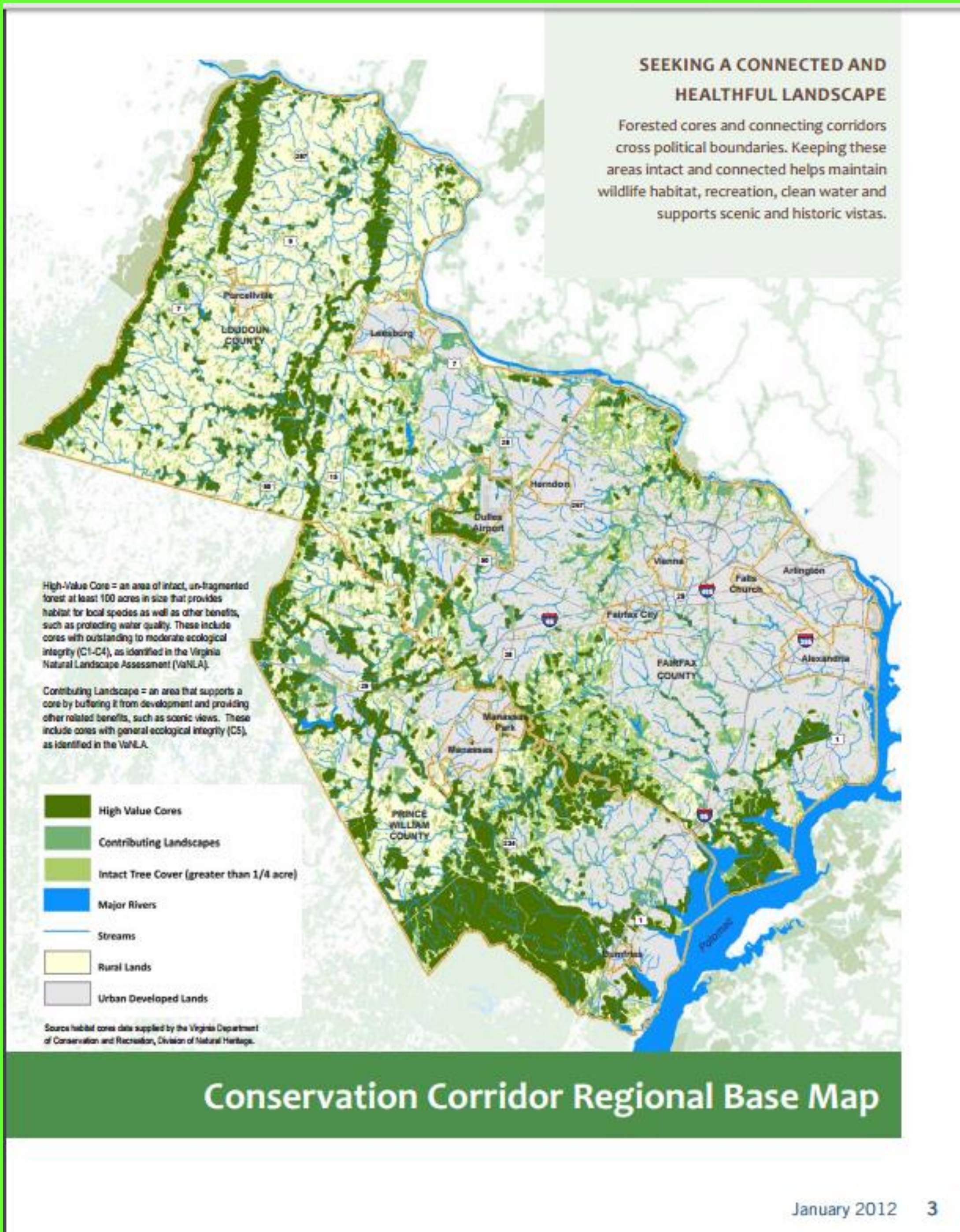


Fig. 1. Typical plant succession in an oak-hickory sere (from Kirk 1975, used with permission from McGraw-Hill, Inc.).

Adapted From 2012 Envirothon Training by Dave Byron, VDGIF

- Protect the Remaining Parts
- Buffer and Link Natural Areas
- Create New Spaces Providing Ecosystem Services
- Restore Landscapes
- Base Goals on Local Analogs (Plants, Animals)
- Work on Your Own Space
- Collaborate and Support Work on Larger Areas

Ecosystem Recovery

An ecosystem has recovered - and is restored - when it contains sufficient biotic and abiotic resources to continue its development without further assistance or subsidy. It will sustain itself structurally and functionally. It will demonstrate resilience to normal ranges of environmental stress and disturbance. It will interact with contiguous ecosystems in terms of biotic and abiotic flows and cultural interactions.

-Society for Ecological Restoration, *The SER International Primer on Ecological Restoration, 2004*

Natural Resource Management

- Assess and monitor resource
- Define goals, issues and threats – consult experts and stakeholders
- Develop a realistic plan – consider resource, goals, maintenance/management requirements and limitations
- Secure People, Funds & Equipment
- Manage system, not species
- Preserve best resources and buffers – prioritize
- Control what you can – people, invasives, deer, erosion
- Use Science-based best practices – remove subjectivity; promote objective, best practices; adaptive management
- Think ahead – 50 years, 500 years

Natural Resource Management
Assessment

- Need to assess resource to understand it
- Conduct inventory/forest stand delineation or evaluation
- Plots: often 1/10 acre (forestry) or 200 sq meters (VA Nat Her)
- Assess for:
  - Forest structure – vertical density from floor to crown with native vegetation
  - Species diversity – biological
  - Soils
  - Hydrology
  - Stand health (signs of human/livestock impacts; recent disturbance; deer herbivory, NNIs, erosion, disease/decline, etc.)
  - Tree size & age distribution
  - Stocking level – combination of average DBH & # stems/acre, can be used for measuring health or potential yield


INCHES
PLEASE HELP PREVENT FOREST FIRES

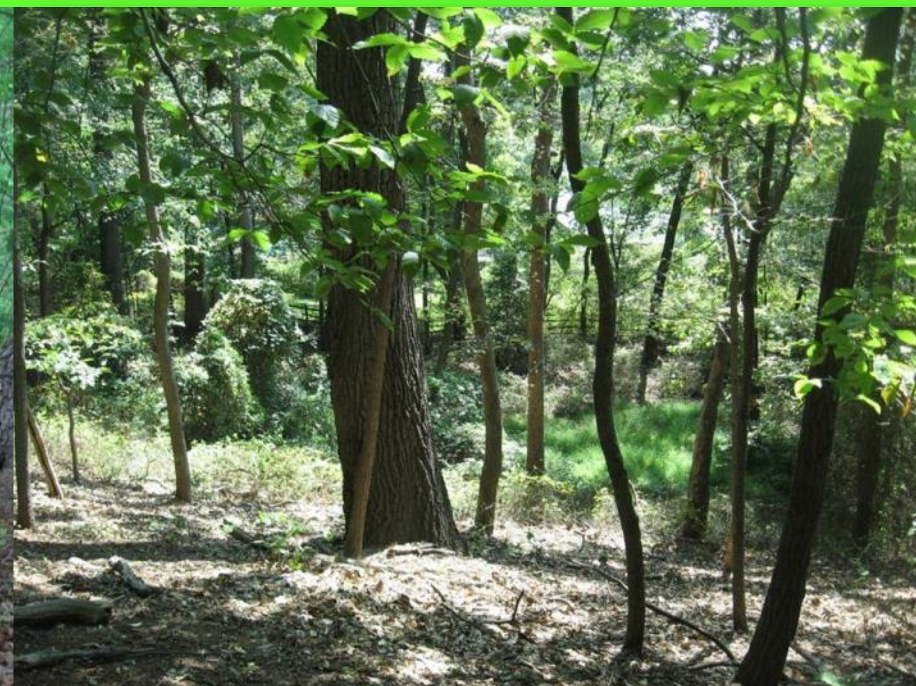

Whitney State Forest

Developing a Search Image

Mt. Vernon District

Healthy and diverse

Groveton Heights



Unhealthy and impacted

What Are You Managing For?

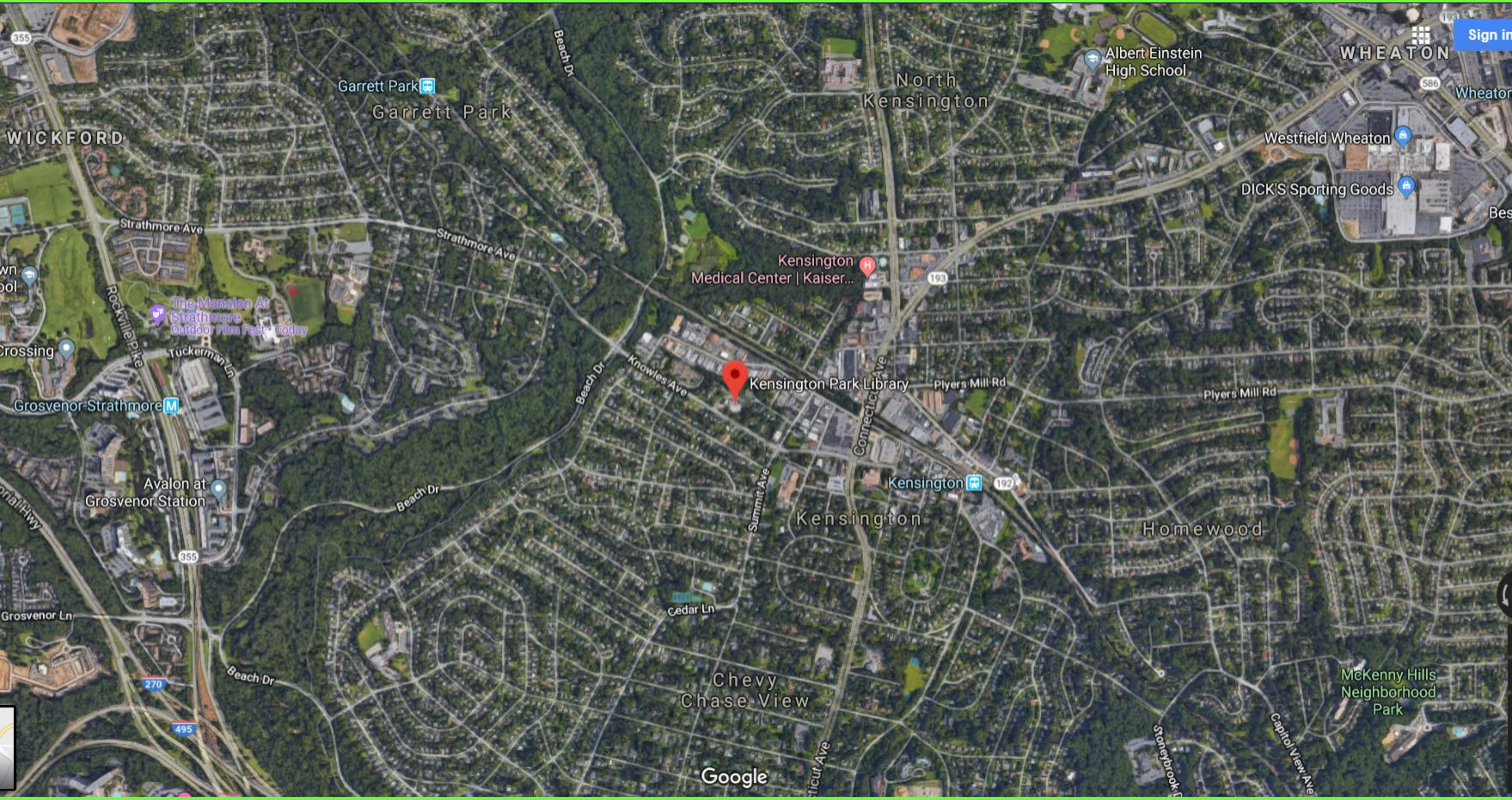
- Aesthetics
- Silviculture
- Recreation
- Water Quality
- Wildlife Habitat
- Community Health/Biodiversity
- Rare, Threatened or Endangered Species

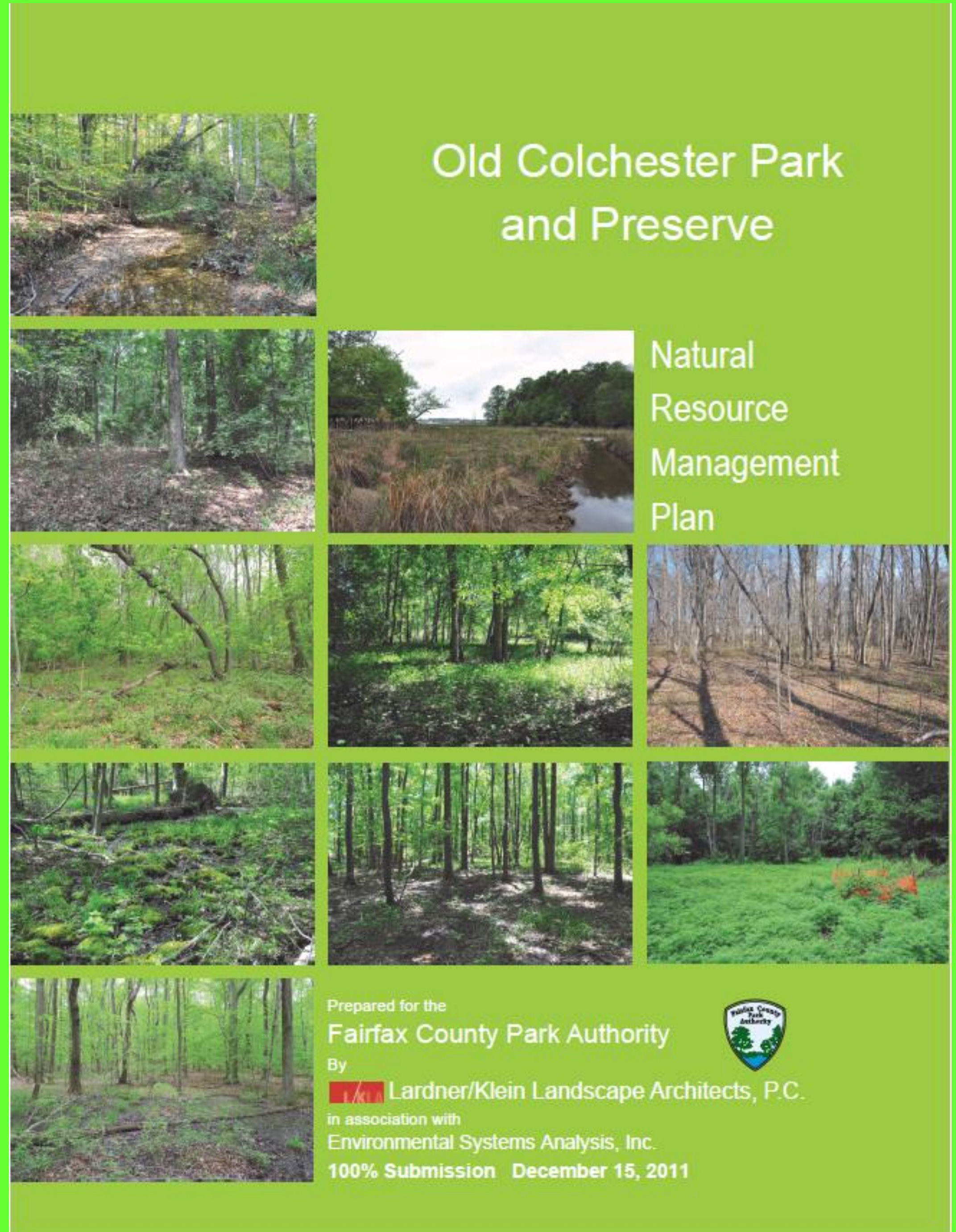

© John White

Restoration

- Restore Ecological Functions
- Create/Restore Naturally Regenerating Native Plant Systems
- Manage for Biodiversity vs Manage for Services/Functions
- Focus on Local Landscape Context
- Use Analogs – What Systems/Species are Around
- Additional Concepts
  - Habitat Heterogeneity
  - Ecological Memory
  - Legacy Forest
  - Land Use History
  - Trophic Cascade

Landscape Context





Old Colchester Park and Preserve

Natural Resource Management Plan

Prepared for the

Fairfax County Park Authority

By

Lardner/Klein Landscape Architects, P.C.

in association with

Environmental Systems Analysis, Inc.

100% Submission December 15, 2011

Natural Resource Management Plan Findings

Goal

Preservation and Protection of the Natural Resources at Old Colchester Park and Preserve.

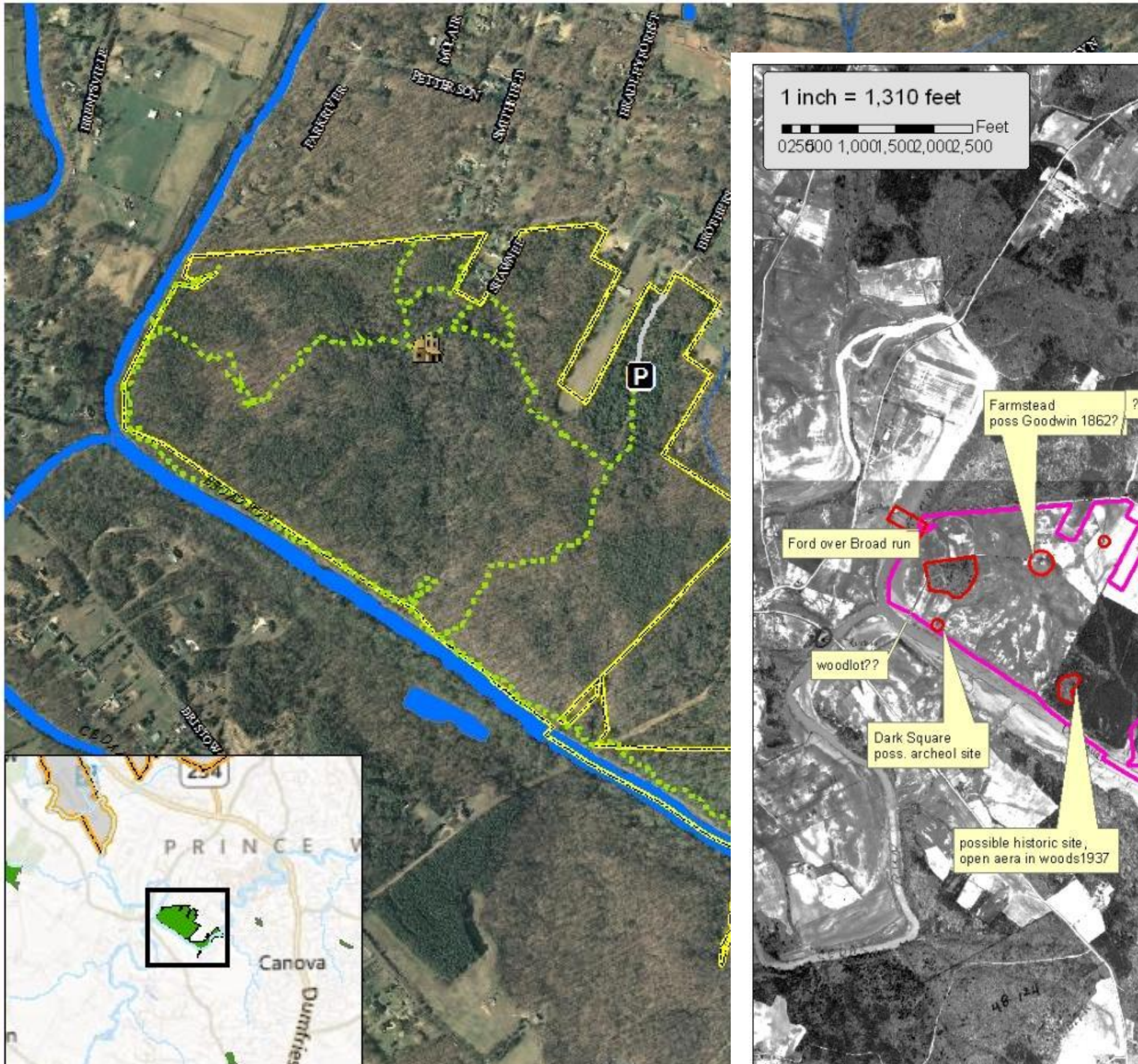
Objectives

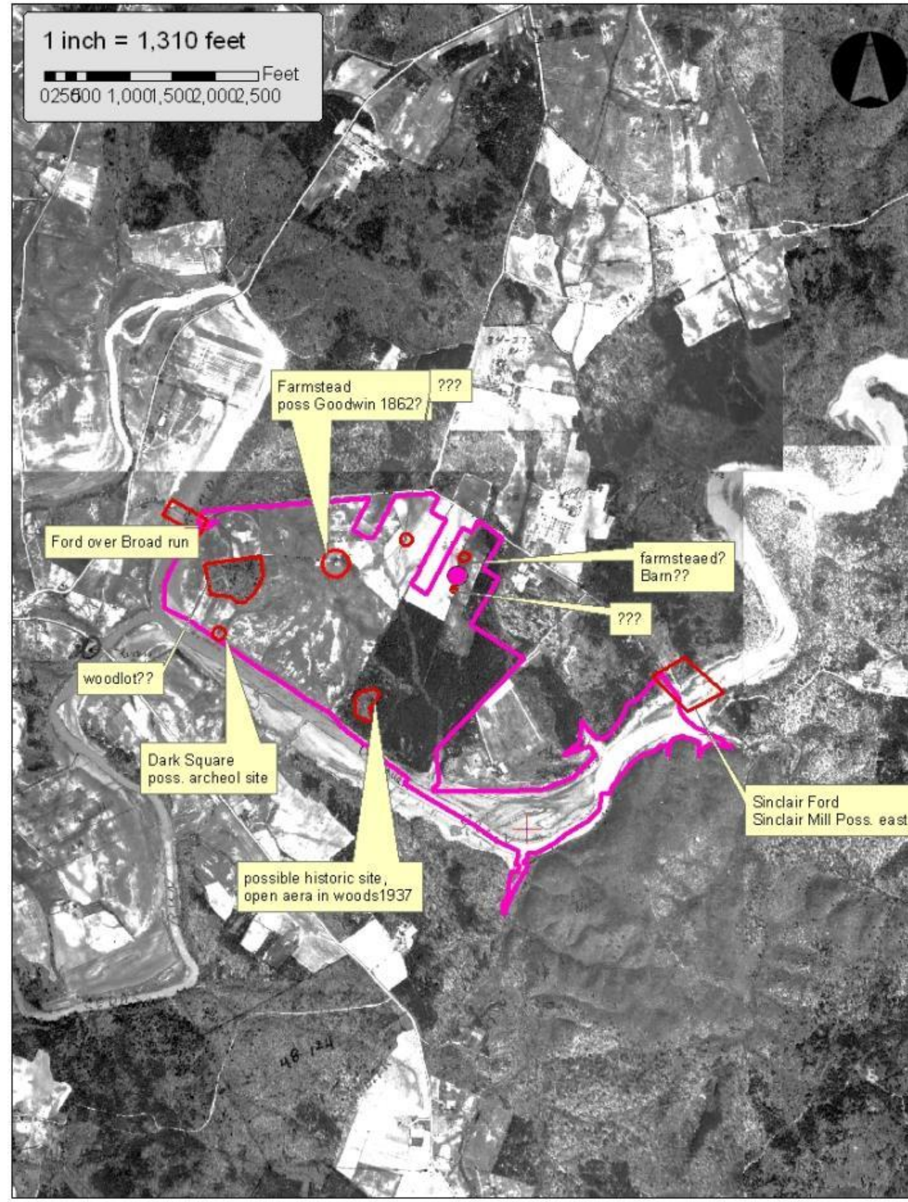
- Objective 1. Protect and Manage Sensitive Resources in the Park
- Objective 2. Reduce and Eliminate Human Activities that Adversely Affect Sensitive Resources in the Park
- Objective 3. Reduce the Deer Population in the Park
- Objective 4. Reduce Non-Native Invasives (NNIs) Plant Species in the Park
- Objective 5. Integrate Passive Recreation Development and Interpretive Activities with Minimal Impact on Sensitive Natural Resources in the Park
- Objective 6. Practice Adaptive Management Approach and Process

Natural Resource Action Plan

- NRAP is a Brief Plan (5-6 pages)
- Assess
- Map Resources (Integral part of plan)
- Define Stresses
- Short-term and Long-term Goals
- Identify Management Resources (people, equipment, funds, time)
- Manage Adaptively (Assess effectiveness, change methods to suit issues, introduce appropriate disturbance patterns)

Doves Landing



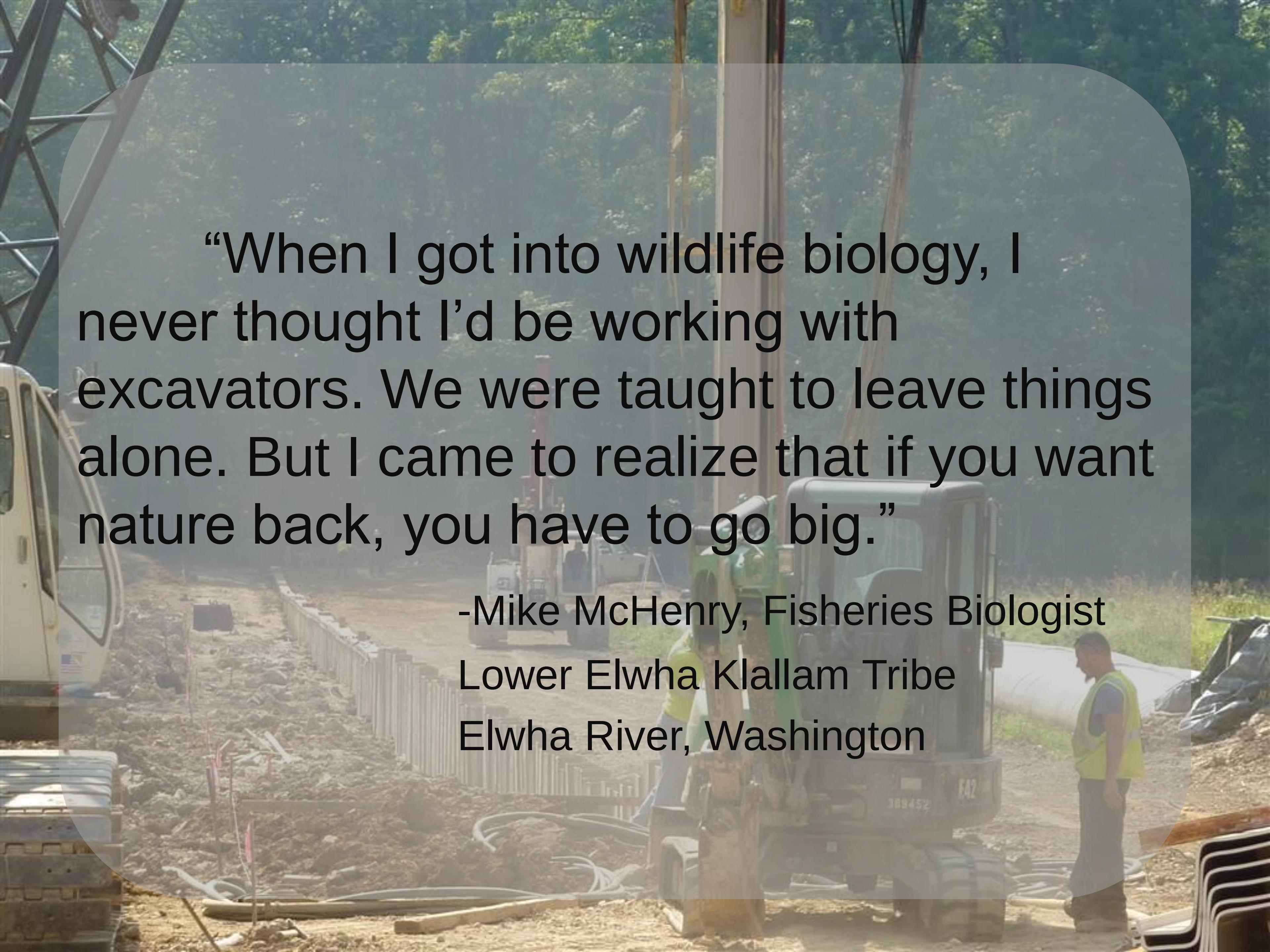


Prince William County
PARKS & RECREATION

Prepared by: Ryan Conklin PP AICP

Getting Started

- What do you have? – Assess resources early in process
- What is the landscape context of your site? (Build on local ecology)
- What does your site have to offer?
- What are your goals?
- Address water, soils and plants
- Use analogs
  - Base efforts on inventory of adjacent or nearby systems and communities
  - Locally common native species (avoid rare – this is not conservation biology)

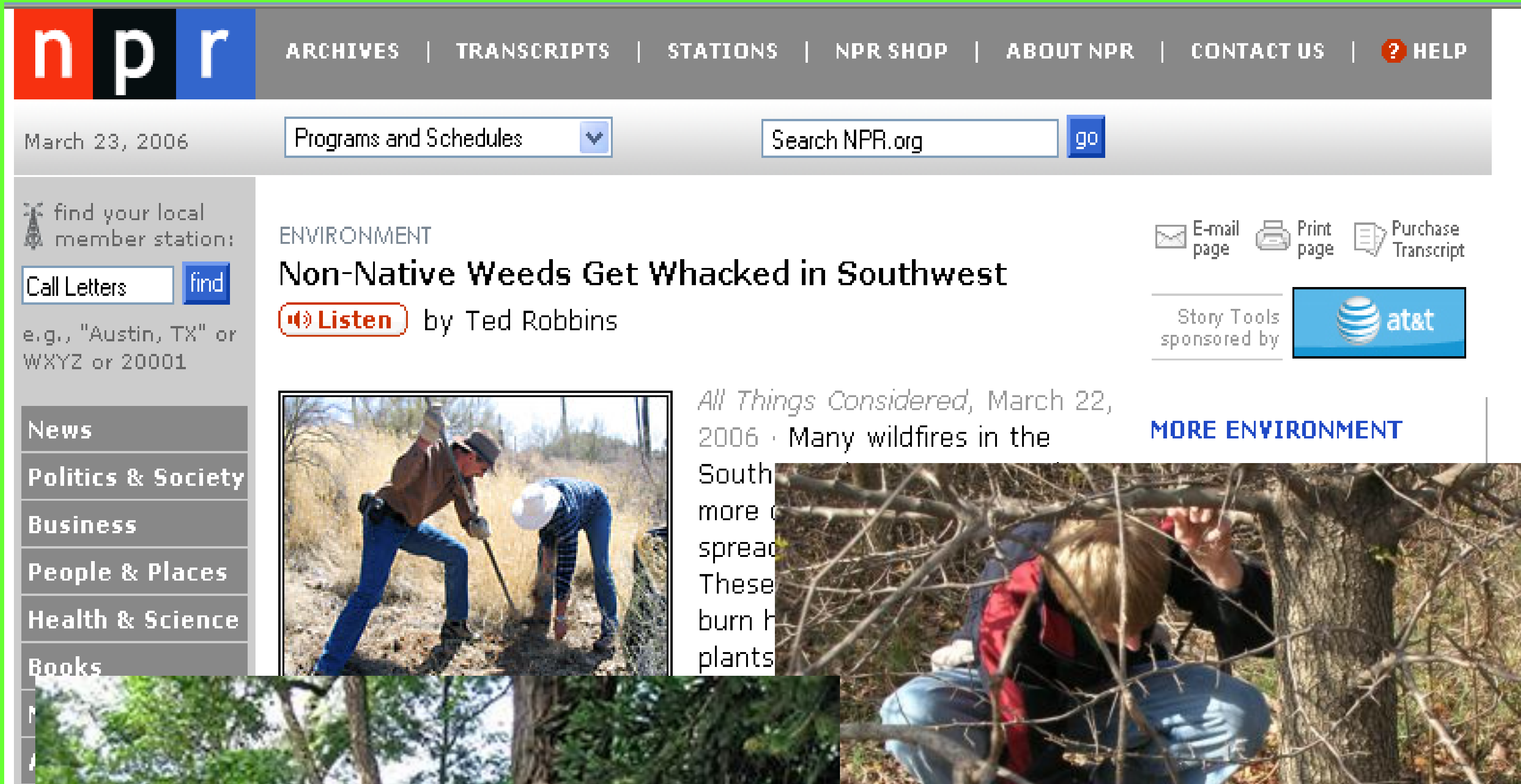


“When I got into wildlife biology, I never thought I’d be working with excavators. We were taught to leave things alone. But I came to realize that if you want nature back, you have to go big.”

-Mike McHenry, Fisheries Biologist
Lower Elwha Klallam Tribe
Elwha River, Washington

Selecting Invasive Species Control Methods

- Hand pulling or cutting
- Mechanical controls
- Prescribed Fire
- Grazing/Goats
- Chemical application



What Can You Do?

Other Means of Control

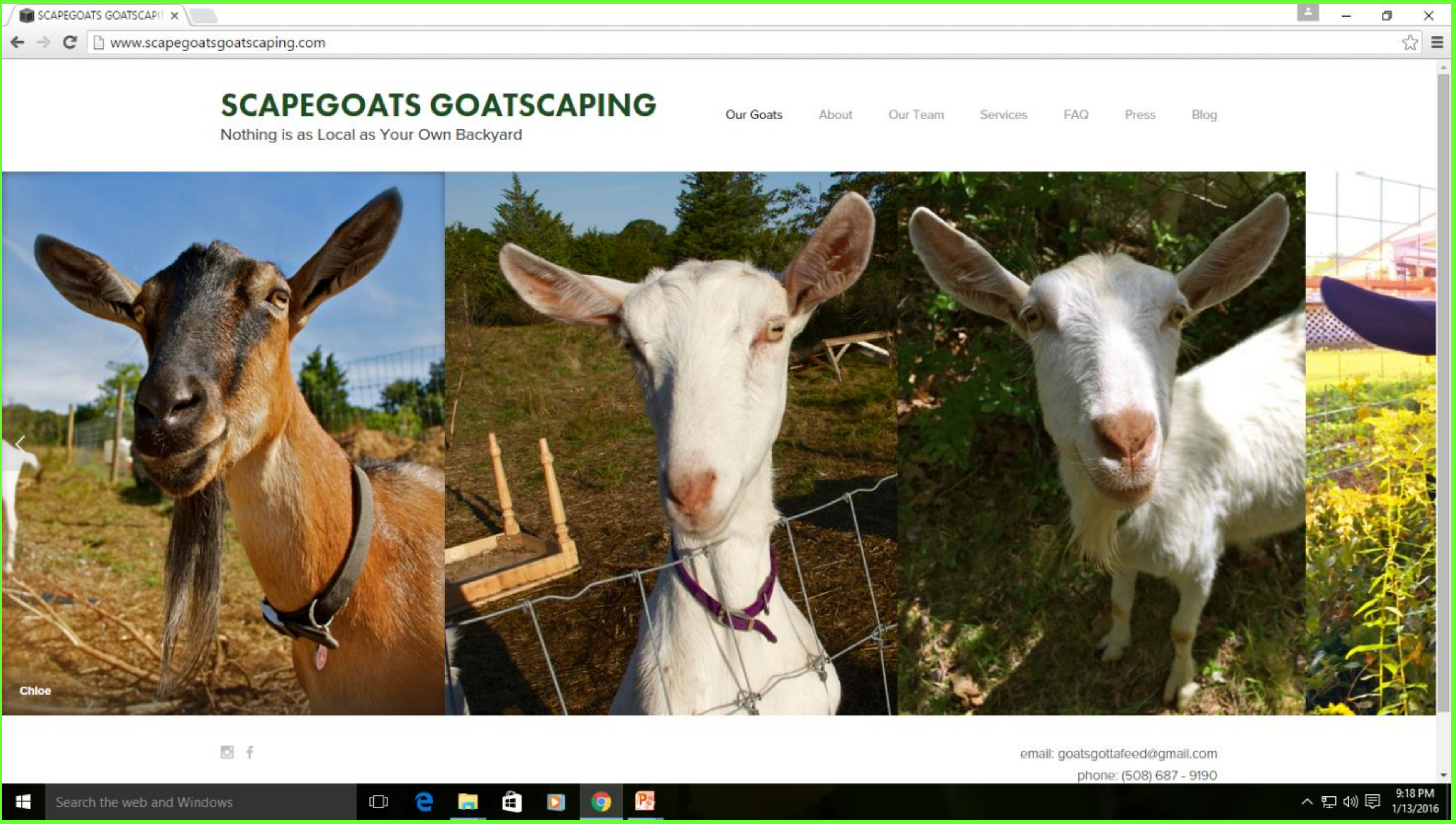


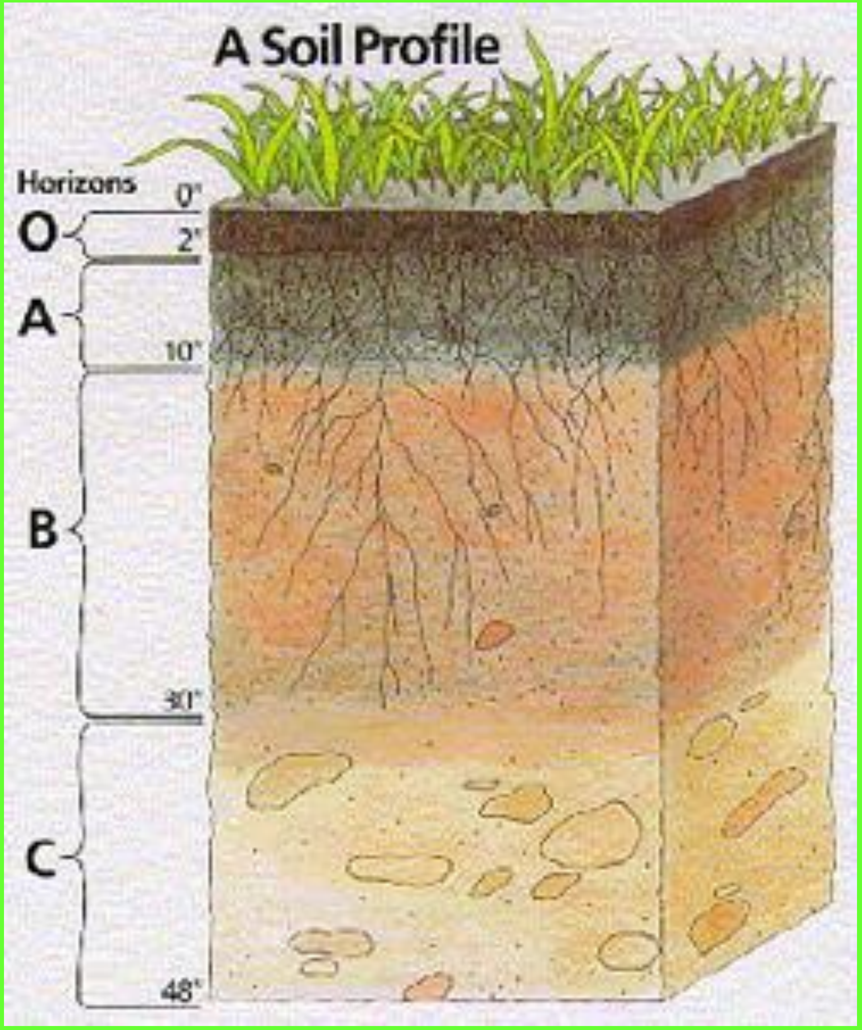
Photo by Gary Alt – Penn State University

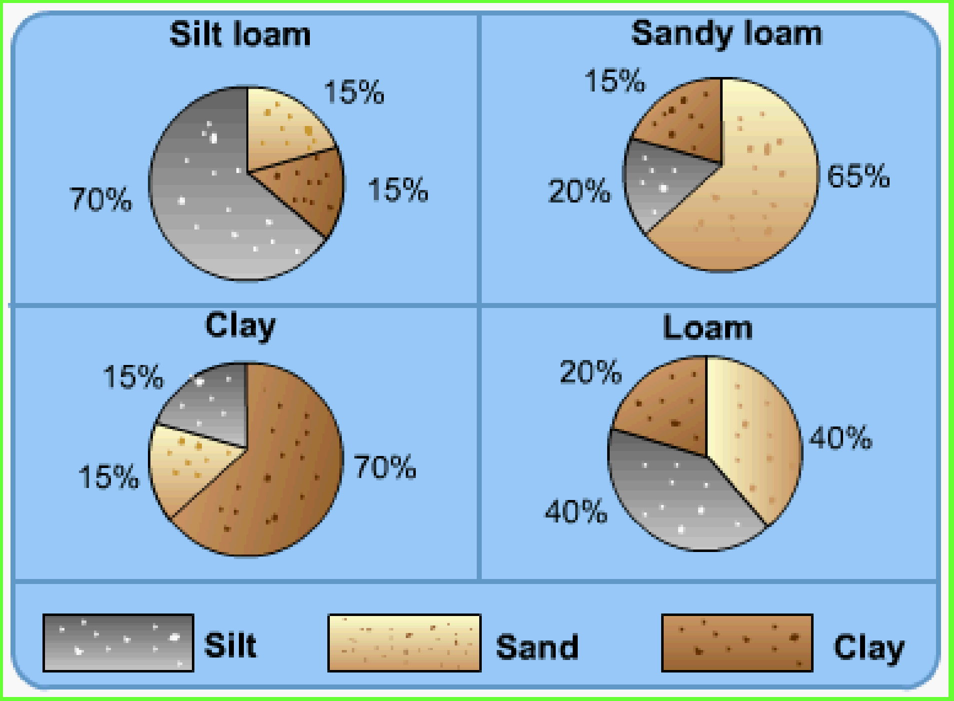
Protect and Restore Soils

Protect and Restore Soils

- Soils are complex
  - Physical structure including parent material
  - Soil biota
- Ecological memory
- Protect first, restore when needed
- Takes time, use restoration principles and natural processes

Soil Structure

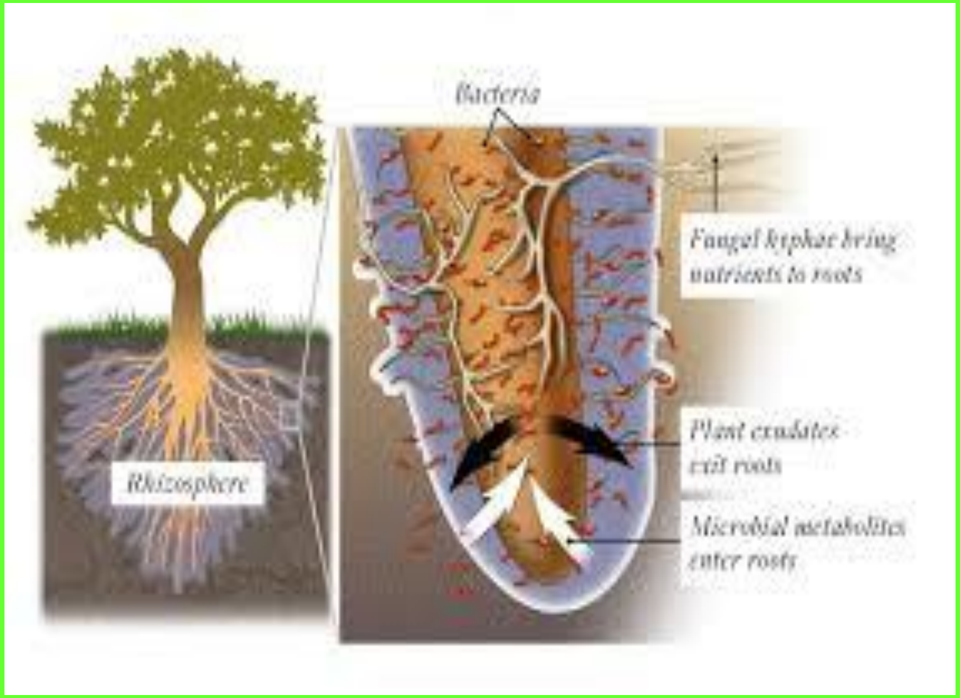





LEVEL BOOK
BEN MEADOWS
Outdoors
Office

Root Exudates

- Roots synthesize, accumulate, and secrete a diverse array of compounds broadly referred to as root exudates.
- 5% to 21% of all photosynthetically fixed carbon being transferred to the rhizosphere through root exudates
- Exudates:
  - Regulate the soil microbial community in their immediate vicinity,
  - Combat herbivores,
  - Encourage beneficial symbioses,
  - Change the chemical and physical properties of the soil, and
  - Inhibit the growth of competing plant species.



Number of Soil Organisms in Healthy Ecosystems

	Ag Land	Prairie	Forest
	Organisms per gram (teaspoon) of soil		
Bacteria	100 mil. -1 bil.	100 mil. -1 bil.	100 mil. -1 bil.
Fungi	Several yards	10s – 100's of yds	1-40 miles (in conifers)
Protozoa	1000's	1000's	100,000's
Nematodes	10-20	10's – 100's	100's
	Organisms per square foot		
Arthropods	< 100	500-2000	10,000-25,000
Earthworms	5-30	10-50	10-50 (0 in conifers)

Source: Natural Resources Conservation Service

Microbial Grazers

- Bacteria play a critical role in fixing nitrogen in the soil.
- Nematods prey on both bacteria and fungi.
- Nematod grazing on bacteria increases nitrogen available in the soil for plants (NH_4). Mineralization of N.
- Plant growth increases sporadically in the presence of nematods grazing on bacteria.
- There is also an increase in soil carbon associated with bacteria and nematod grazers.

Source: *Interactions of Bacteria, Fungi, and their Nematode Grazers: Effects on Nutrient Cycling and Plant Growth; Authors Russell E. Ingham, J. A. Trofymow, Elaine R. Ingham, David C. Coleman February 1985*

Image From Organic Life

Fungus in Field and Forest

- Roles of fungus
  - Decomposers – saprophytic fungi – convert dead organic material into fungal biomass, carbon dioxide (CO_2), and small molecules, such as organic acids.
  - Mutualists – mycorrhizal fungi – get carbon from the plant, in return help solubolize phosphorus and bring soil nutrients (phosphorus, nitrogen, micronutrients, and perhaps water) to plant.
  - Pathogens or parasites – cause reduced production or death when they colonize roots and other organisms.

Image: microsopic photo of stained European beech leaf with stomatum in upper right

Source: Quantification of Fungal Hyphae in Leaves of Deciduous Trees by Automated Image Analysis
O. DANIEL, F. SCHO¨ NHOLZER,* AND J. ZEYER, Switzerland; June 1995

Mycorrhiza

- Mycorrhiza – “fungus root” – a symbiotic relationship between a plant root and a fungal hyphae/mycelium
- Mycorrhizal fungus – fungal component – provides nutrients, water and growth hormone to the plant
- Mycorrhizal plant – plant symbiont – provides sugar, amino acids, fatty acids and vitamins to the fungus
- Mycorrhizal fungi are wherever the roots are
- Up to 90% of vascular plants form and depend on mycorrhizal associations
  - Ectomycorrhizal Fungi (EMF) – most woody plants in North America
  - Arbuscular Mycorrhizal Fungi (AMF) – most herbaceous plants in NA

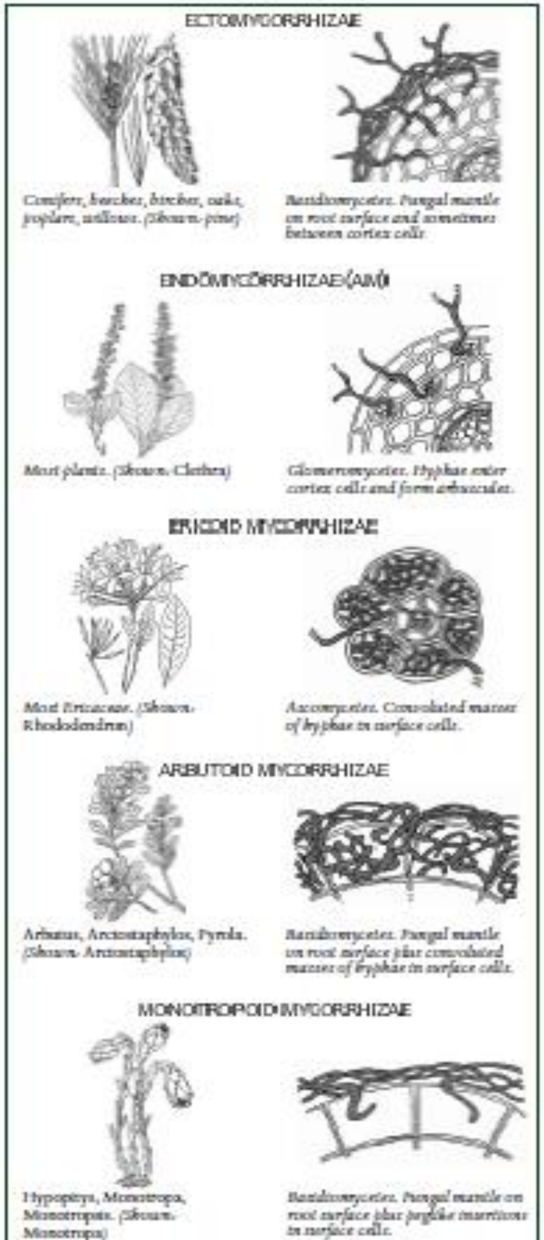
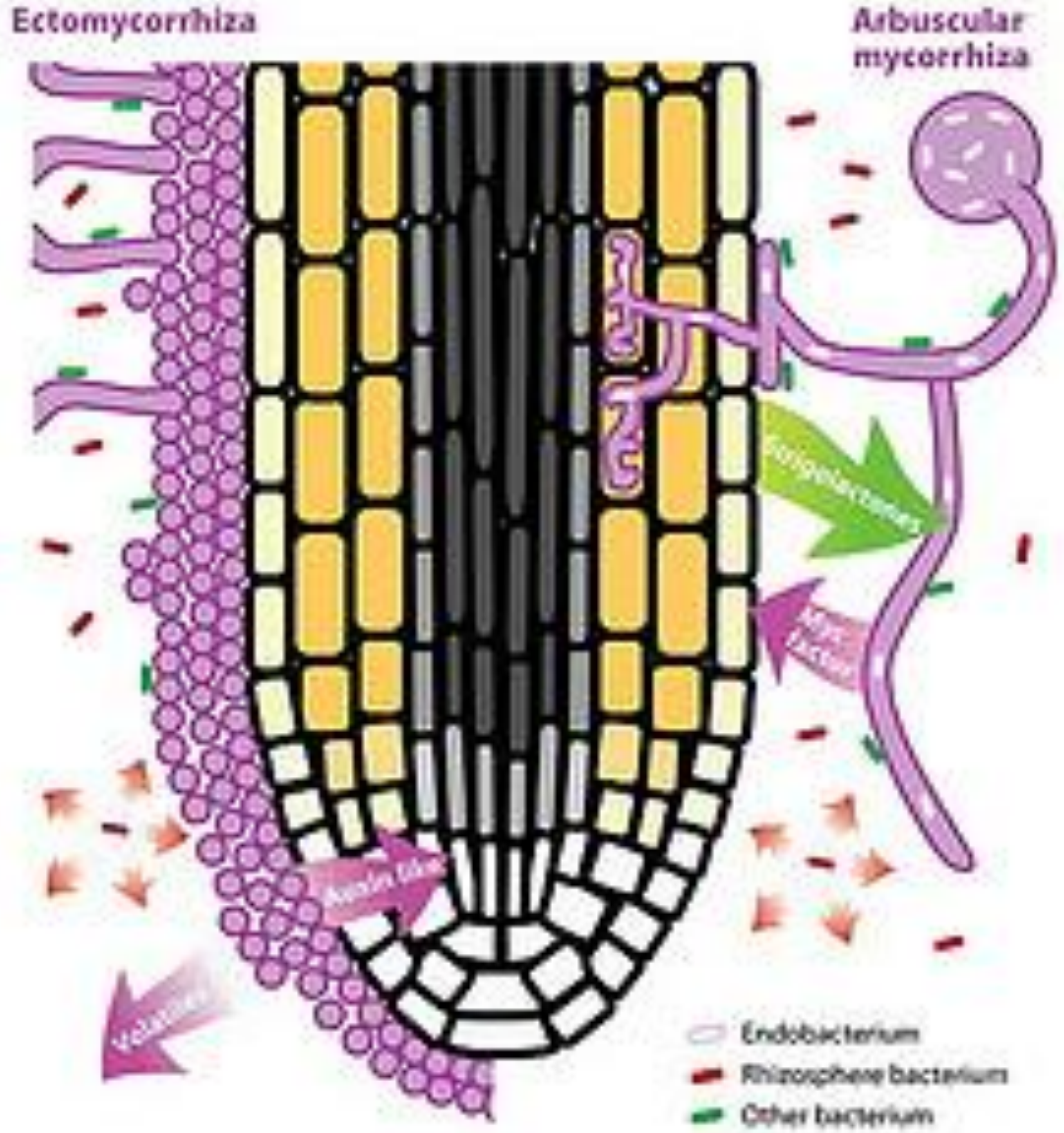
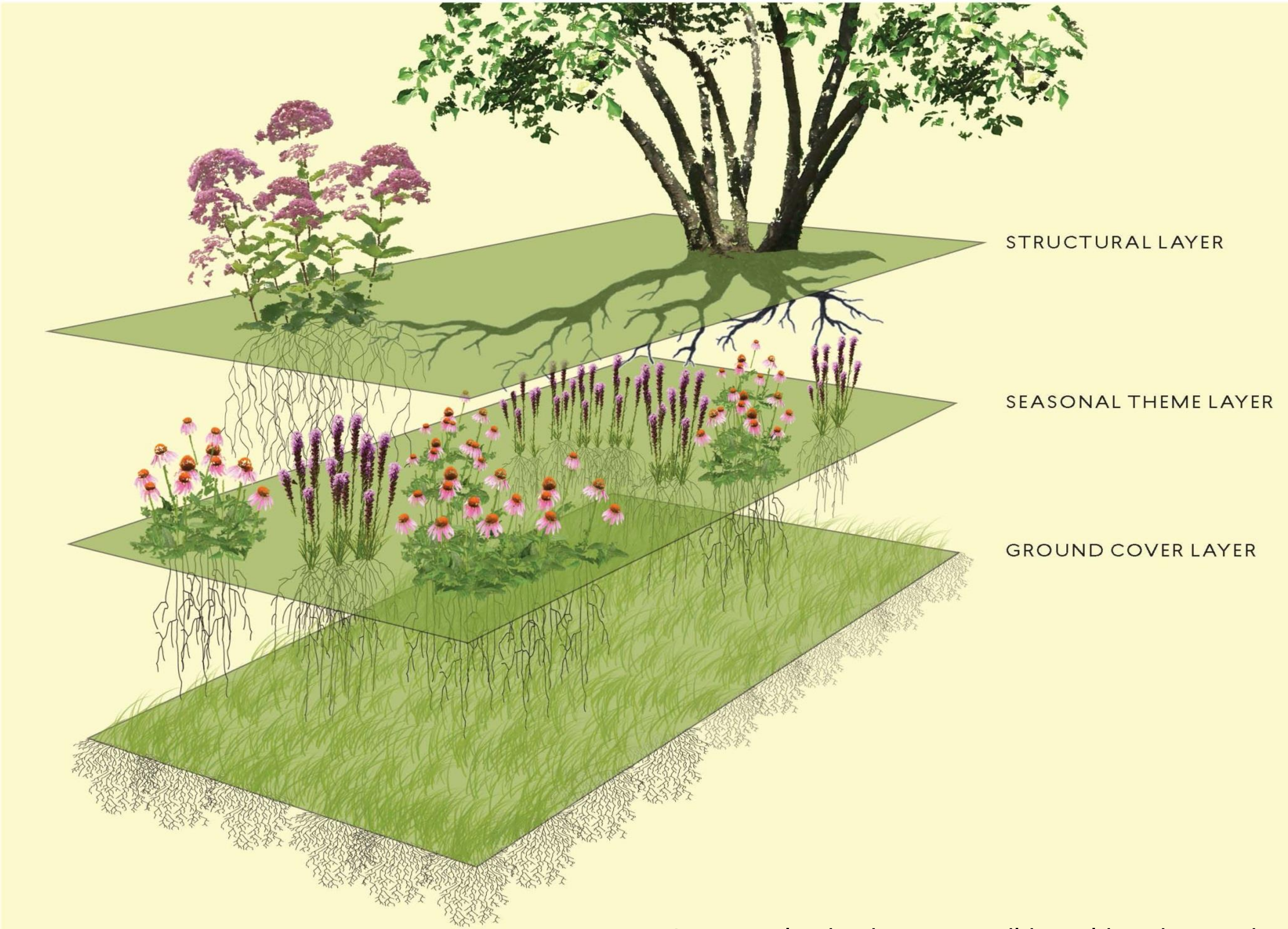


Figure 1. Diversity of mycorrhizal symbionts discussed in the text. Plant illustrations from Britton and Brown's Illustrated Flora of the Northeastern United States and Canada (1913). Drawings of mycorrhizae by W. J. Hayden.



LAYERS OF A DESIGNED PLANT COMMUNITY



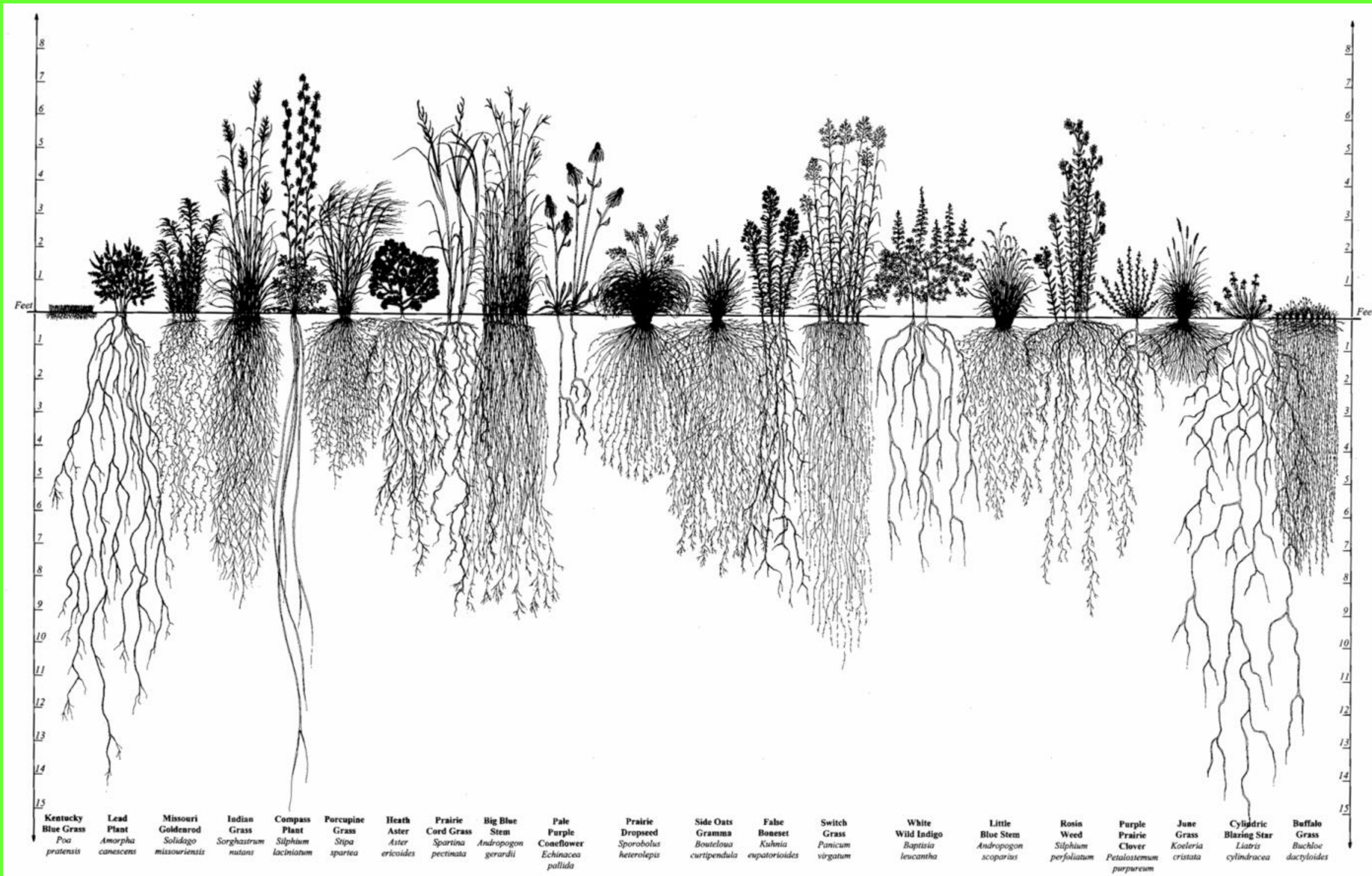
Source: Planting in a Post Wild World; Rainer and West

Rebuilding Soils

- Protect, protect, protect
- Consider your location (geology, slope, landscape position, target community type)
- Consider scale of your efforts – yards or acres
- Reintroducing soil carbon (amendments – compost, biochar; using plants and animals)
- Rebuild structure (ripping, aerating, tilling, tillage radishes, early succession systems)
- Engineered soils
- Focus on composition, porosity and biota


CATERPILLAR

Root Systems of Prairie Plants

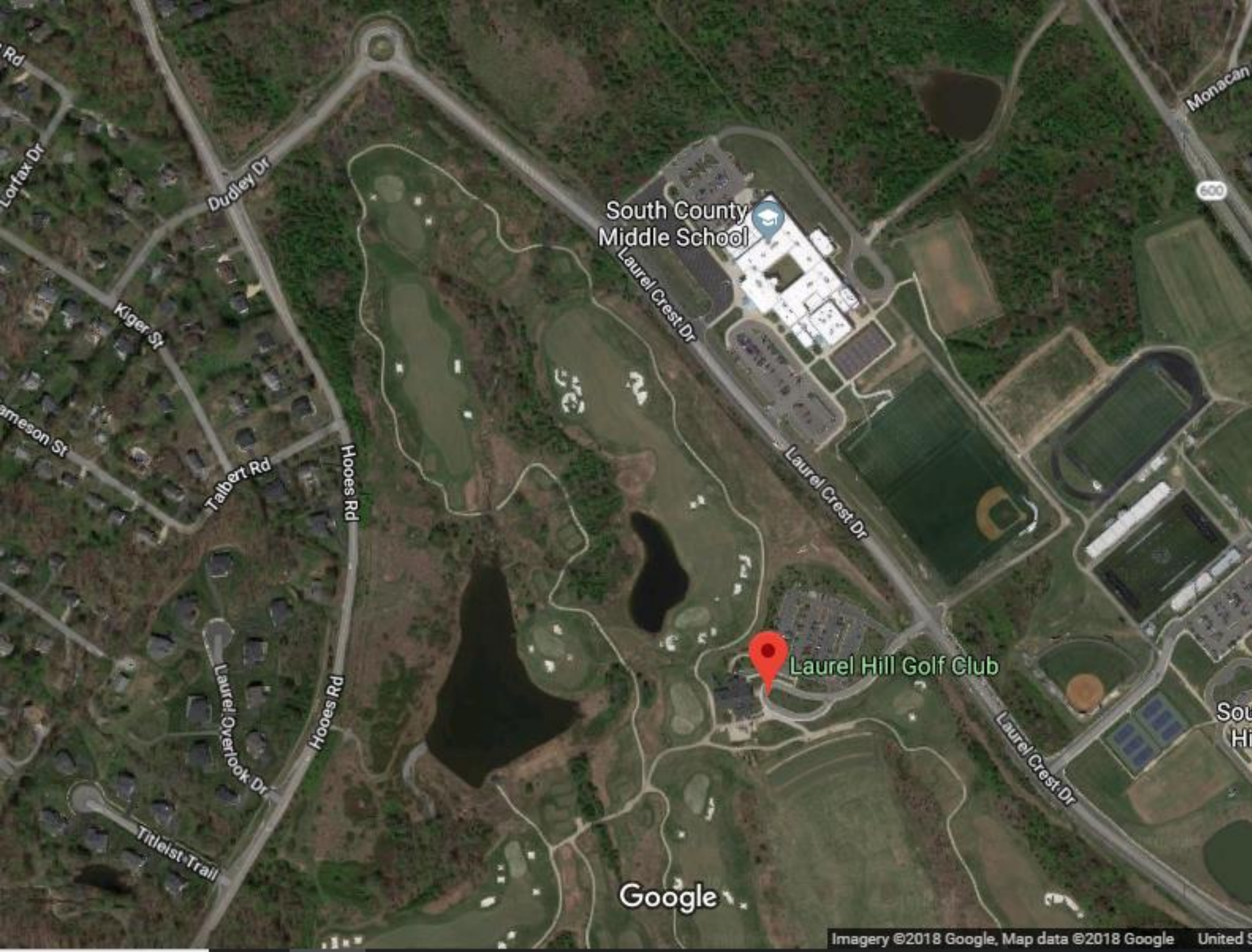



LOW PRICES


CARL W. NEUTZEL SERVICES
410-329-6791
AerWay


CARL W. NEUTZEL SERVICES
CARL W.
NEUTZEL
329-6791


FINN
NAPA



South County Middle School
Laurel Crest Dr
Laurel Crest Dr
Laurel Crest Dr
Laurel Hill Golf Club
Dudley Dr
Lorfax Dr
Kiger St
Talbert Rd
Hooes Rd
Hooes Rd
Laurel Overlook Dr
Titleist Trail
Monacan R
600
Google
Imagery ©2018 Google, Map data ©2018 Google

Treeless Area Technical Manual

Prepared for

Fairfax County Park Authority

by

Lardner/Klein Landscape Architects, P.C.

in association with

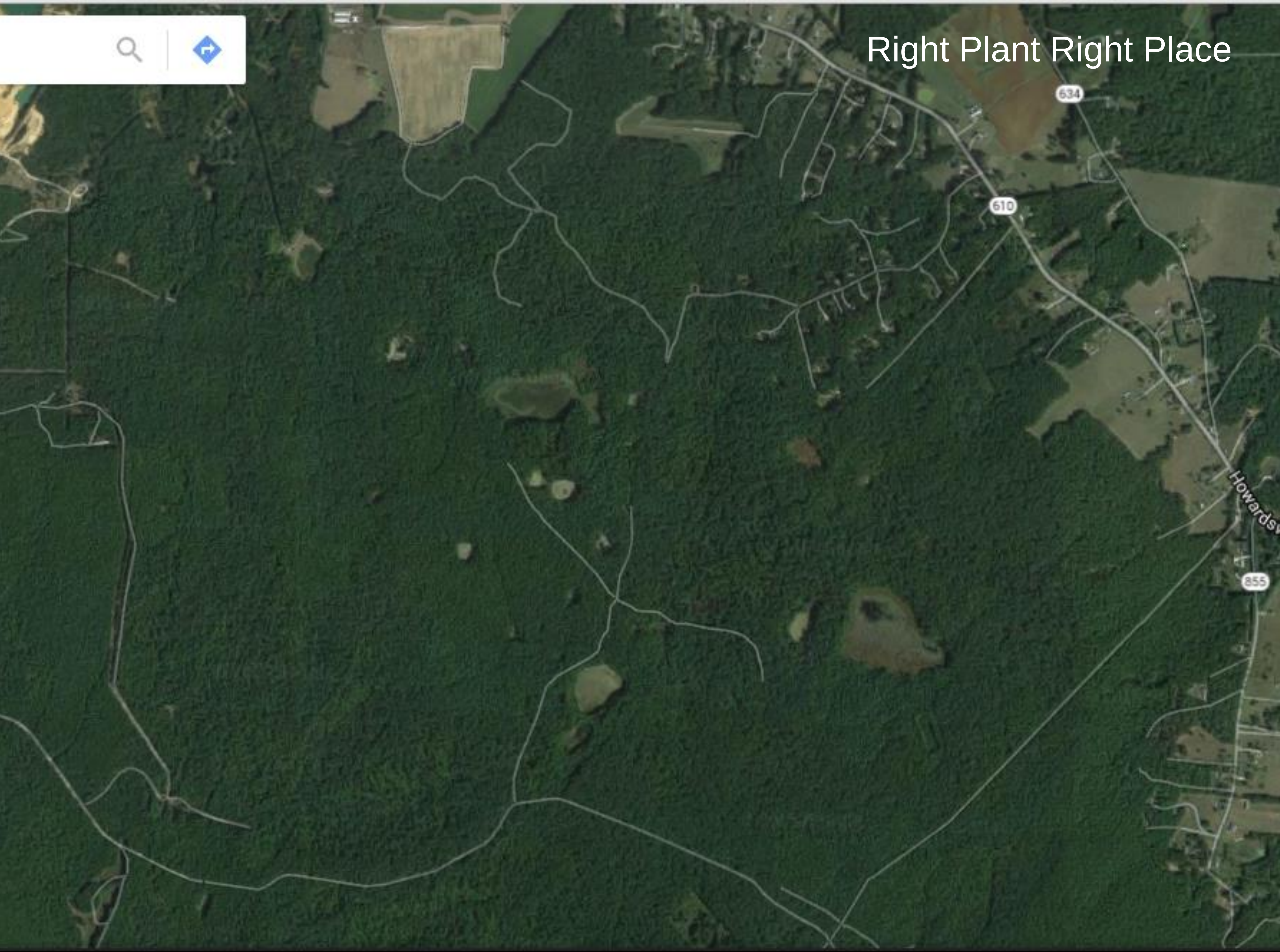
Environmental Systems Analysis, Inc.

and Wayfarer Environmental Technologies, LLC

January 2012

Protect Natural Areas

Preserve Remnants


Right Plant Right Place
634
610
855

Provide for needs of plants and animals

Insect-Plant Relationships

- Flowering plants coevolved with insect pollinators
- 90% of flowering plants rely on pollinators
- 75% of food crops rely on pollinators
- 40% of invertebrate pollinators are threatened with extinction (including 25% of native bumblebees)
- 90% of insect herbivores are host plant specialists
- Oak species support 557 species of lepidoptera, 800 species of gall-forming insects (mostly cynipid wasps), and hundreds of other insect species
- The foundation for the terrestrial food web is the transfer of energy from plants to insects

Woody Plants

Common Name	Plant Genus	Butterfly/moth species supported
Oak	Quercus	534
Black cherry	Prunus	456
Willow	Salix	455
Birch	Betula	413
Poplar	Populus	368
Crabapple	Malus	311
Blueberry	Vaccinium	288
Maple	Acer	285
Elm	Ulmus	213
Pine	Pinus	203
Hickory	Carya	200
Hawthorn	Crataegus	159
Spruce	Picea	156
Alder	Alnus	156
Basswood	Tilia	150
Ash	Fraxinus	150
Rose	Rosa	139
Filbert	Corylus	131
Walnut	Juglans	130
Beech	Fagus	126
Chestnut	Castanea	125

Herbaceous Plants

Common Name	Plant Genus	Butterfly/moth species supported
Goldenrod	Solidago	115
Asters	Aster	112
Sunflower	Helianthus	73
Joe pye, Boneset	Eupatorium	42
Morning glory	Ipomoea	39
Sedges	Carex	36
Honeysuckle	Lonicera	36
Lupine	Lupinus	33
Violets	Viola	29
Geraniums	Geranium	23
Black-eyed susan	Rudbeckia	17
Iris	Iris	17
Evening primrose	Oenothera	16
Milkweed	Asclepias	12
Verbena	Verbena	11
Beardtongue	Penstemon	8
Phlox	Phlox	8
Bee balm	Monarda	7
Veronica	Veronica	6
Little bluestem	Schizachyrium	6
Cardinal flower	Lobelia	4

-Doug Tallamy
http://www.bringingnaturehome.net/

Animal Needs

- *Food*
- *Water*
- *Shelter*
- *Places to Raise Young*

Adaptive Management

Consider Maintenance Up-Front

- Keep it simple
- Use Adaptive Management
- Methods are scale and resource dependent
- Mowing is the most accessible tool
- Woody plants make mowing difficult
- Chemicals are not always the worst thing
- Return intervals are critical for resource health and maintenance planning

Dos and Don'ts

- Establish naturally regenerating native plant systems
- If you plant, use common species and local genetic stock
- If you disturb the soil, be prepared to deal with it
- Eradicate NNIs, especially the woodies
- Adaptive Management: use whatever methods available/appropriate/feasible and change it up
  - Mechanical
  - Chemical
  - Fire
  - Grazing
  - Return interval
  - Other?
- Stick with it and monitor

Elklick Preserve


This shameful waste
WEAKENS AMERICA !
Remember—Only you can
PREVENT FOREST FIRES!




Big things of the world
Can only be achieved by attending to
Their small beginnings.
- Lao Tzu, Tao The Ching