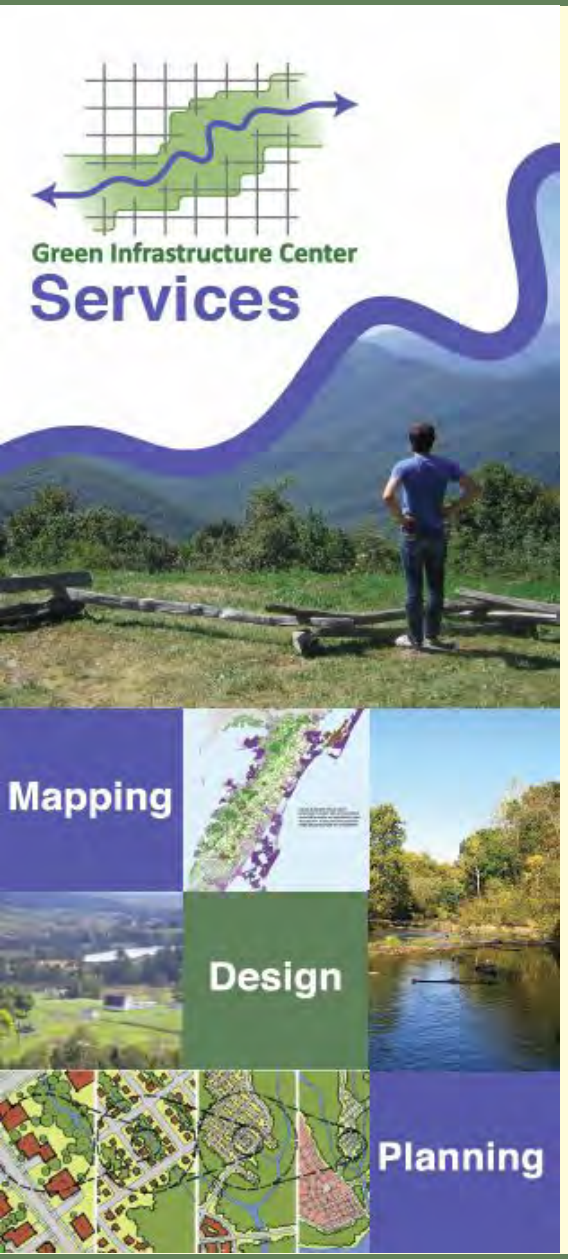
Evaluating and Conserving Green Infrastructure at Multiple Scales

Michigan Green Infrastructure Conference

Lansing Michigan

May 8, 2014

Developed by Karen Firehock
The Green Infrastructure Center, Inc.



The Green Infrastructure Center's mission is to help communities evaluate their green assets and manage them to maximize ecological, economic and cultural returns.

We do this by:

Technical and mapping consulting

Teaching courses and workshops

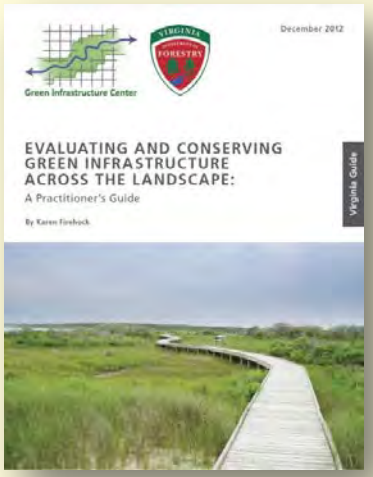
Research into new methodologies

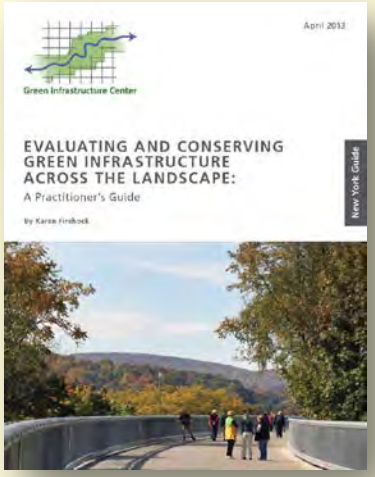
Where We Work

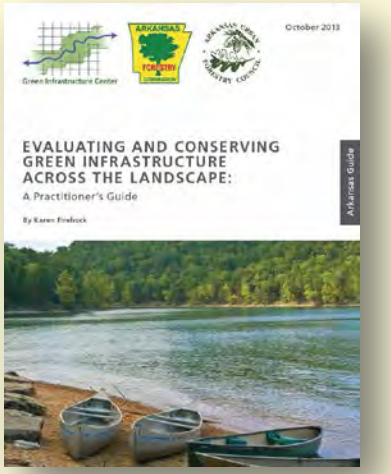
Launched in Virginia, the GIC has conducted 15 projects from multi-county regions, to counties, cities, towns and watersheds. We also work in NY, AR, NC and SC. We can work anywhere!

Our planning guides are based on seven years of field testing. We can build a model for any state to map green infrastructure connections.

To view GIC's projects and case studies visit: www.gicinc.org/projects







Slide Show Topics

- ❑ Why We Need Multi Scale Thinking
- ❑ Green Infrastructure Defined
- ❑ Planning at Multiple Scales:

Region/City/Watershed/Site

- ❑ Making the Case

Why do we need better multi-scale planning? When we don't do this we get...

- Traffic congestion
- Poor water quality
- Bad air quality
- Loss of critical habitat
- Loss of working lands

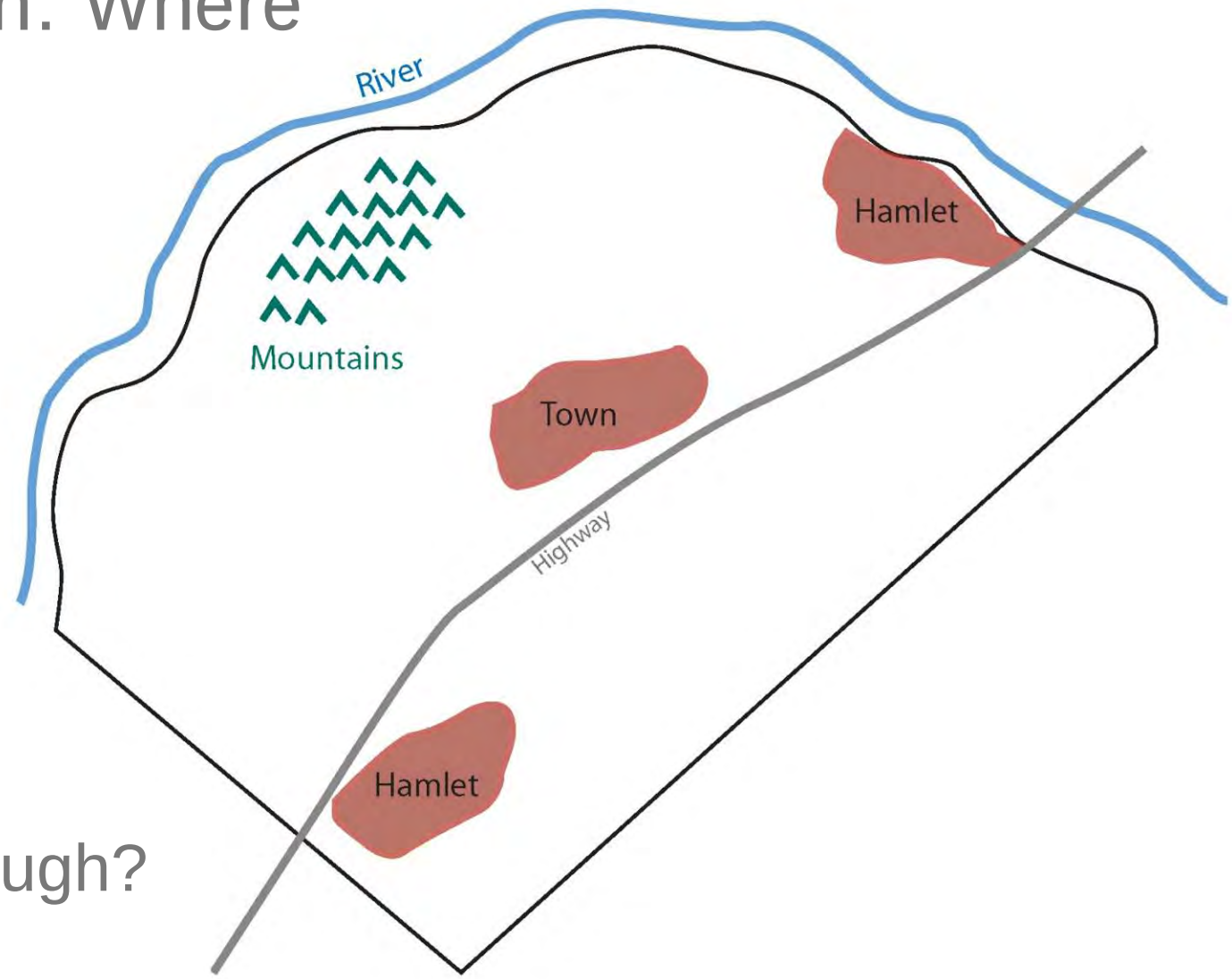
While you viewed this slide, America lost another 3 acres of open space

First Question: Where to develop?

Smart Growth =

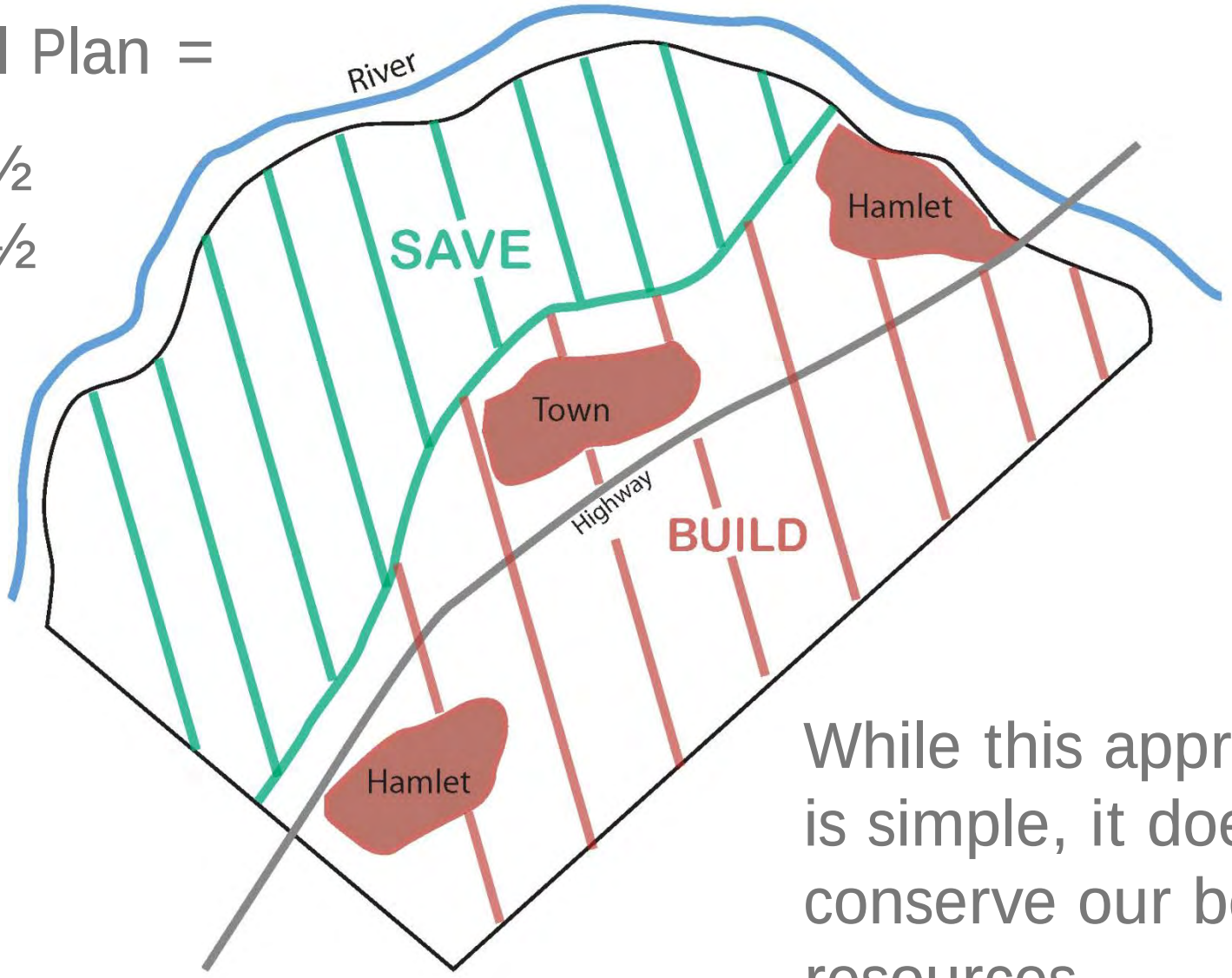
Using Existing (grey) Infrastructure

But is this enough?



Typical Plan =

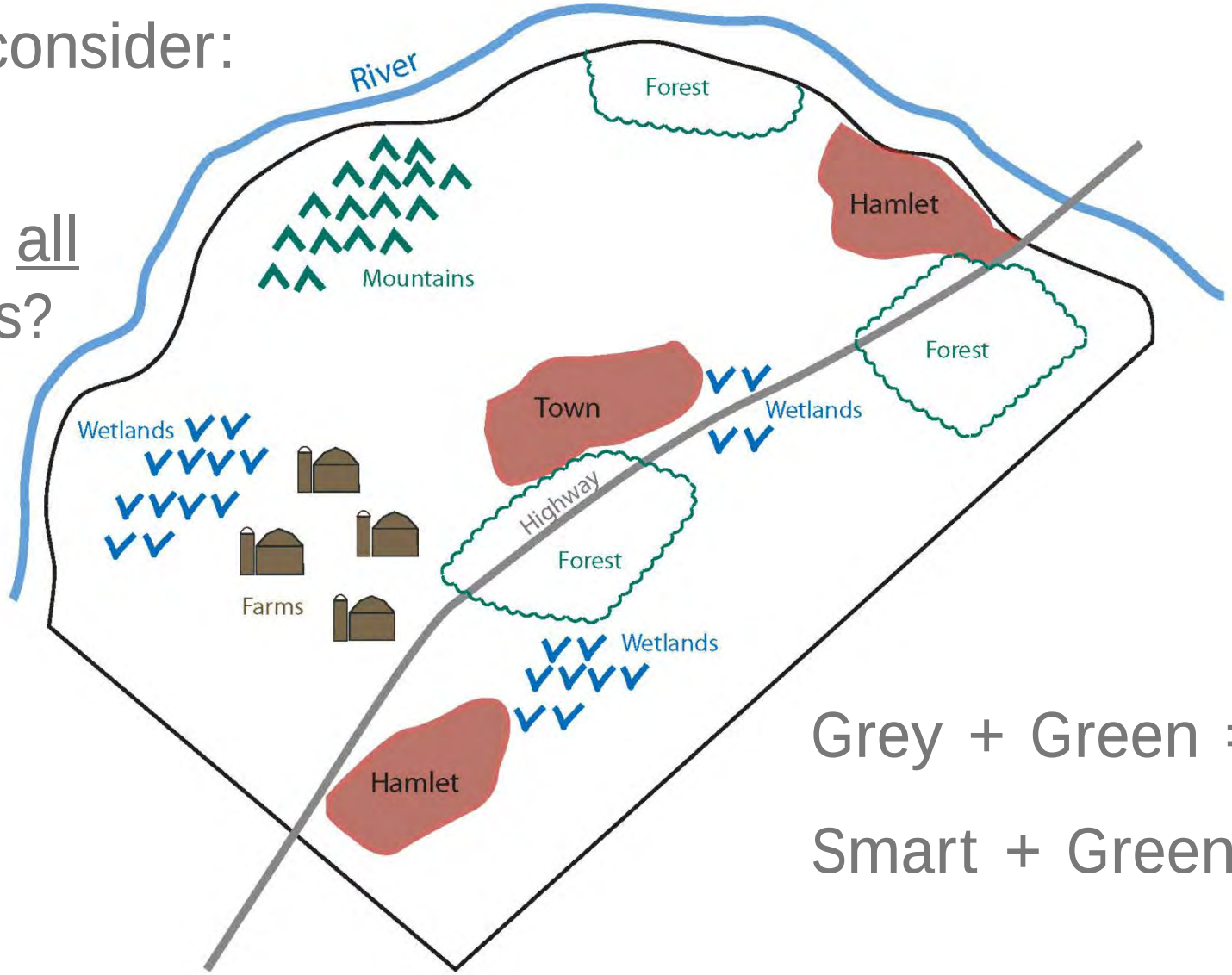
Save ½
Build ½



While this approach is simple, it does not conserve our best resources.

Need to consider:

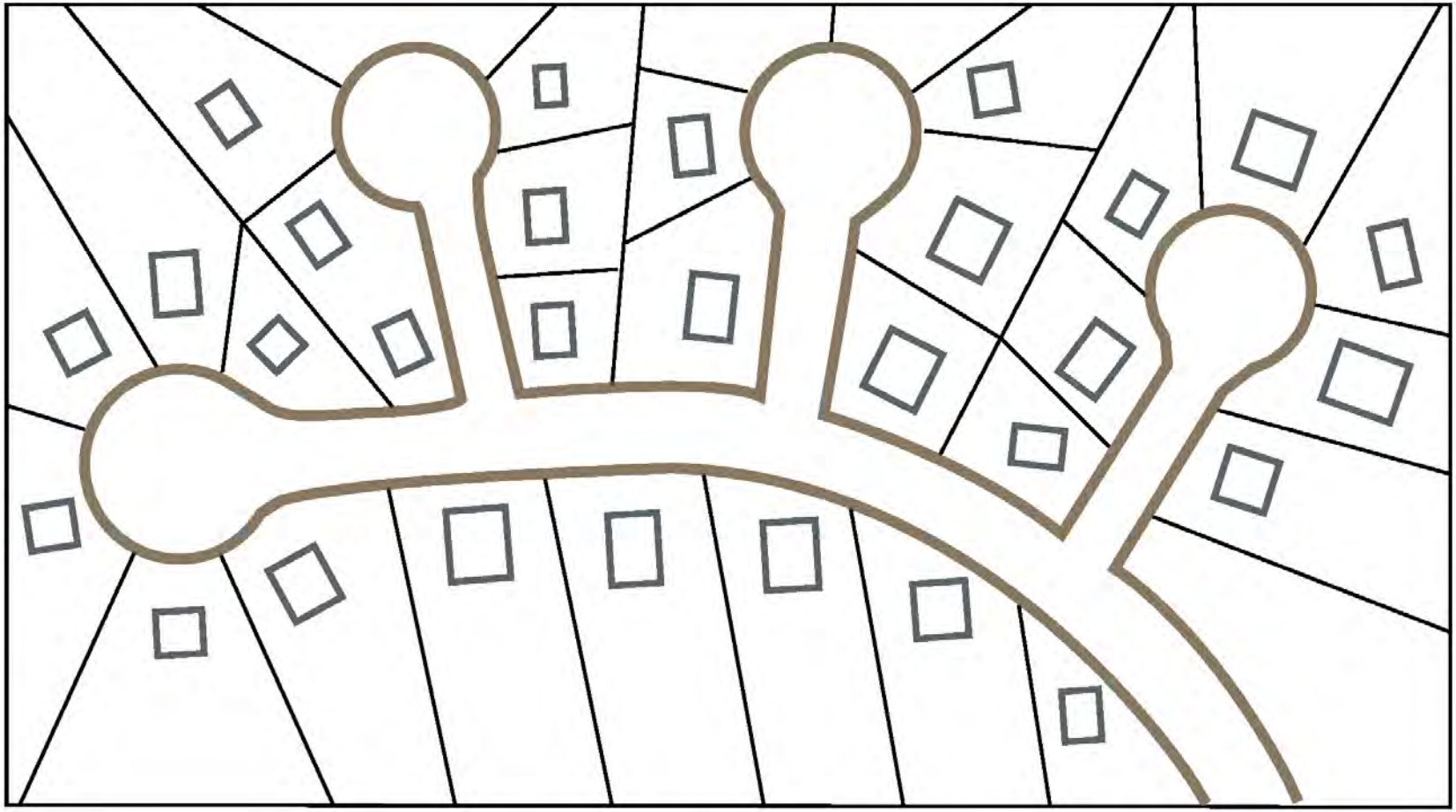
What are <u>all</u> the assets?



Grey + Green =

Smart + Green

Traditional Development



Clustering = setting buildings closer together to conserve green space

Within a subdivision, clustering can add to open spaces and provide an amenity for wildlife and recreation. But which land is protected and how it is connected are critical.

The problem of clusters that don't look beyond parcel boundaries

Infrastructure: What's in a name?

Infrastructure (n): the substructure or underlying foundation…on which the continuance and growth of a community or state depends.

What is Green Infrastructure?

A planimetric map of a Washington DC shows a neighborhood's gray infrastructure including buildings and roads (left). Classified high-resolution satellite imagery adds a green infrastructure data layer (trees and other vegetation) (right). Source: American Forests

Origin of the Term “Green Infrastructure”

Florida coined the term “Green Infrastructure.” in a *1994* report to the governor on land conservation strategies.

It was intended to reflect the notion that natural systems are important components of our “infrastructure.”

When Did GI Definition Expand to Include BMPs?

2006: the U.S. EPA begins calling integrated best management practices -- previously referred to as **Low Impact Development** (LID) strategies -- “Green Infrastructure.” This led to confusion!

Used in concert – best management practices such as biofilters, no mow zones, permeable pavers, filterra boxes, downspout protection and green roofs can significantly reduce urban runoff impacts.

LID applies structural methods to counter human induced changes to the land at a site scale.

- **First Conservation:** Evaluate existing green infrastructure assets. First, prevent stormwater, then mitigate. (MI Low Impact Development Manual, 2008)

- **Second Mitigation:** LID is mitigation and is applied at the site scale after resources are protected to counter any potential hard surface impacts.

LID is **not a license to develop** anywhere.
Low Impact Development is ***not*** no impact development.

Trees: the original green infrastructure!

Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

Estimates for the amount of water a typical street tree can intercept in its crown, range from 760 gallons to 4000 gallons per tree per year, depending on species.

Natural Assets Are Green Infrastructure

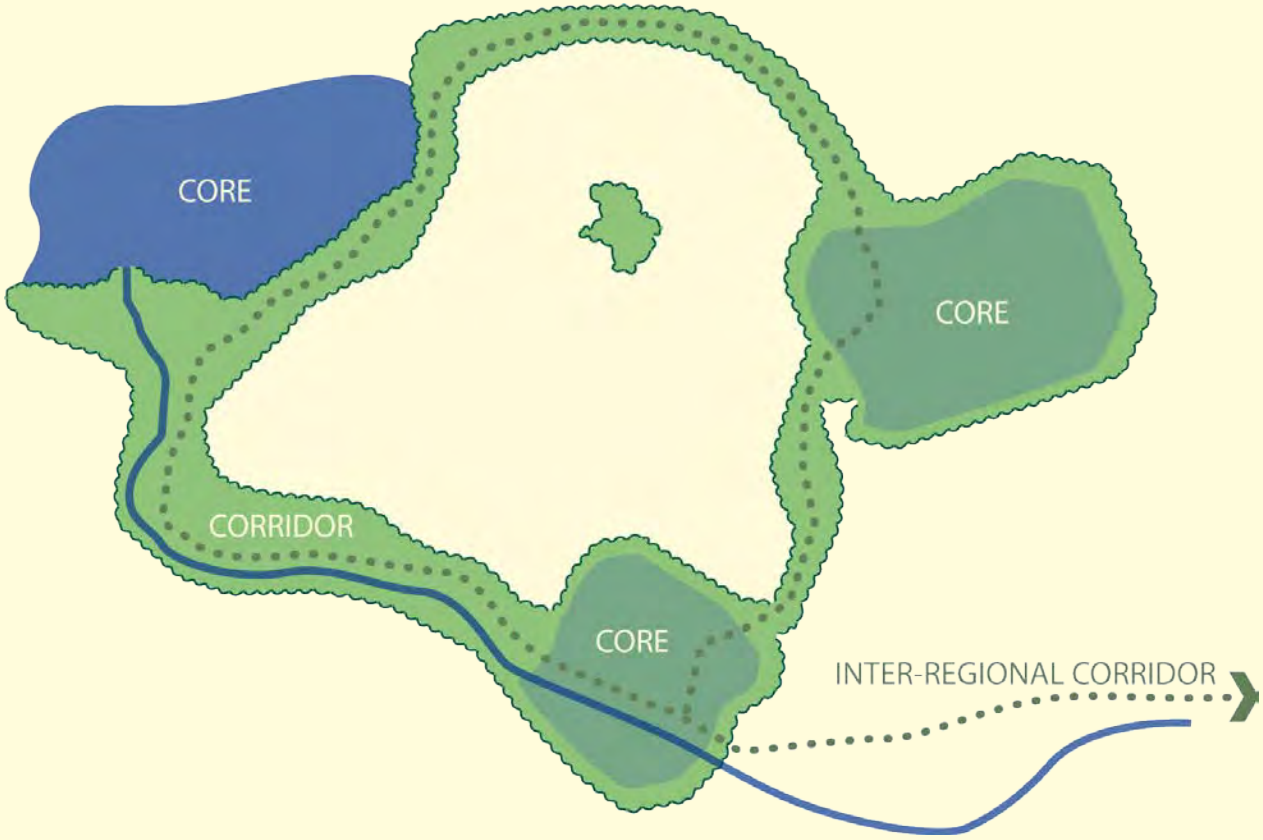
Green infrastructure includes all landscape elements that support our existence.

Traditional Development	Green Infrastructure Based-Development
Plan for grey infrastructure first (roads, stormwater pipes)	First, assess natural features and functions and protect them.
Green spaces in leftover lands (e.g. steep slopes and floodplains)	Plan for parks, trails, habitat connections before siting buildings.
Work within confines of parcel = pocket parks, inner trails, gated systems	Connect land and water habitats to region and across ownerships

Green Infrastructure Planning For A Connected Landscape

It's about connecting the landscape!

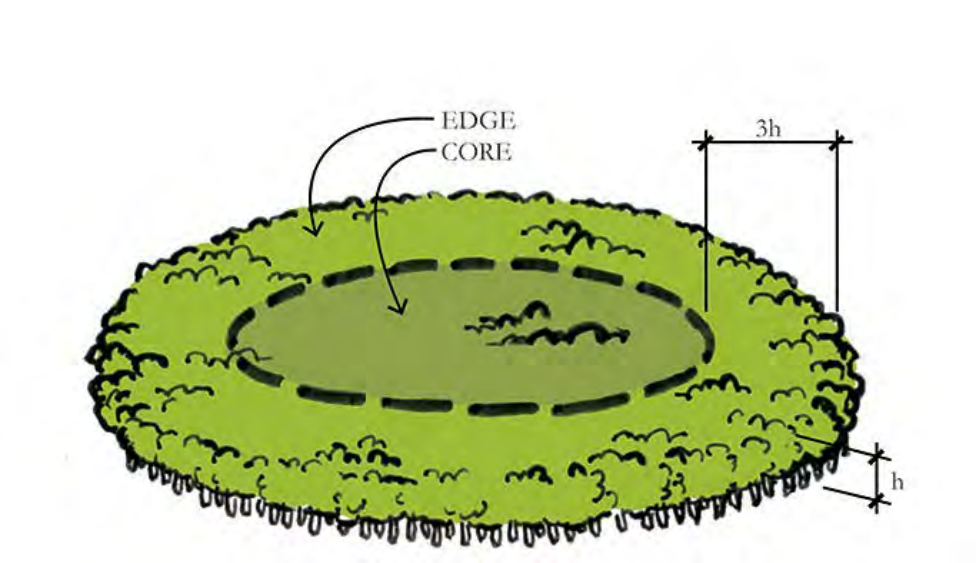
Not just key habitats but how we connect them!



How to Calculate Interior Habitat

Take the average tree height @ 100 feet and multiply by 3 to get edge. Subtract that to learn what remains and whether there is enough area to constitute a core. If smaller, it may still be a key “patch” or “site.”

Interior = Total Area – 3(h)



Who Prefers Interior Forest Cores?

Birds, e.g. cerulean warbler, Scarlet tanager

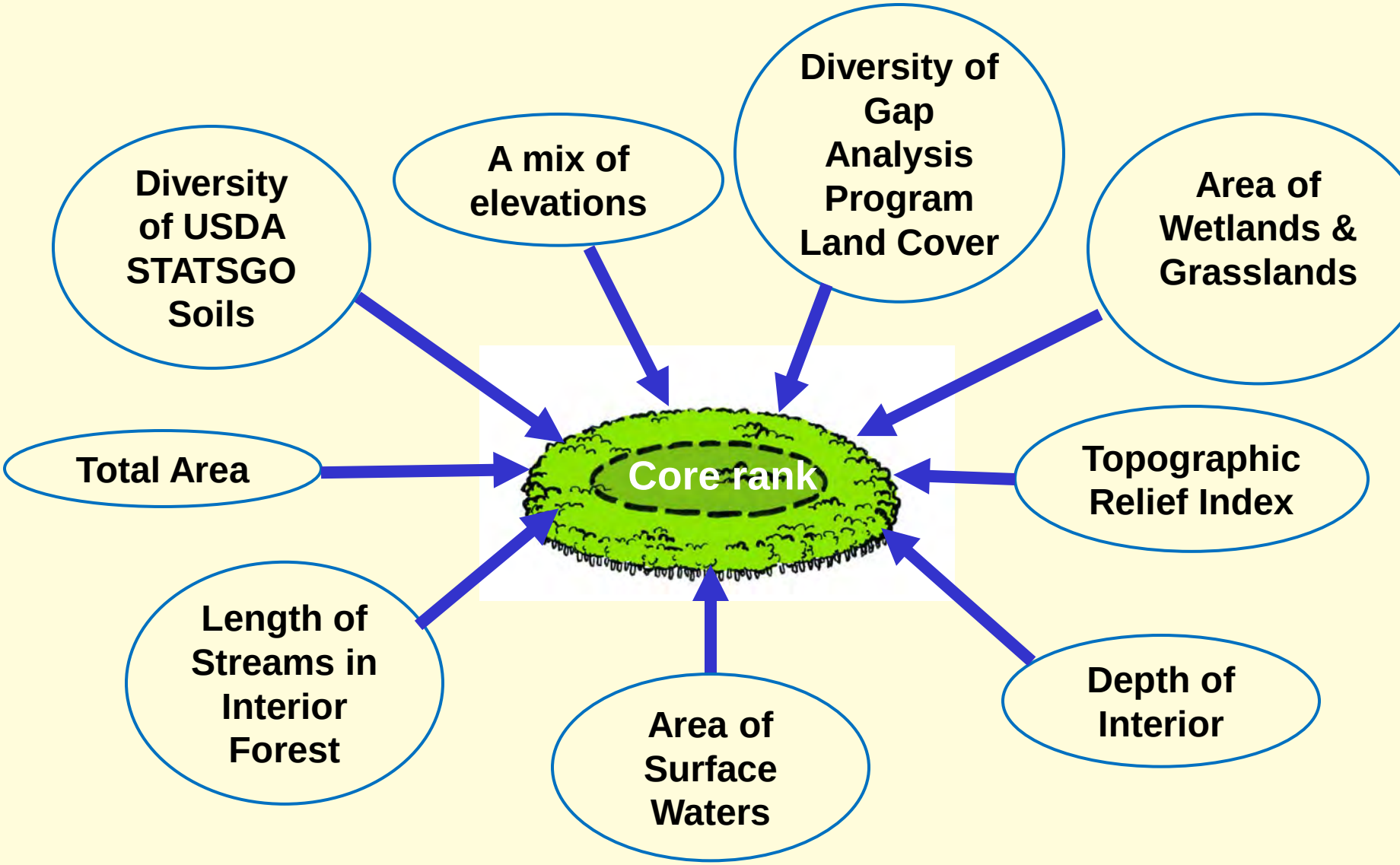
Mammals, e.g. black bear, bobcat, n. flying squirrel

Amphibians, e.g. spotted salamander

Species Protection in Michigan

- Karner Blue Butterfly
- Kirtlands Warbler
- Canada Lynx
- Indiana Bat
- Eastern Massasauga Rattlesnakes

We can build a model of habitat cores and rank them

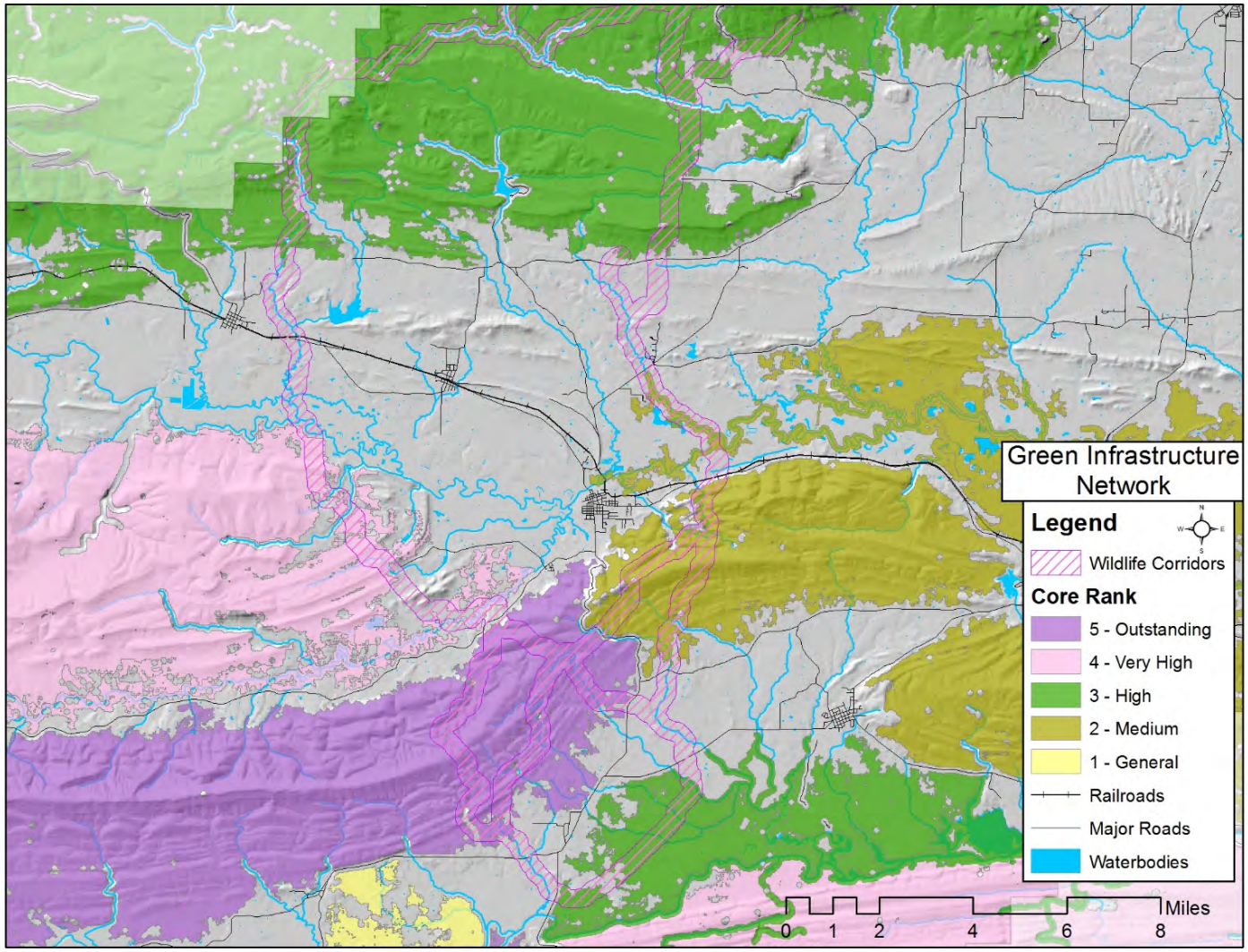


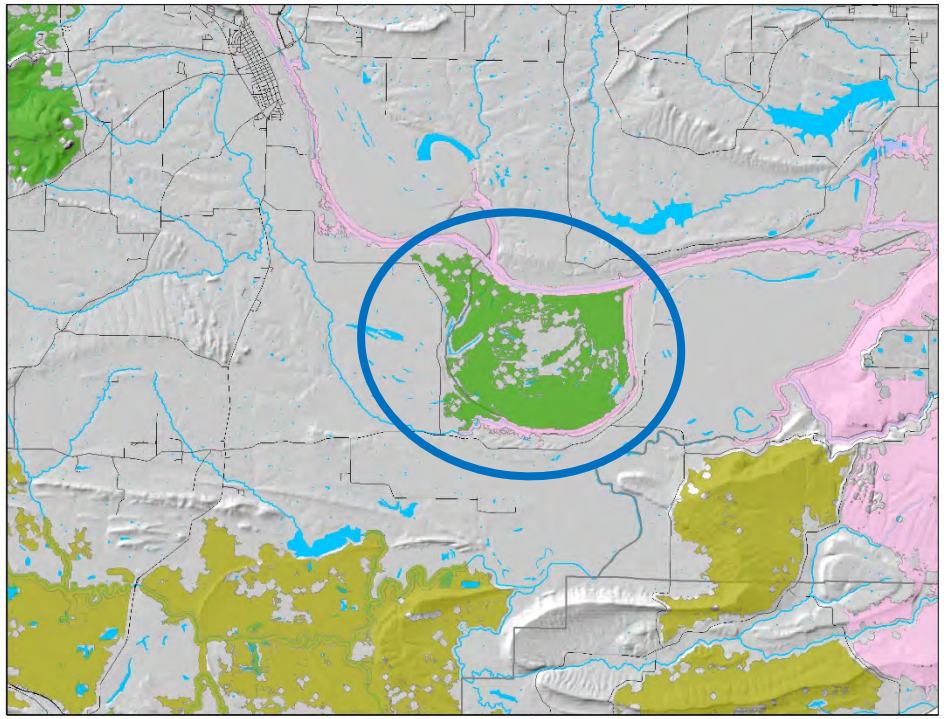
Example

This map shows the highest value cores and connected corridors =

High Integrity Cores

Connector Patches



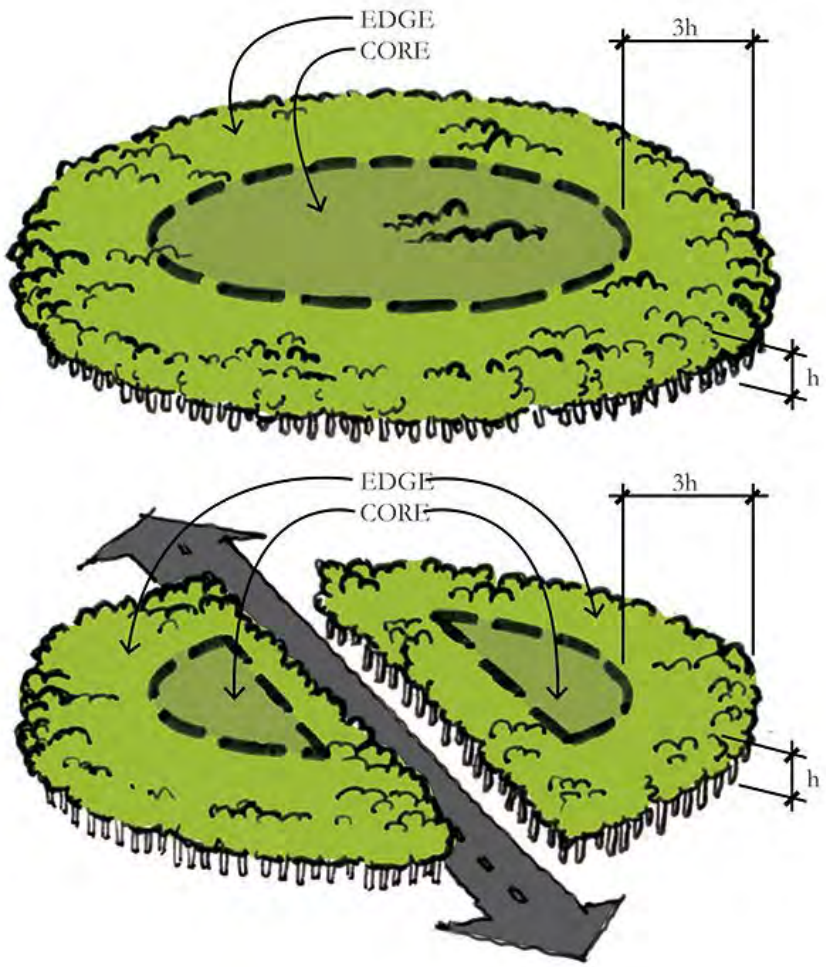


Each core area has a data table telling what it contains...

See example high ranked core at left has:

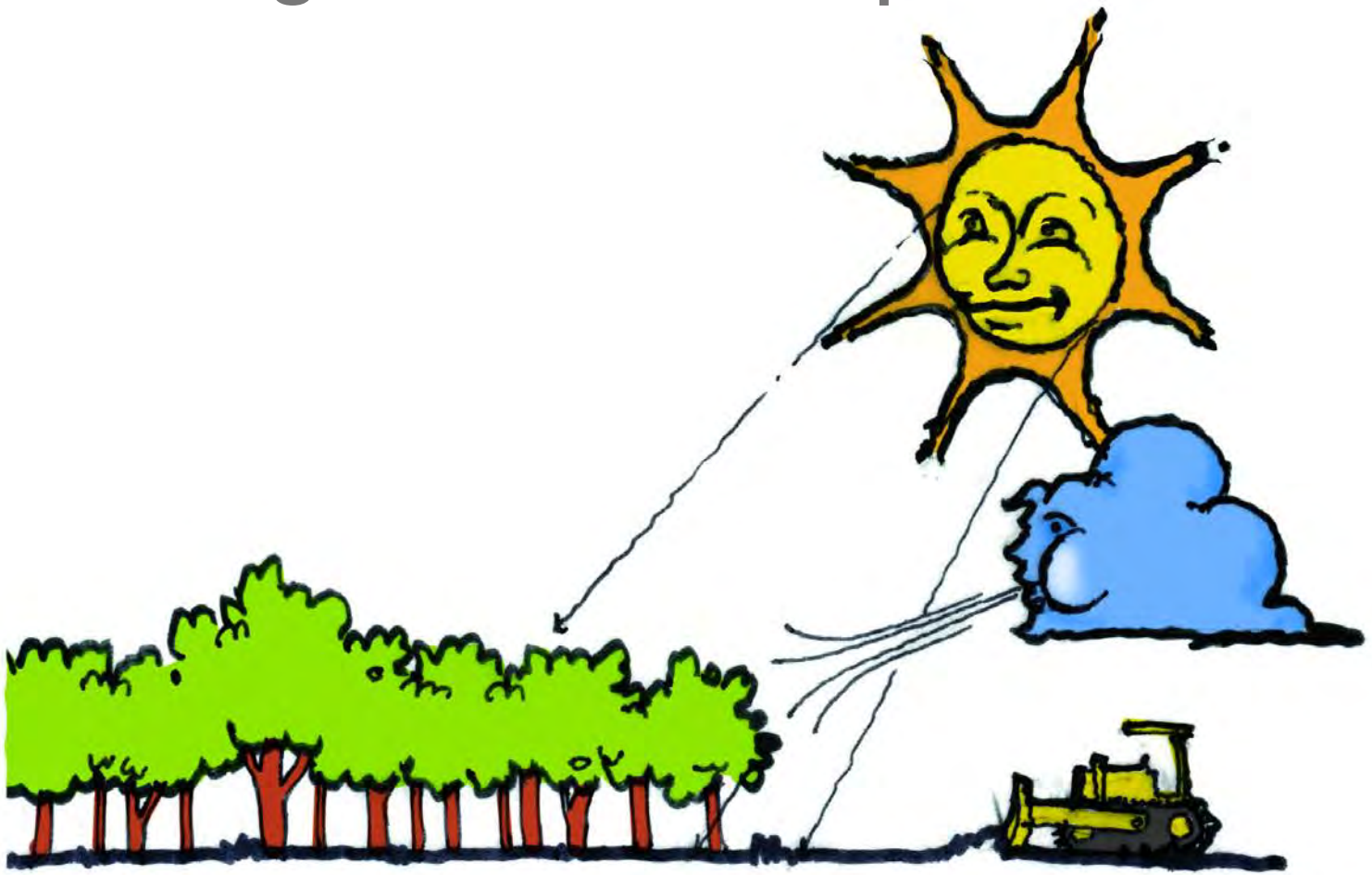
- ✓ 4,469 acres
- ✓ 6 soil types
- ✓ 6 habitat types
- ✓ 4.5 acres of wetlands
- ✓ 2.5 acres of surface water

Dividing a large core into two smaller cores = less interior habitat



Edge area = Average tree height (h) X 3
Core = Total area - Edge area
Ideally, Core ≥ 100 acres

More Edge = More Impact Zones



Who Causes Trouble at the Edges?

Brown Headed Cow Bird

Invasive plants/trees

Domestic (and wild) cats

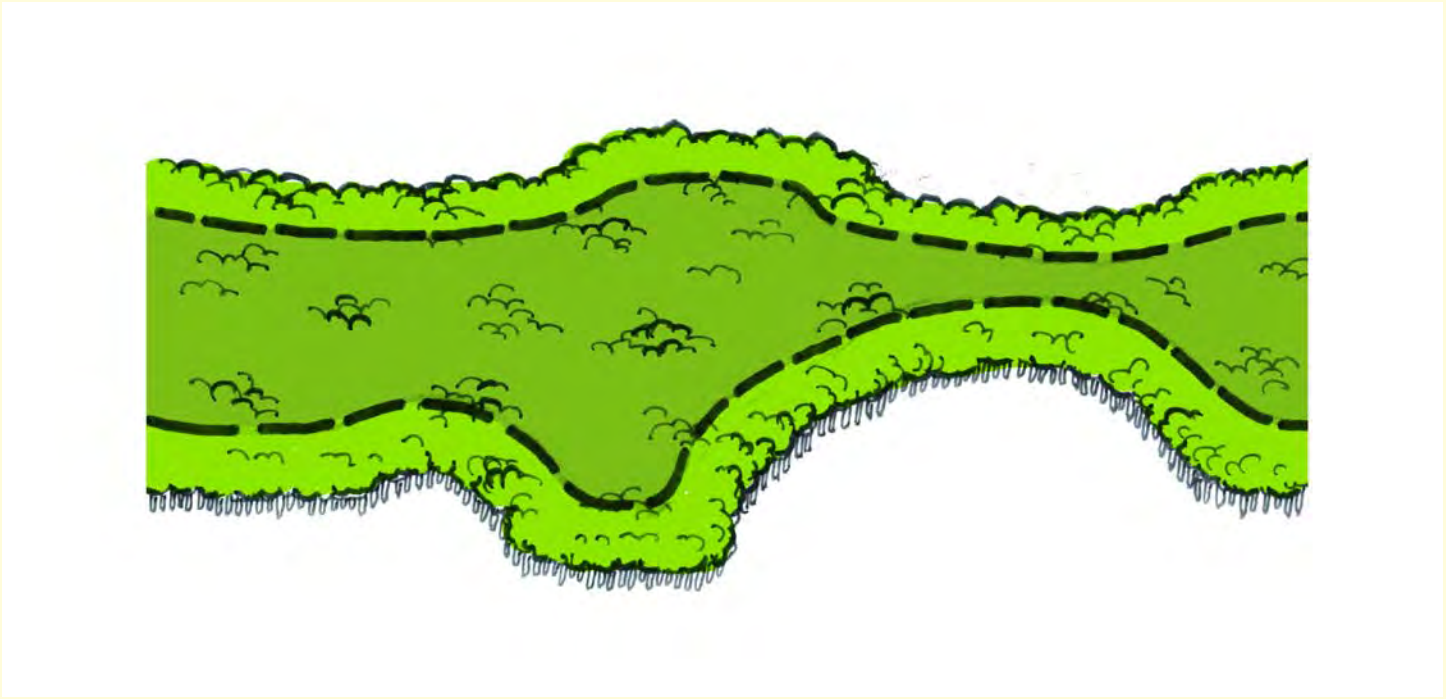
Type of Edge Matters Too!

The hard edge (top) is not as conducive to supporting species' diversity as the bottom soft (more gradual) edge.

Corridors May Not Be Uniform.

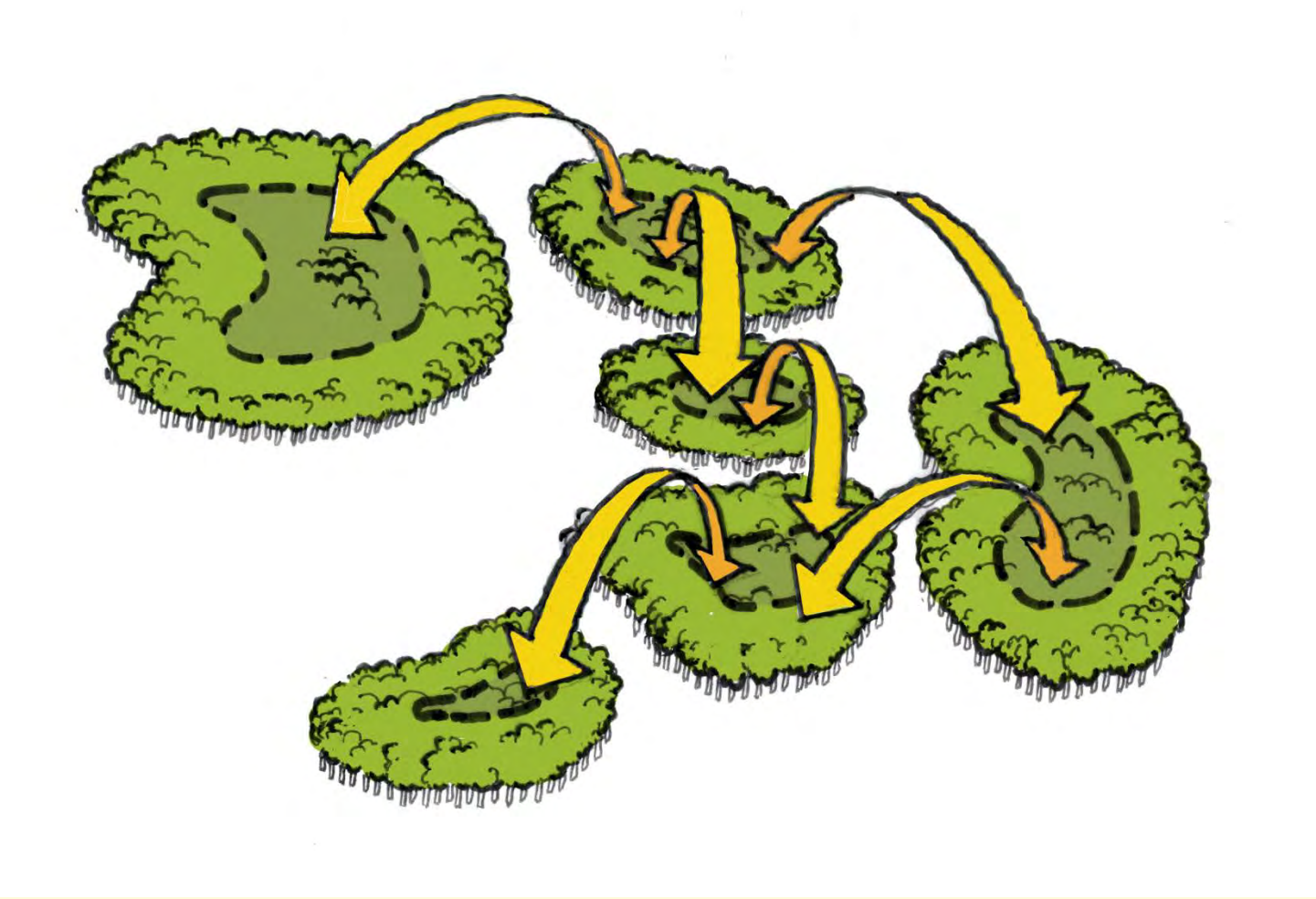
The ideal is 100 meters of safe space in the middle and 100 meters of edge.

minimum width = 300 meters wide



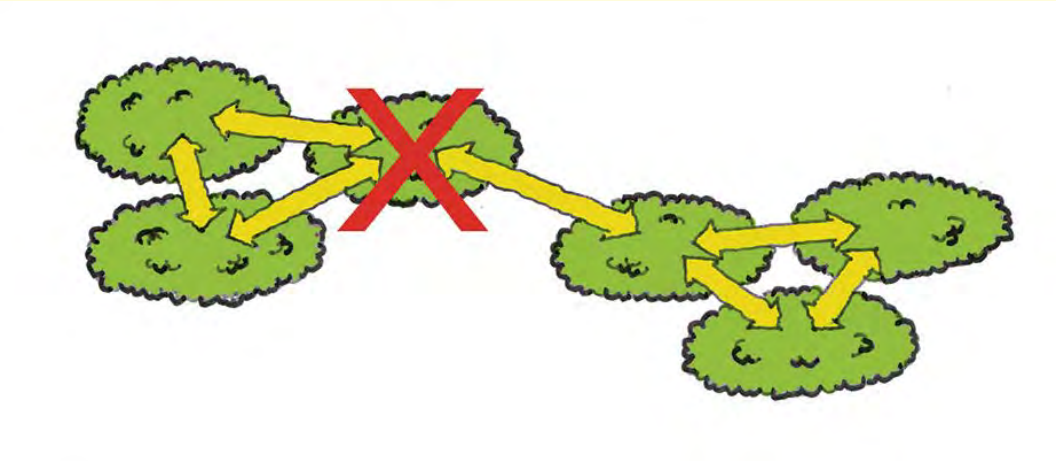
Who Can Use Corridors? (300 meters is ideal...)

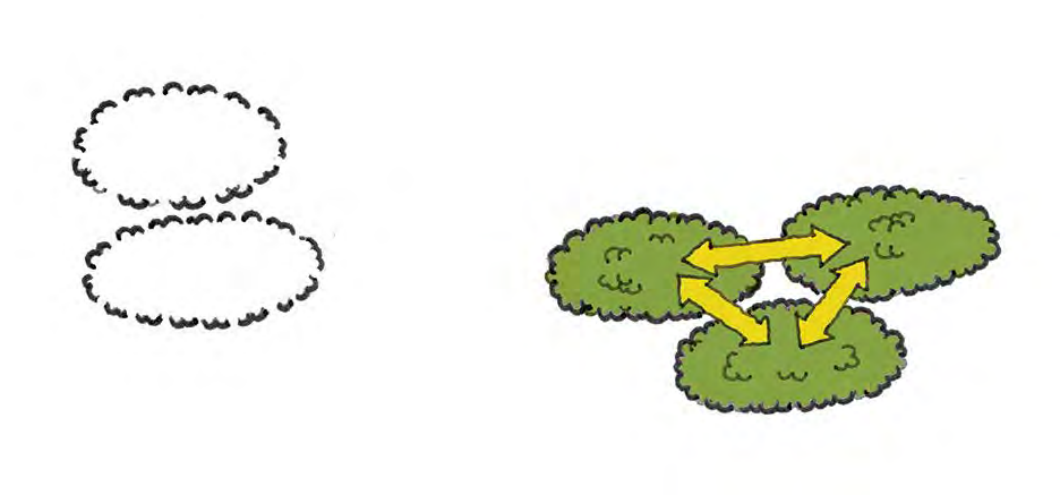
When Direct Corridors Are Lost, Some Species Can Still Hop Across.



When Cores Are Lost, Species May Decline

If cores or patches are too far apart, or if a core is lost, species may become isolated and decline over time.





Benefits of Conserving Green Infrastructure

- Conserving working lands such as farms and forests, that contribute to the economy.
- Protecting and preserving water quality and supply.
- Providing cost-effective stormwater management and hazard mitigation.
- Preserving biodiversity and wildlife habitat.
- Improving public health, quality of life and recreation networks.

Six Steps for Green Infrastructure Planning

1) **Set Your Goals:** What does your community/organization value?

2) **Review Data** – What do we know or need to know, to map identified values?

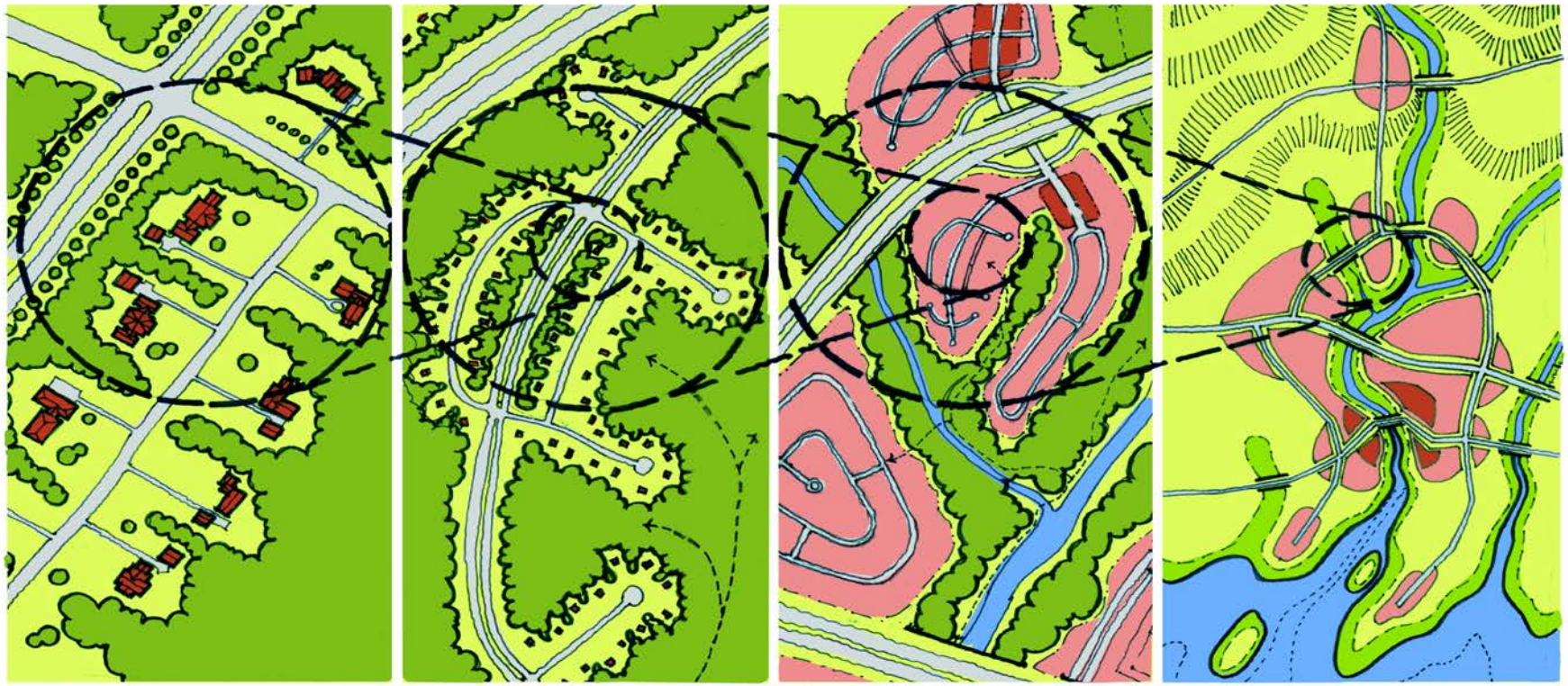
3) **Map Your Community's Ecological and Cultural Assets** – Based on the goals established in Step One and data from Step Two.

4) **Risk Assessment** – What assets are most at risk and what could be lost if no action is taken?

5) **Rank Your Assets and Determine Opportunities** – Based on those assets and risks you have identified, which ones should be restored or improved?

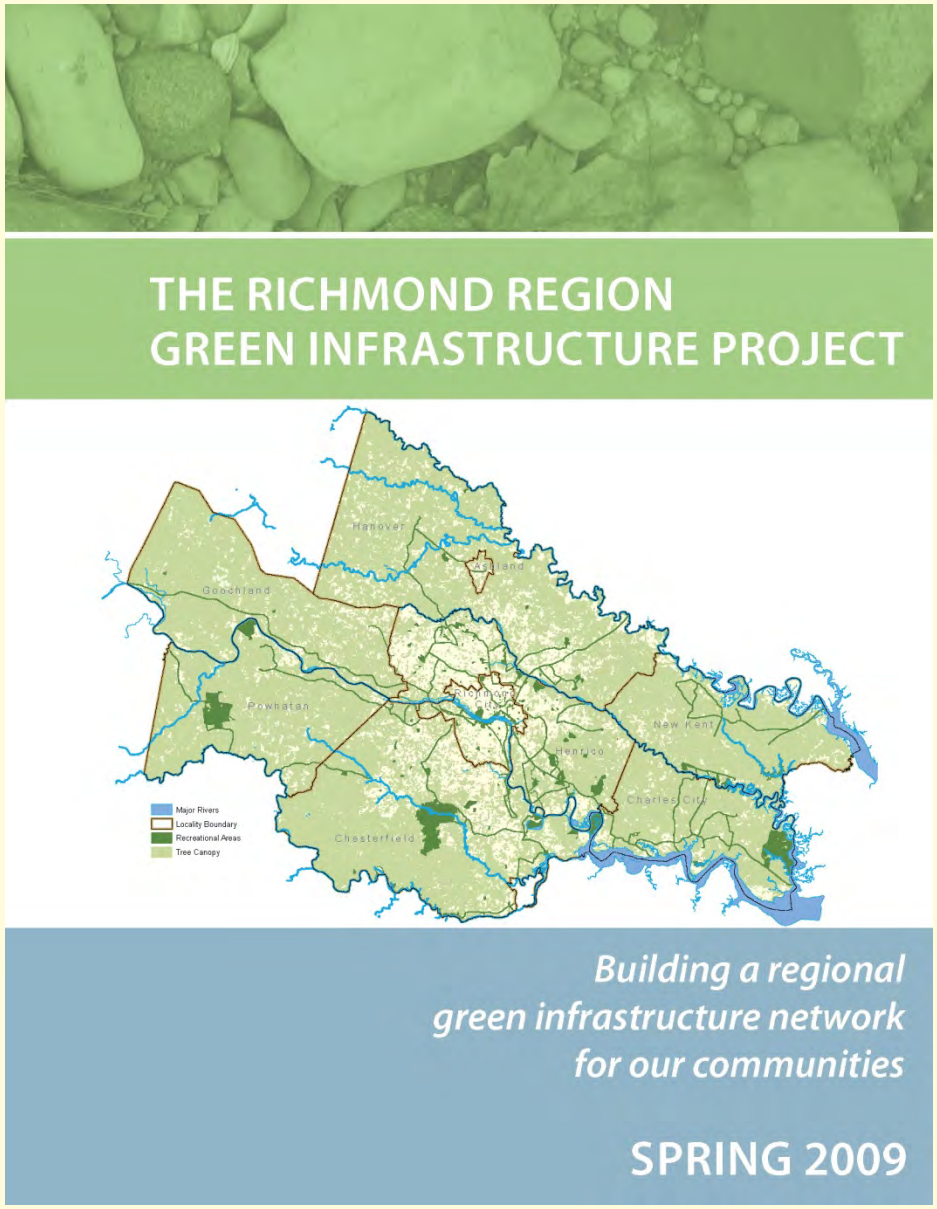
6) **Implement Opportunities** – Include natural asset maps in both daily and long-range planning (park planning, comp plans, zoning, tourism and economic development, seeking easements etc)

How Do We Conserve Green Infrastructure at Multiple Scales?

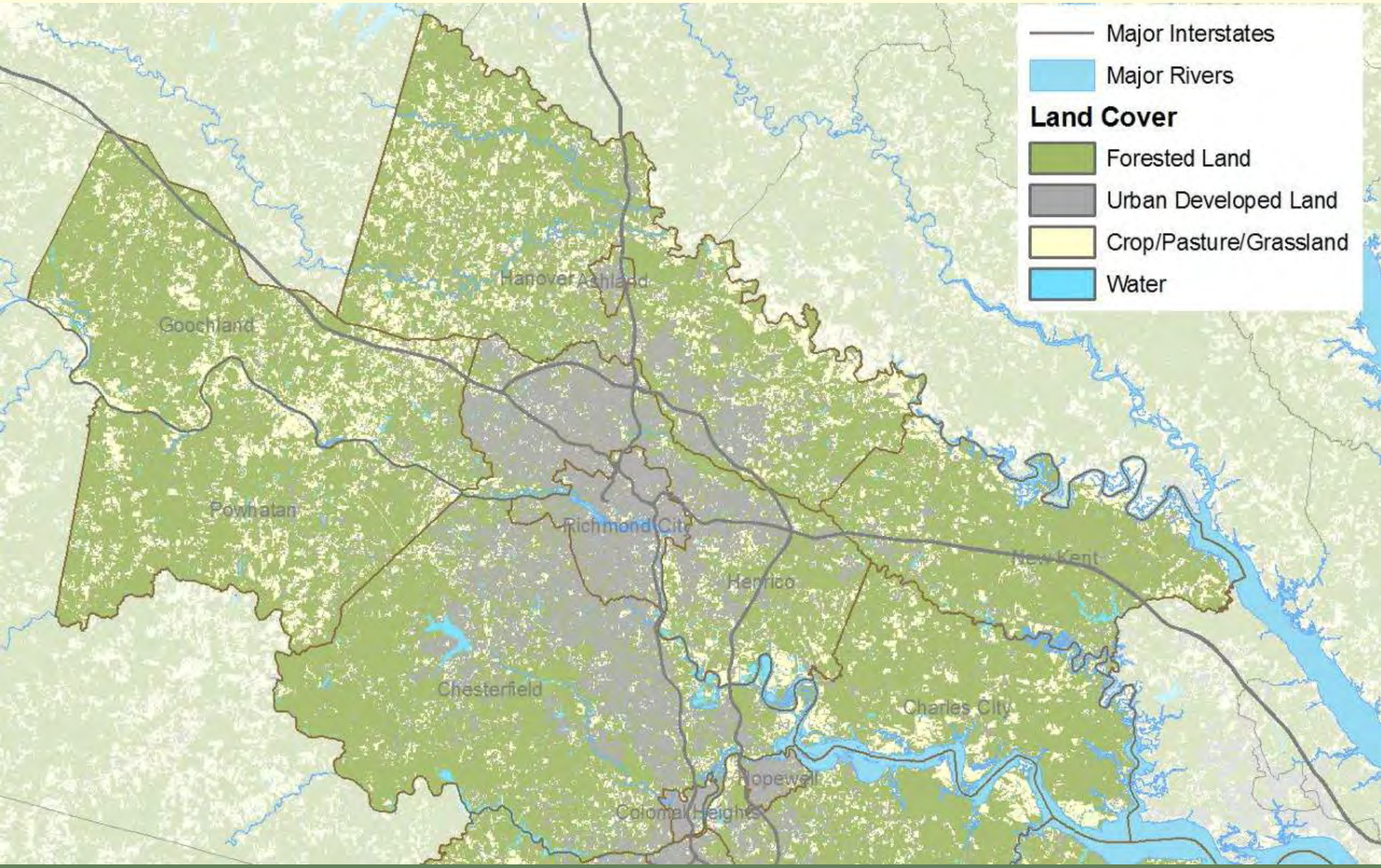


A Case Example from Virginia

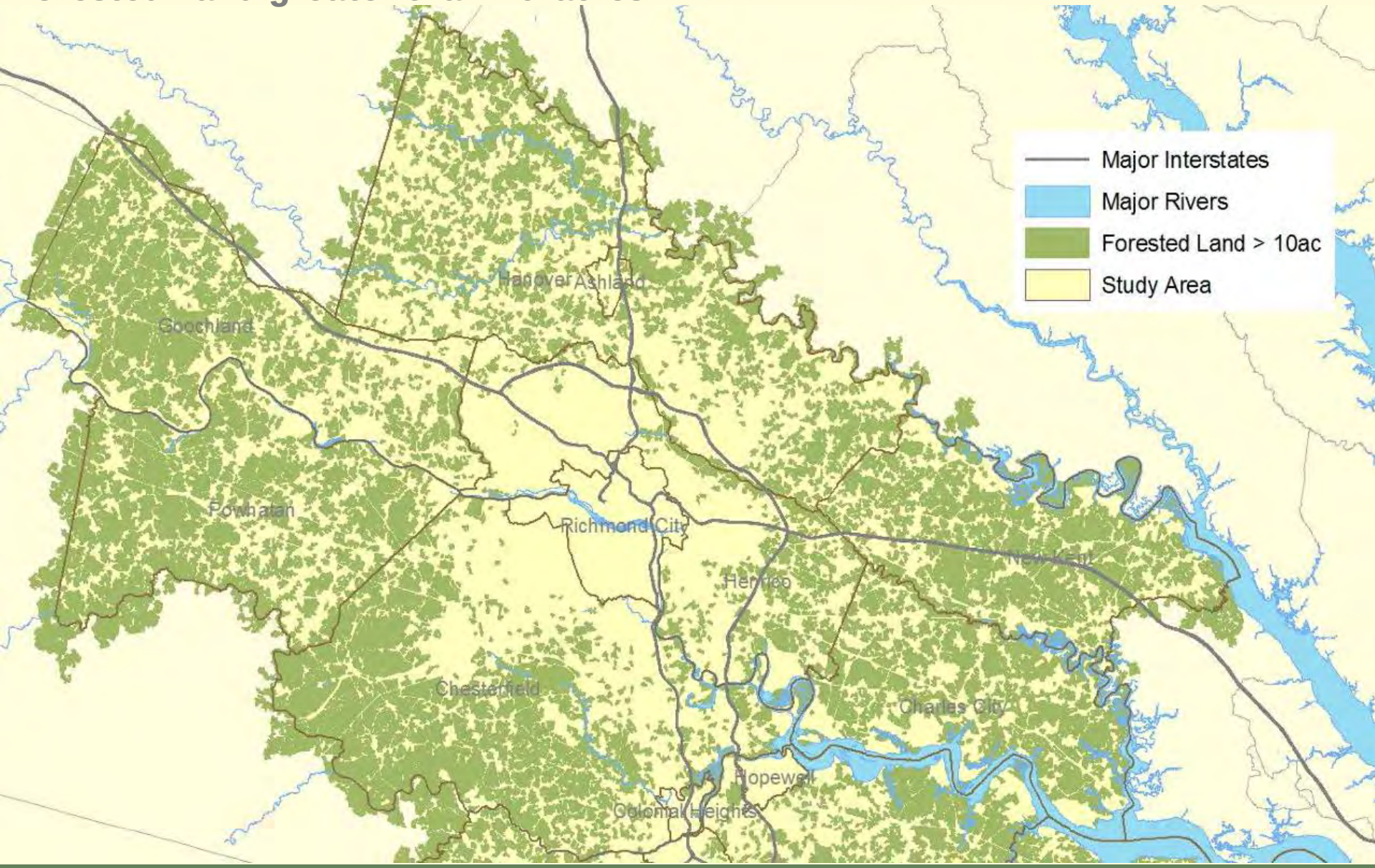
Region



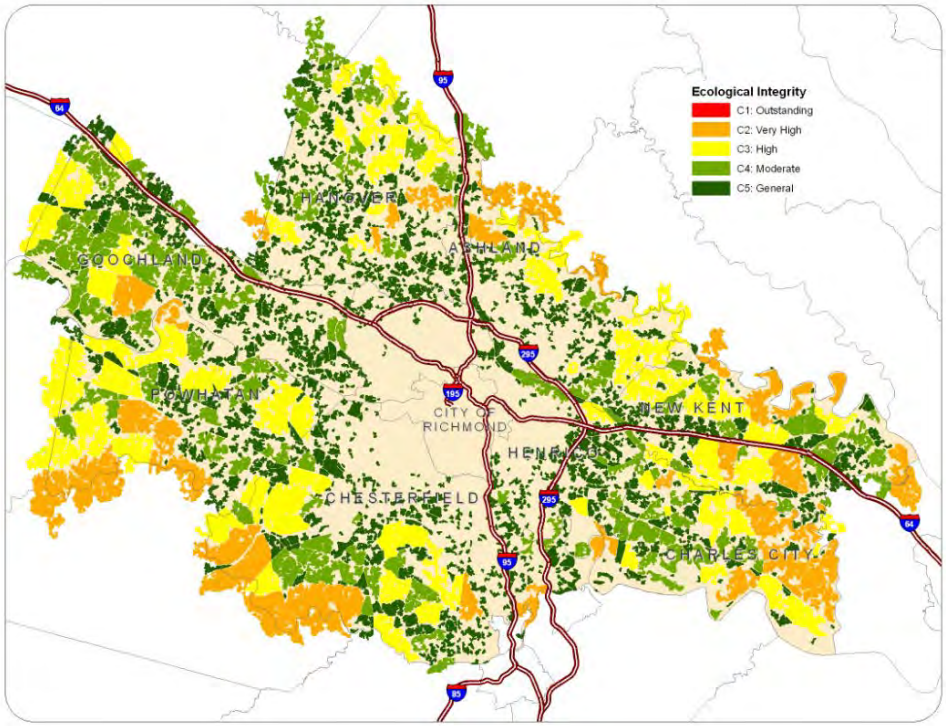
Land Cover

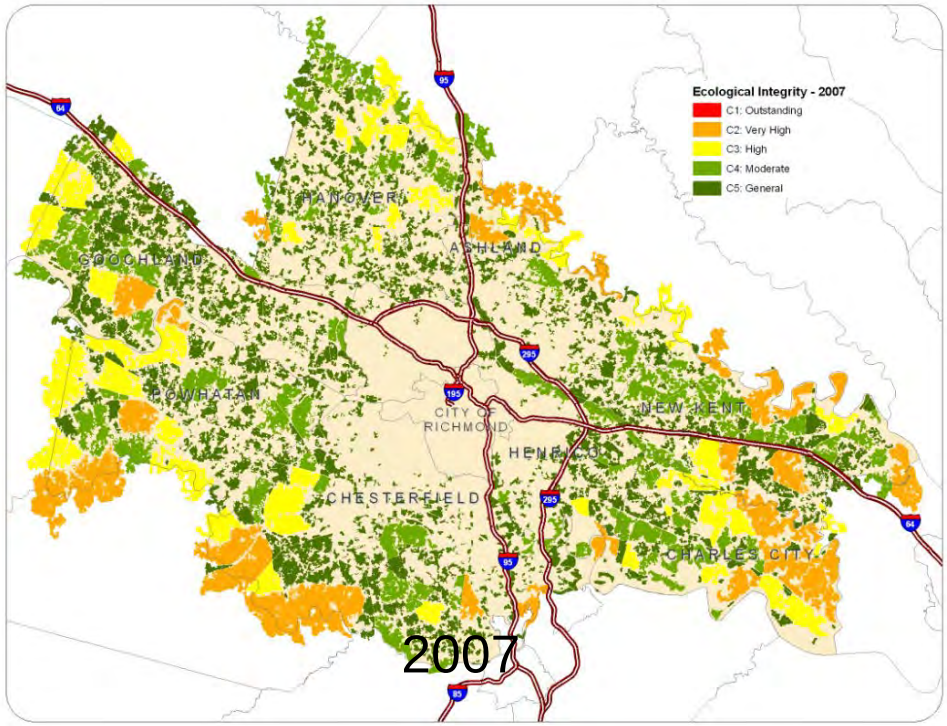

Major Interstates
Major Rivers
Land Cover
Forested Land
Urban Developed Land
Crop/Pasture/Grassland
Water
Hanover
Ashland
Goochland
Powhatan
Richmond City
Henrico
New Kent
Chesterfield
Charles City
Hopewell
Colonial Heights

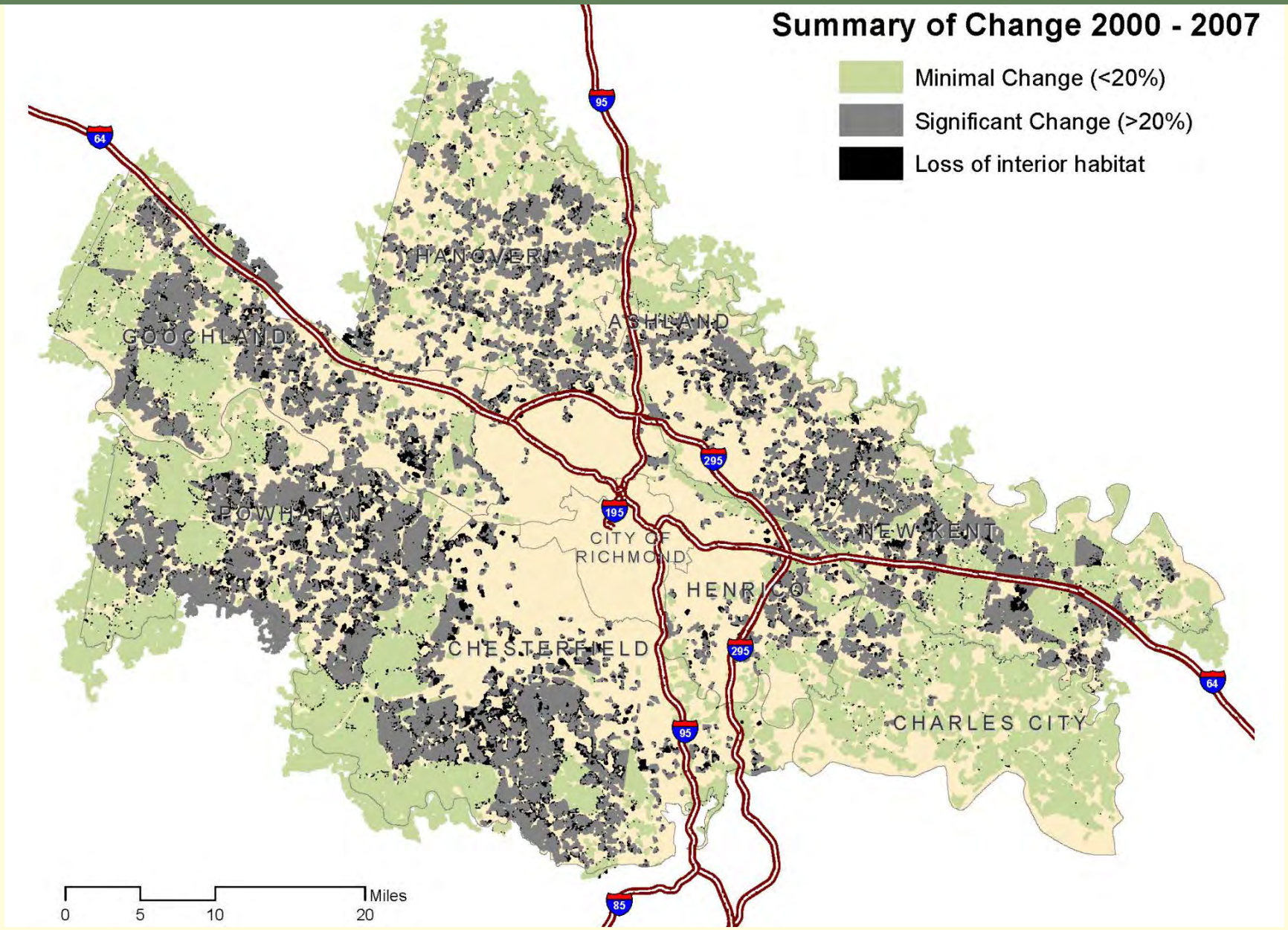
Forested Land greater than 10-acres



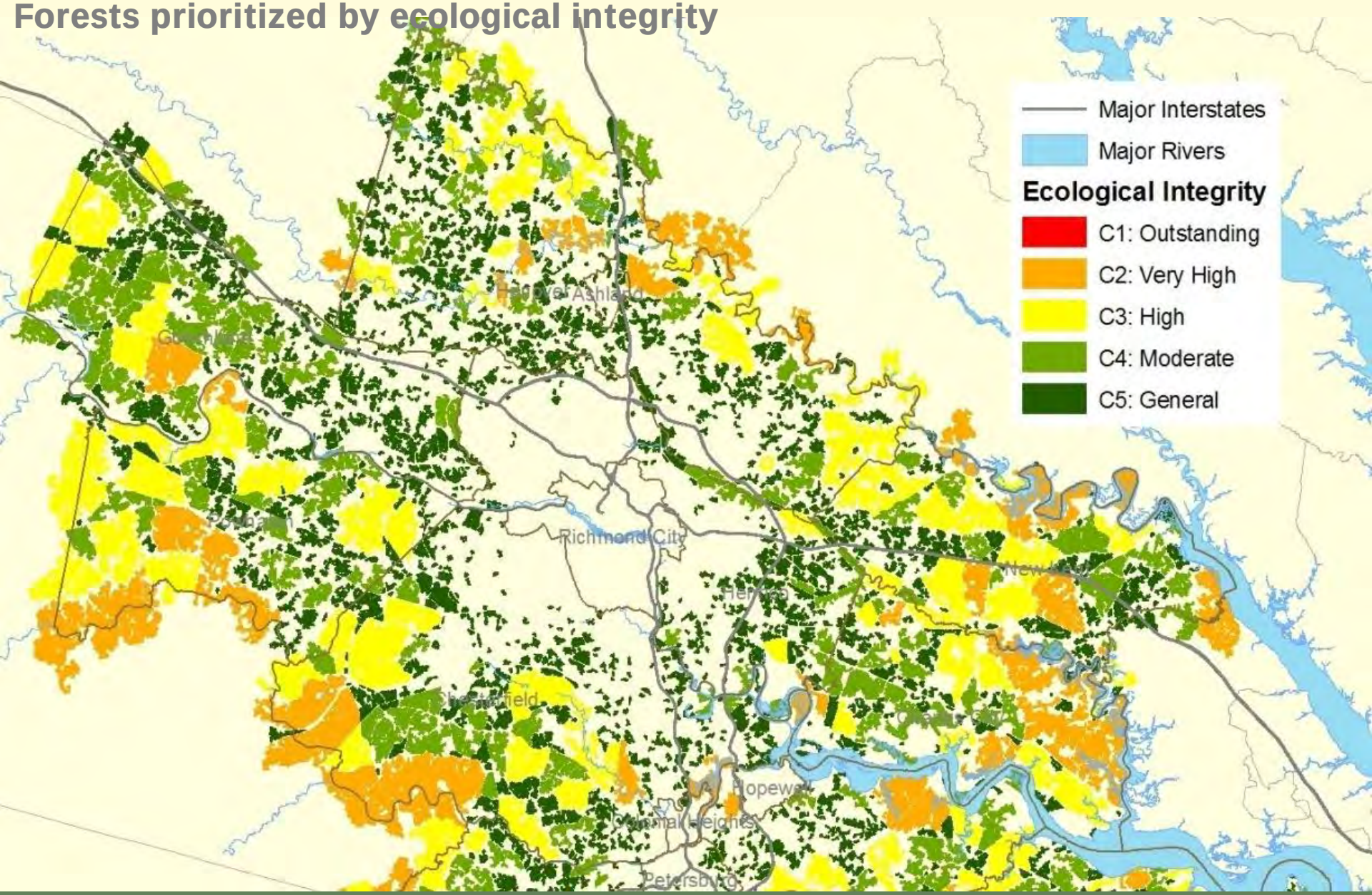
Identify Trends & Priorities



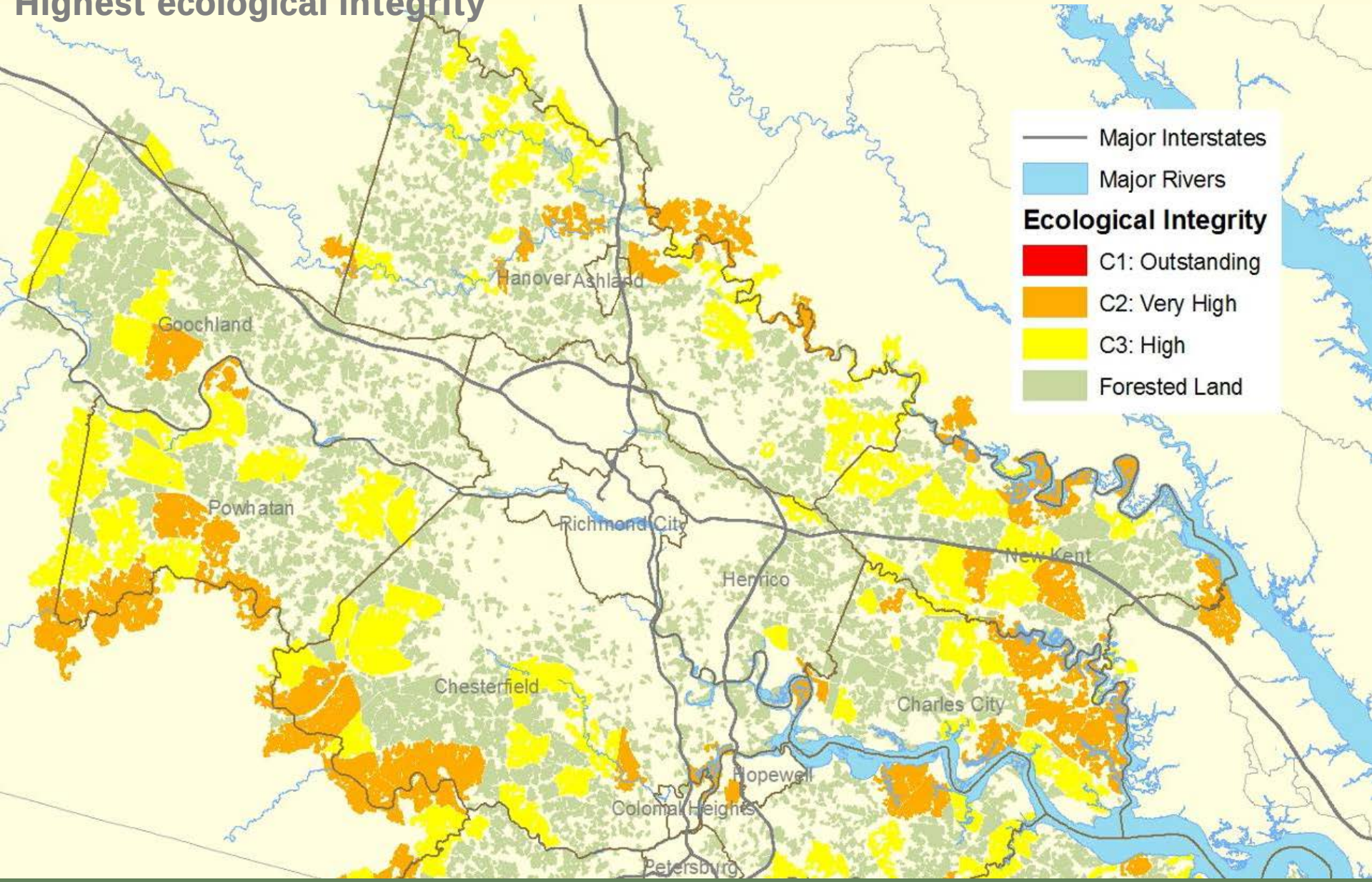



Summary of Change 2000 - 2007
Minimal Change (<20%)
Significant Change (>20%)
Loss of interior habitat
HANOVER
ASHLAND
GOOCHLAND
POWHATAN
CITY OF RICHMOND
HENRICO
NEW KENT
CHESTERFIELD
CHARLES CITY
64
95
295
195
85
Miles
0
5
10
20

Forests prioritized by ecological integrity

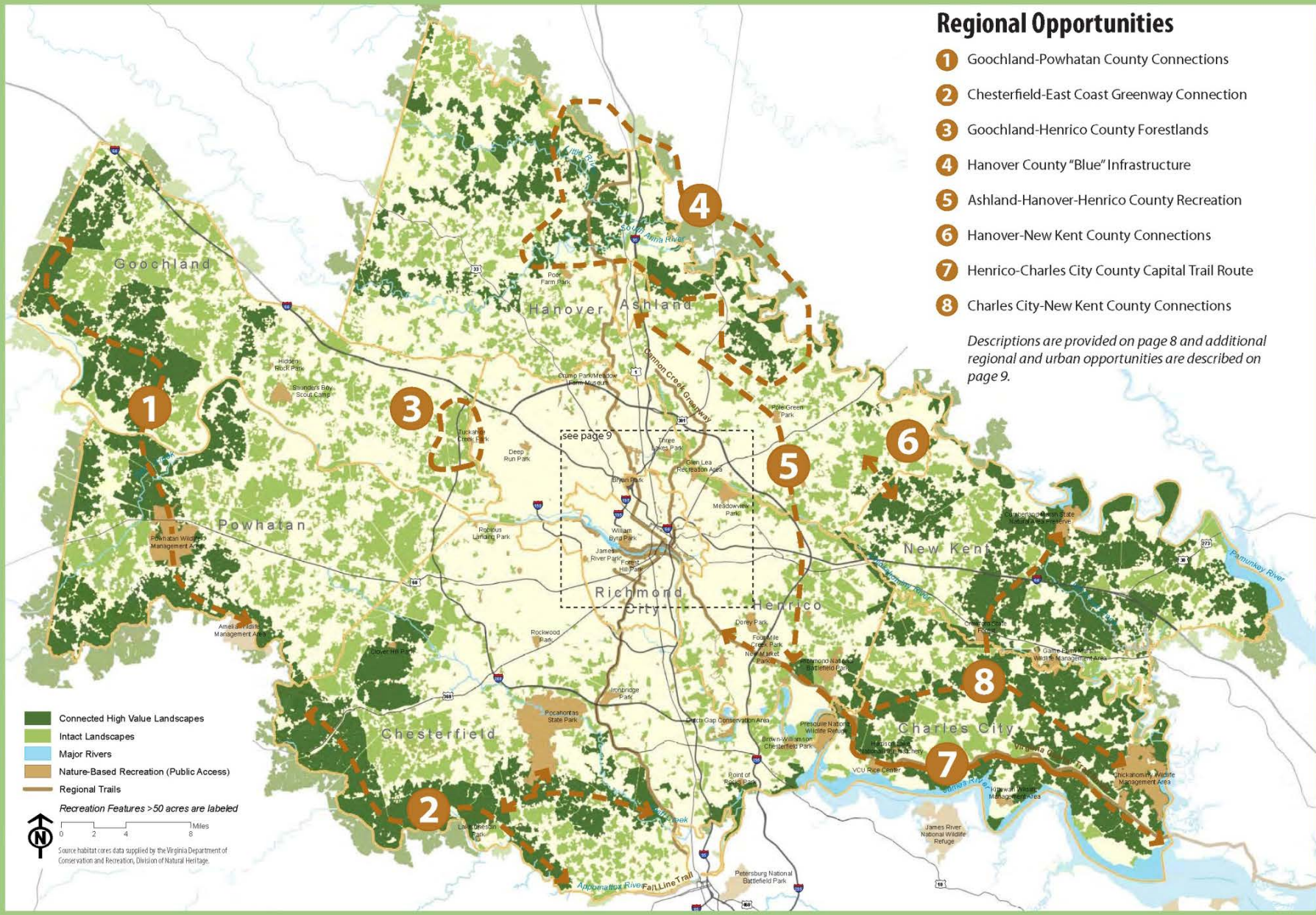


Highest ecological integrity



STRATEGIC GREEN INFRASTRUCTURE

a base map for regional planning




County Scale
Example Plan
New Kent
COUNTY · VIRGINIA
COMMUNITY DEVELOPMENT
HERITAGE AND NATURAL RESOURCES
HANOVER
KING WILLIAM
HENRICO
CHARLES CITY
Hampstead
Foster's Castle
Funstall Raid
White House Site
Pamunkey Reservation
Pamunkey River
Cumberland March State Natural Area Preserve
Sweet Hall Marsh
Saint Peter's Church
Mari Hill
Crumps Mill
George W. Watkins School
New Kent School
Dandridge House Old Courthouse
Old Jail
Quinton Community Park
Criss Cross
Criss Cross Park
Emmaus Baptist Church
Cedar Grove
Heritage Public Library
Olivet Presbyterian Church
Crawford State Forest
Spring Hill
Mount Shirley
Game Farm Marsh Wildlife Management Area
Chickahominy Reservoir
Waxpool Creek Reservoir
Moysonec
Wahrani Nature Trail
Beaverdam Creek
Mill Creek
Baikers Creek
Natural Resource-Based Recreation
Boat Ramp
Campground
Horseback Riding
Hunting and Shooting
Nature Trail
Recreation Feature
Golf Course
Conservation Lands (public holdings)
Proposed Bike Routes On-Road
Proposed Bike Routes Off-Road
Scenic Road
Birding & Wildlife Trails
Heritage Resources
Chickahominy Indians Eastern Division
State/National Historic Site
Historical Marker
County Resources
Visitor Center
John Smith Travels 1607-08
Washington-Rochambeau Route 1781
J.E.B. Stuart Ride 1862
Streams
Connected Intact Landscapes
Contributing Intact Landscapes
Forest Cover
Miles
0 0.5 1 2 3 4
N

City Scale: Virginia

Richmond City Green Infrastructure Assessment

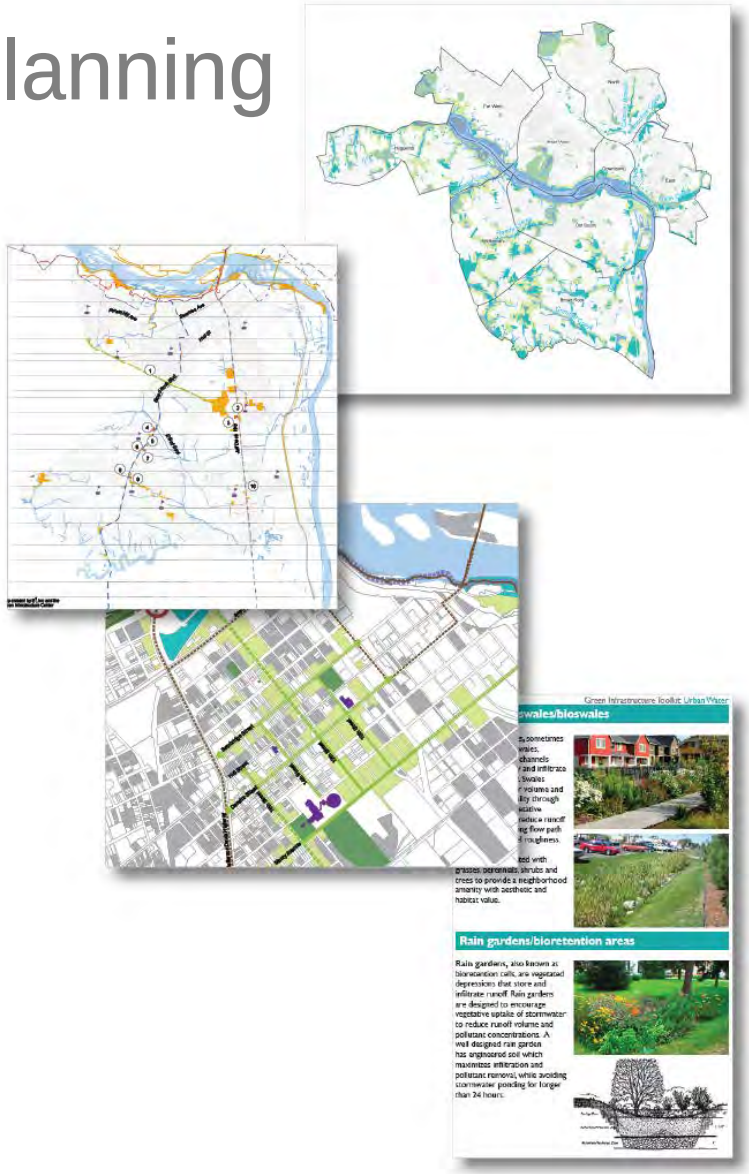
Implementation Approach: Planning Across City Scales

City: Develop citywide green infrastructure network based on suitability of vacant parcels.

Planning District: Create interactive database to evaluate suitability of vacant parcels for various goals.

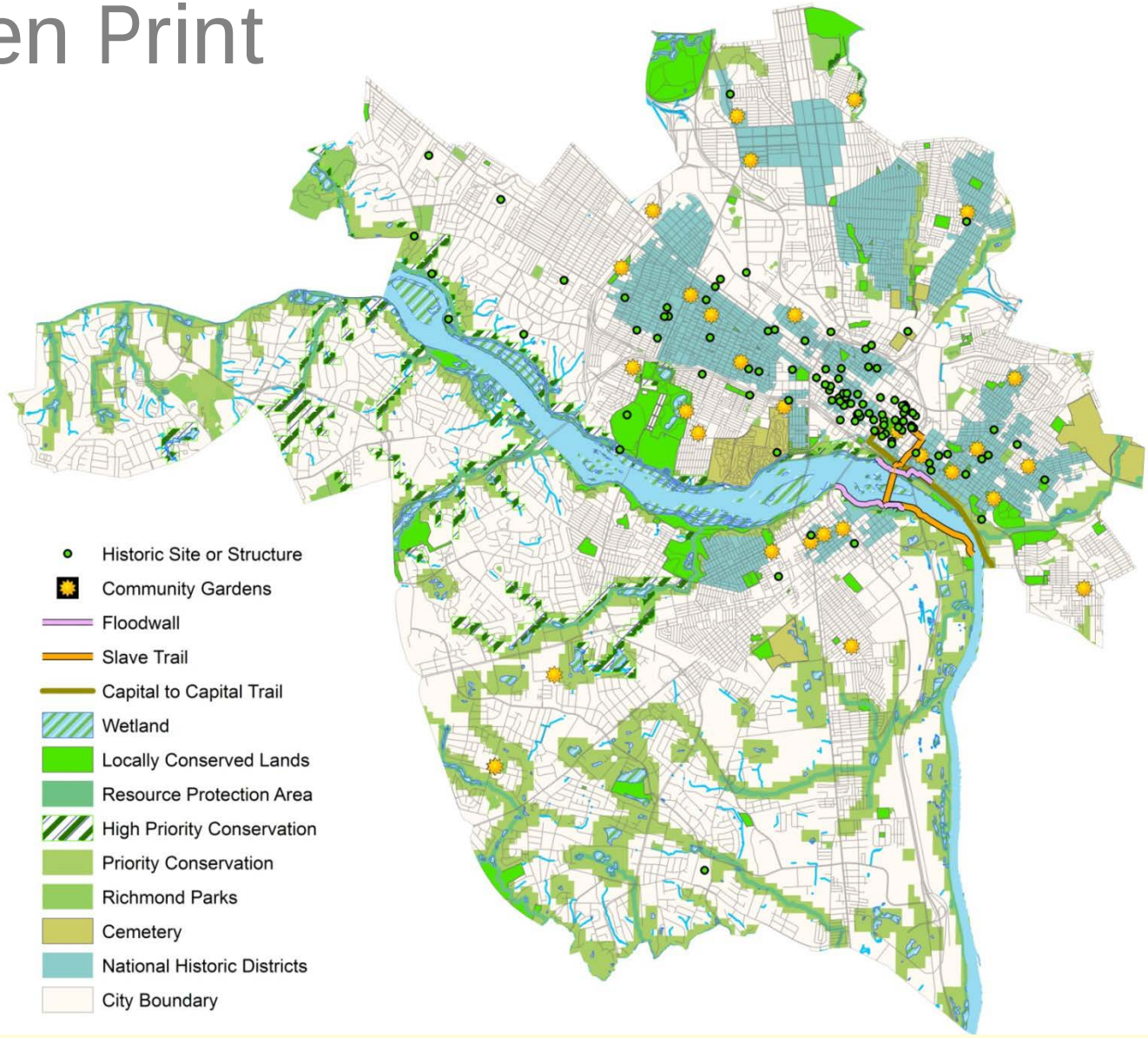
Neighborhood: Develop concept plans and prototypes to connect neighborhoods to the city's green infrastructure network.

Project: Provide case studies and strategies that can be implemented to enhance Richmond's green infrastructure network.



First: Richmond Regional Planning District Commission maps city green assets = city green print

City Green Print



Richmond Green Infrastructure Assessment

Produced by the Green Infrastructure Center and E² Inc. for the City of Richmond, Virginia
December 2010

City Scale Opportunities

- The 2009 regional green infrastructure assessment revealed a significant decline of green infrastructure over the last decade due to sprawling development outside the city.

- The City of Richmond includes over 9,000 vacant parcels.

- Many of these sites can be used to expand the green infrastructure network and increase infiltration!

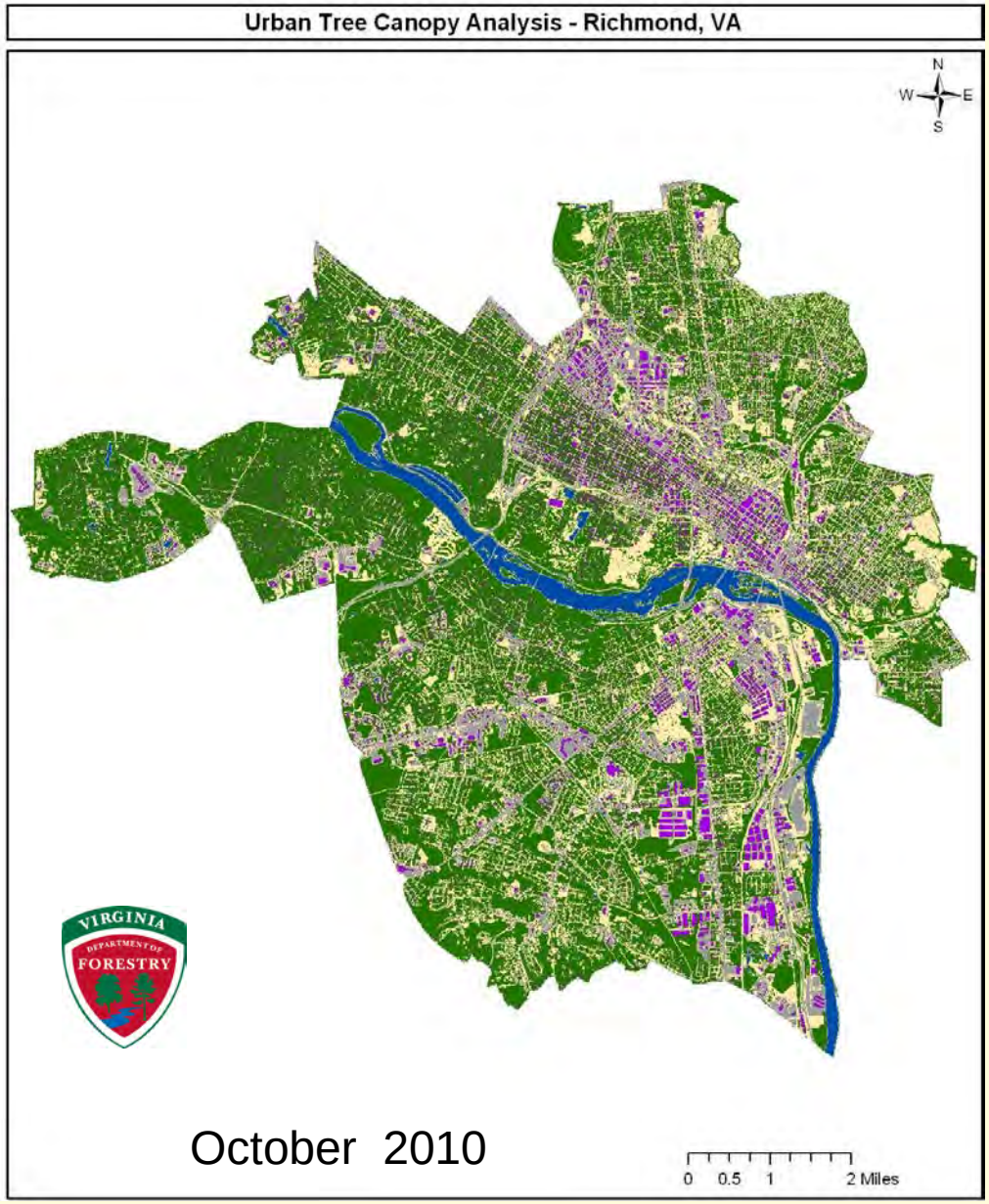
City: Land Cover:

42% Tree Canopy

23% Other Vegetation

24% Non-Building Impervious

11% Building Impervious

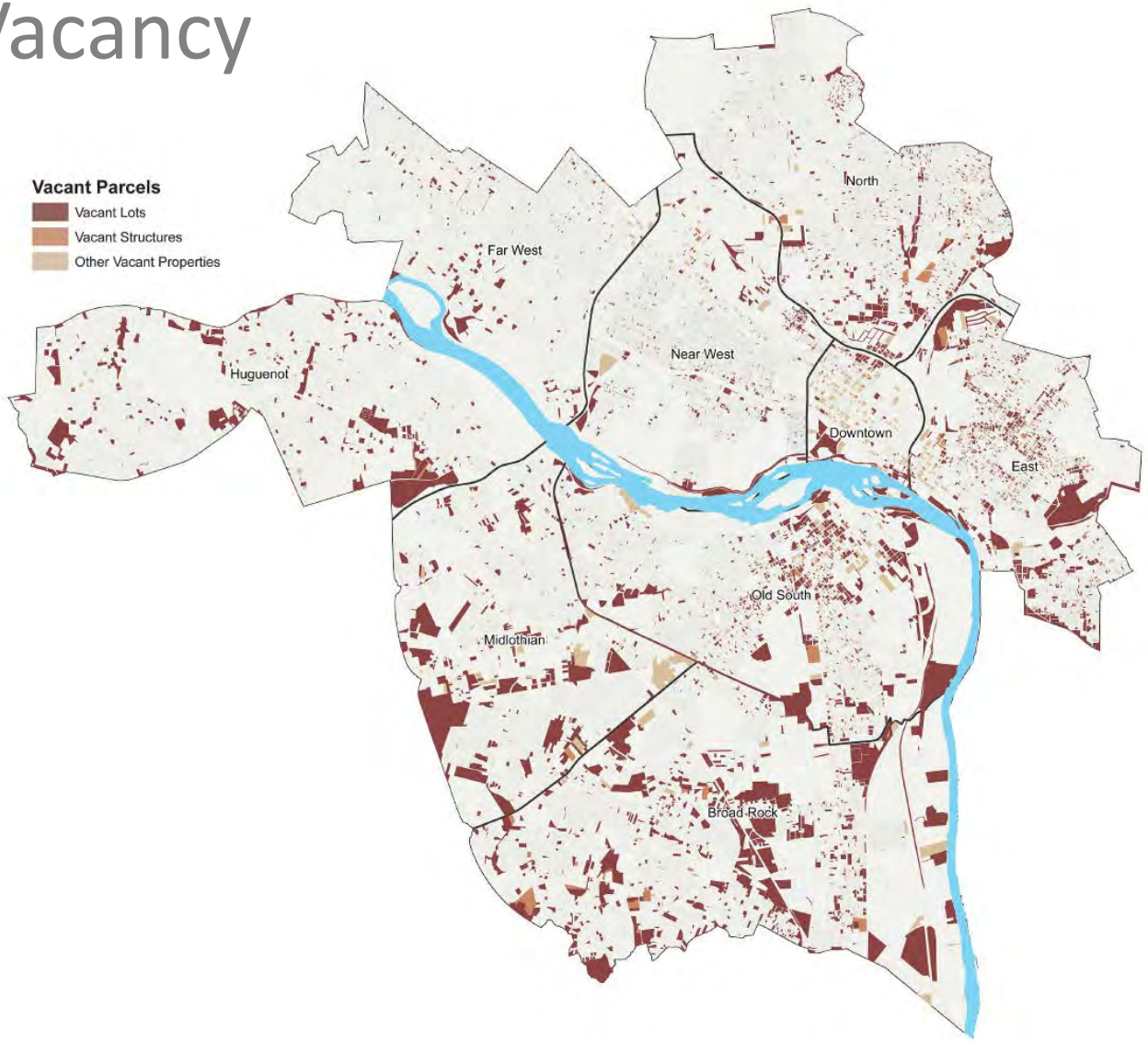


City: Citywide Vacancy

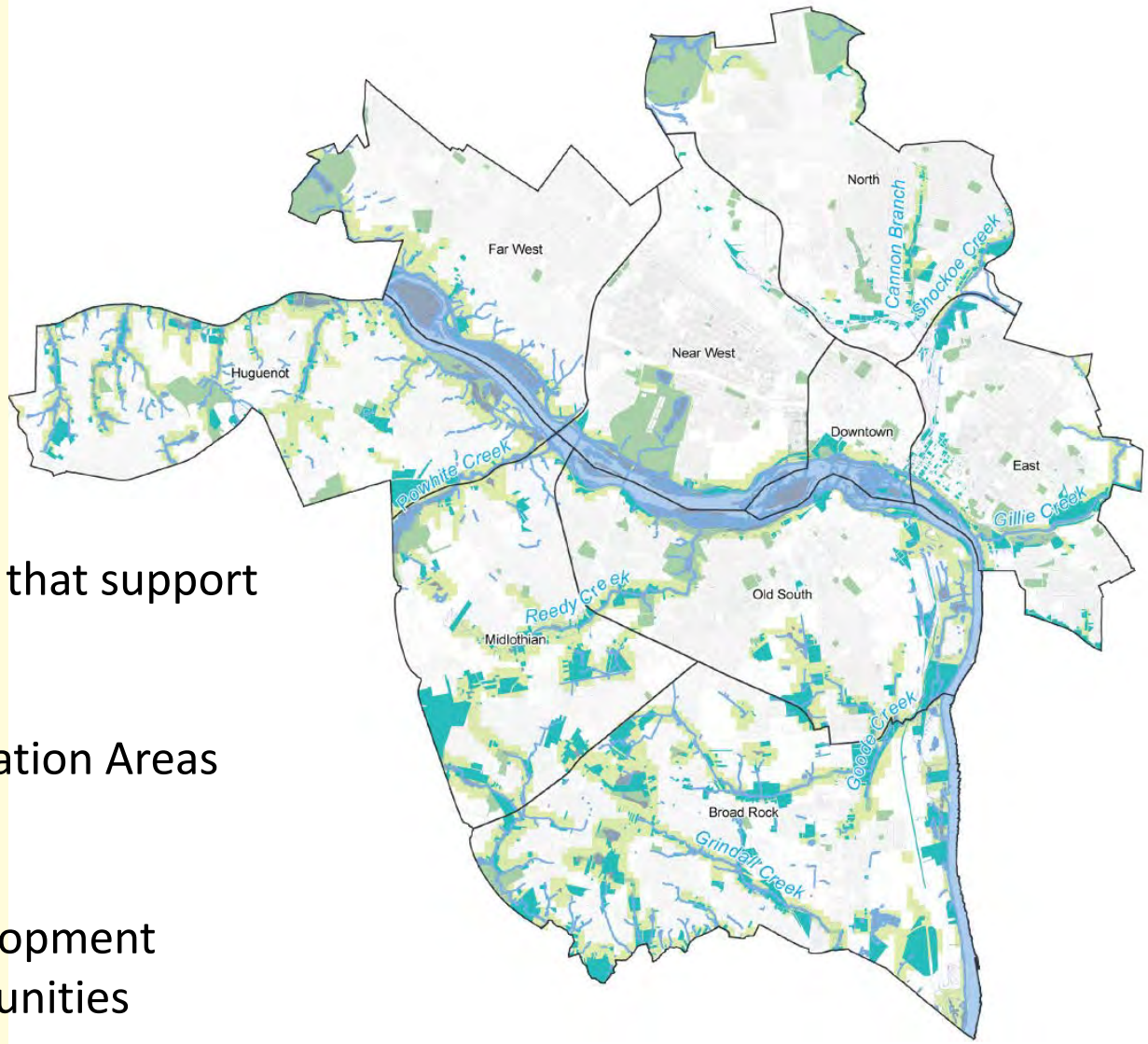
Vacant parcel inventory, grouped by:

- vacant lots
- vacant structures
- vacant properties (parcels that have unknown status)

= 9000 vacant parcels



Potential citywide green infrastructure network based on ecological suitability of vacant parcels through the city.



These parcels met criteria that support the following goals:

- Protect Priority Conservation Areas
- Improve water quality
- Increase park access
- Support greenway development
- Identify network opportunities

Choosing Priority Areas

Broad Rock selected based on analysis of vacant parcel inventory and input of city staff. It has significant ecological assets + high priority watersheds + vacancy

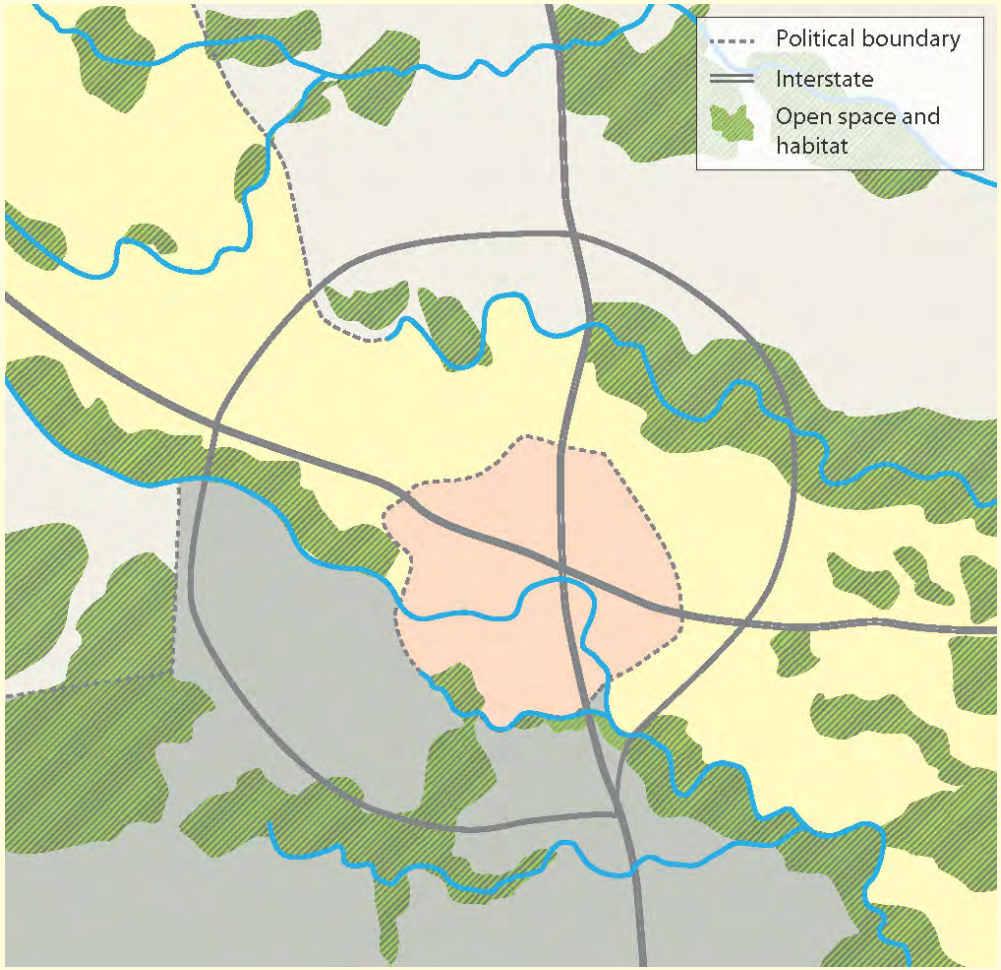
	Total Area (acres)	Priority Conservation Areas		Park Land		Vacant Lots	
		Total Area (acres)	Percent	Total Area (acres)	Percent	Total Area (acres)	Percent
Broad Rock	7939	2891	36%	154	2%	1087	14%
Downtown	1128	396	35%	98	9%	76	7%
East	3434	492	14%	215	6%	457	13%
Far West	3989	852	21%	246	6%	108	3%
Huguenot	5342	1897	36%	301	6%	465	9%
Midlothian	4369	1369	31%	128	3%	569	13%
Near West	4267	68	2%	472	11%	154	4%
North	4684	531	11%	538	11%	263	6%
Old South	5257	1797	34%	351	7%	552	11%
Downtown Master Plan Area	2201	739	34%	106	5%	229	10%

Table 1. Summary of parkland, Priority Conservation Areas, and vacant parcel acreage by planning district.

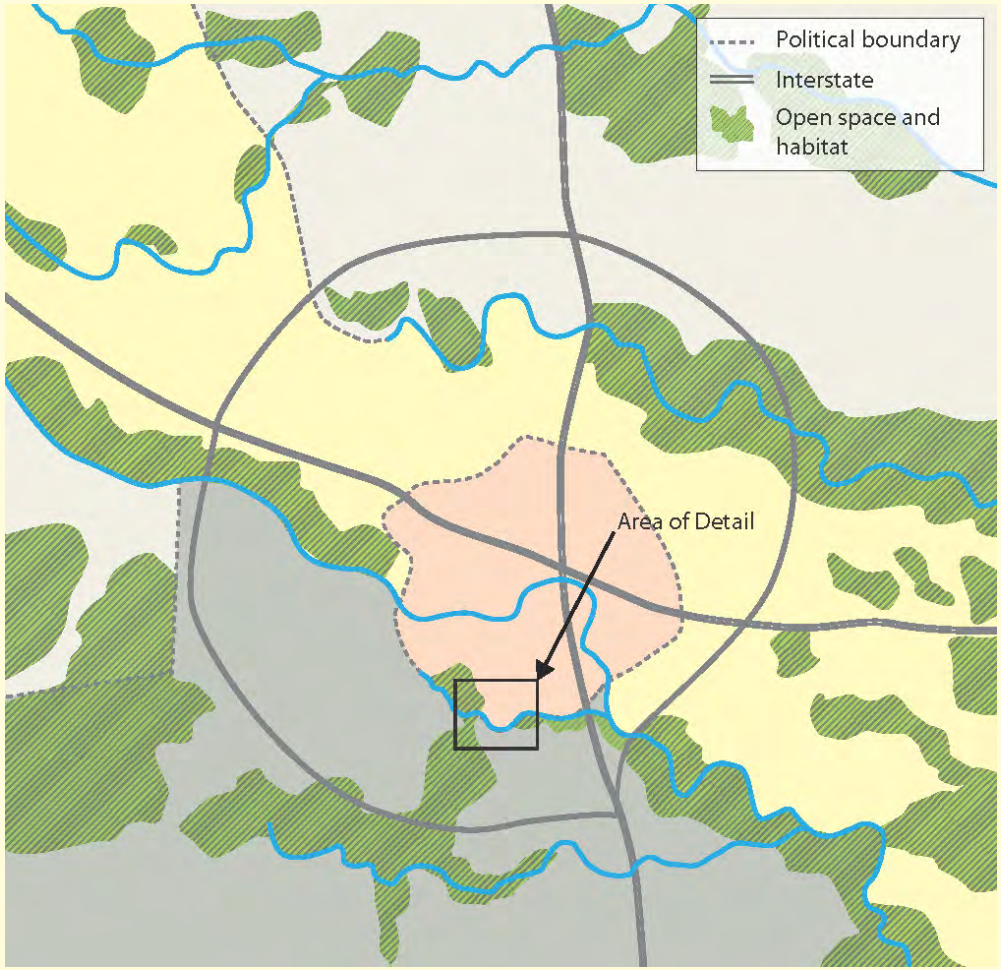
Planning District Selection Considerations	Broad Rock	Downtown	East	Far West	Huguenot	Midlothian	Near West	North	Old South	Downtown Master Plan
Which districts have significant Priority Conservation Areas?	✓				✓				✓	
Which districts contain high priority watersheds?	✓								✓	
Which districts are lacking existing parkland (by percent area)?	✓	✓				✓				✓
Which districts offer a critical mass of vacant parcels that could offer network opportunities?	✓		✓		✓	✓			✓	✓
Which districts offer greenway leadership capacity?*	✓							✓	✓	
Which districts have other City initiatives to consider?**	✓									
How might neighborhood equity factor into district selection?	✓								✓	

Table 2. Focus area selection criteria by planning district.
*James River Trail, Jefferson Davis Corridor, and Cannon Creek Greenway
**Broad Rock, Oak Grove Elementary School, and Bellemeade Community Center

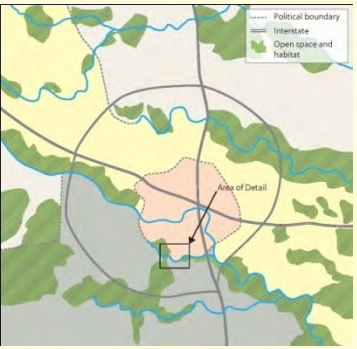
How can we link regional green infrastructure to local projects?



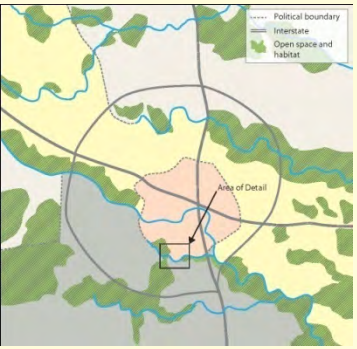
How can we link regional green infrastructure to local projects?

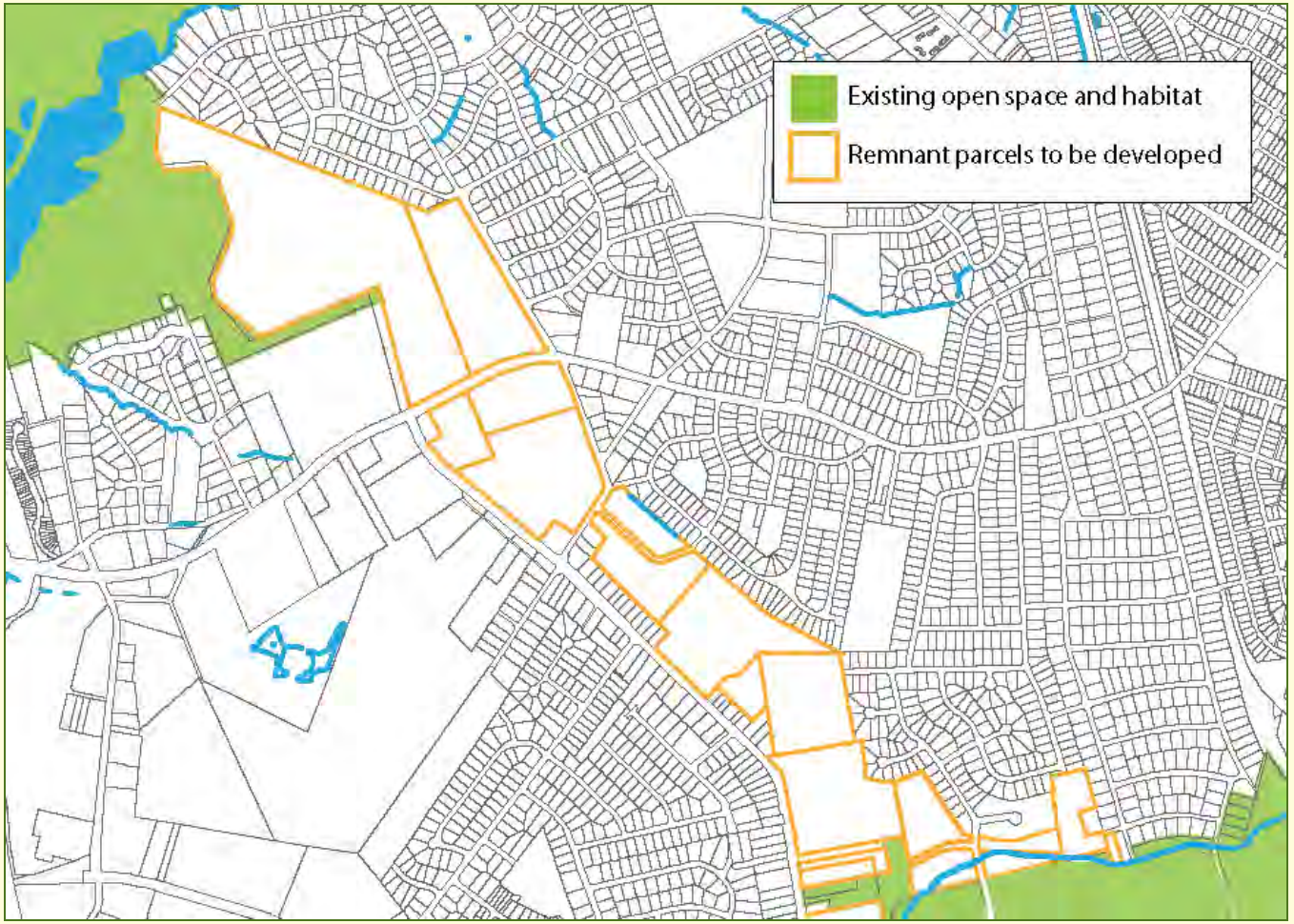


How can we link regional green infrastructure to local projects?



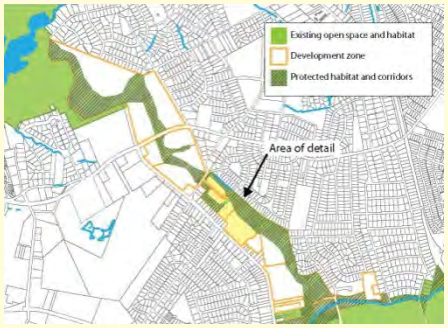
Vacant parcels can provide corridor opportunities to re-green and reconnect the urban landscape.



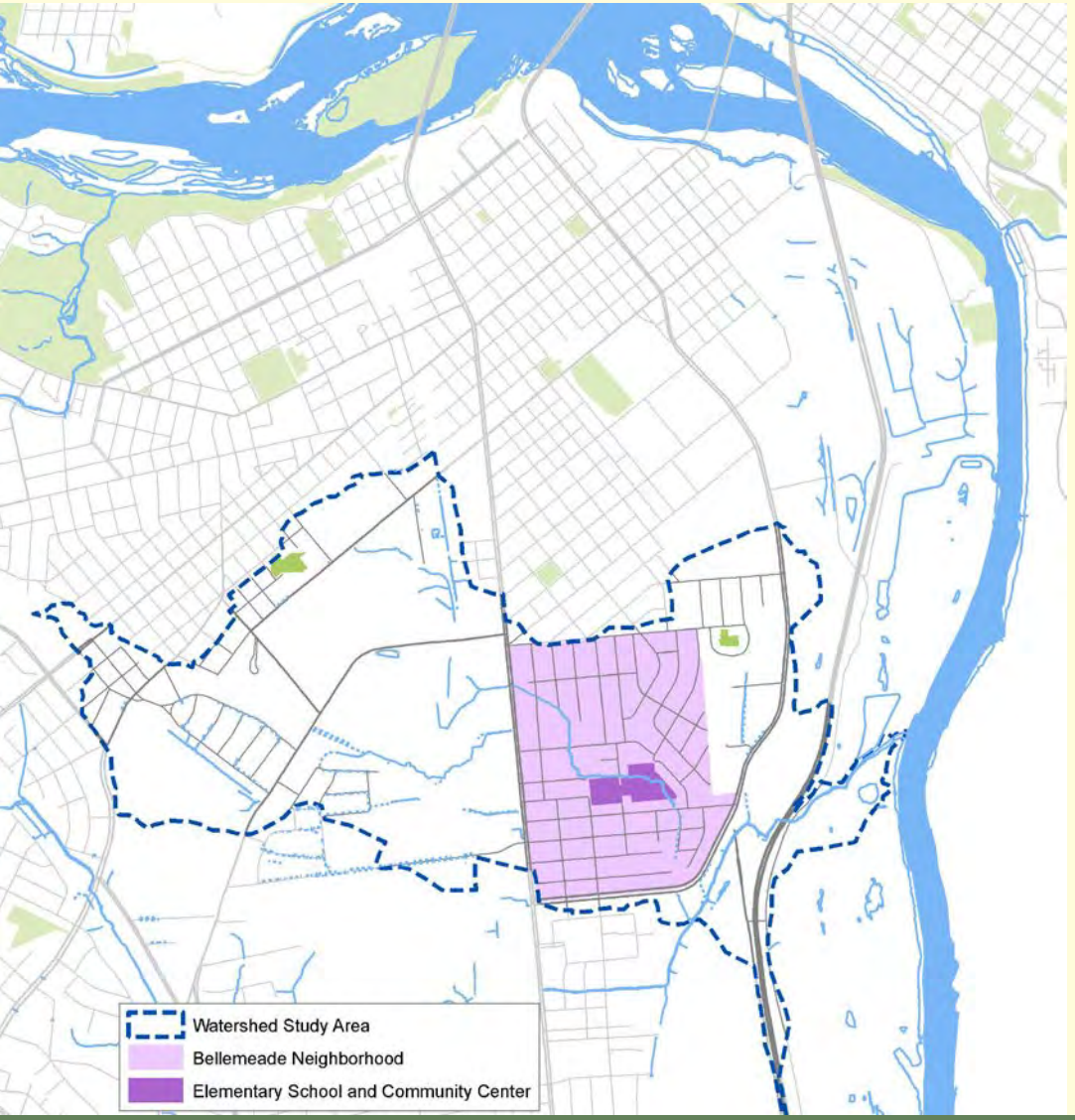


If each parcel leaves or replants a green strip, they can be connected for form a corridor – urban greenway trails can be created within an urban fabric.

Look for other ways for existing parcels to link to greenways.



Watershed Scale: Upper Goodes Watershed

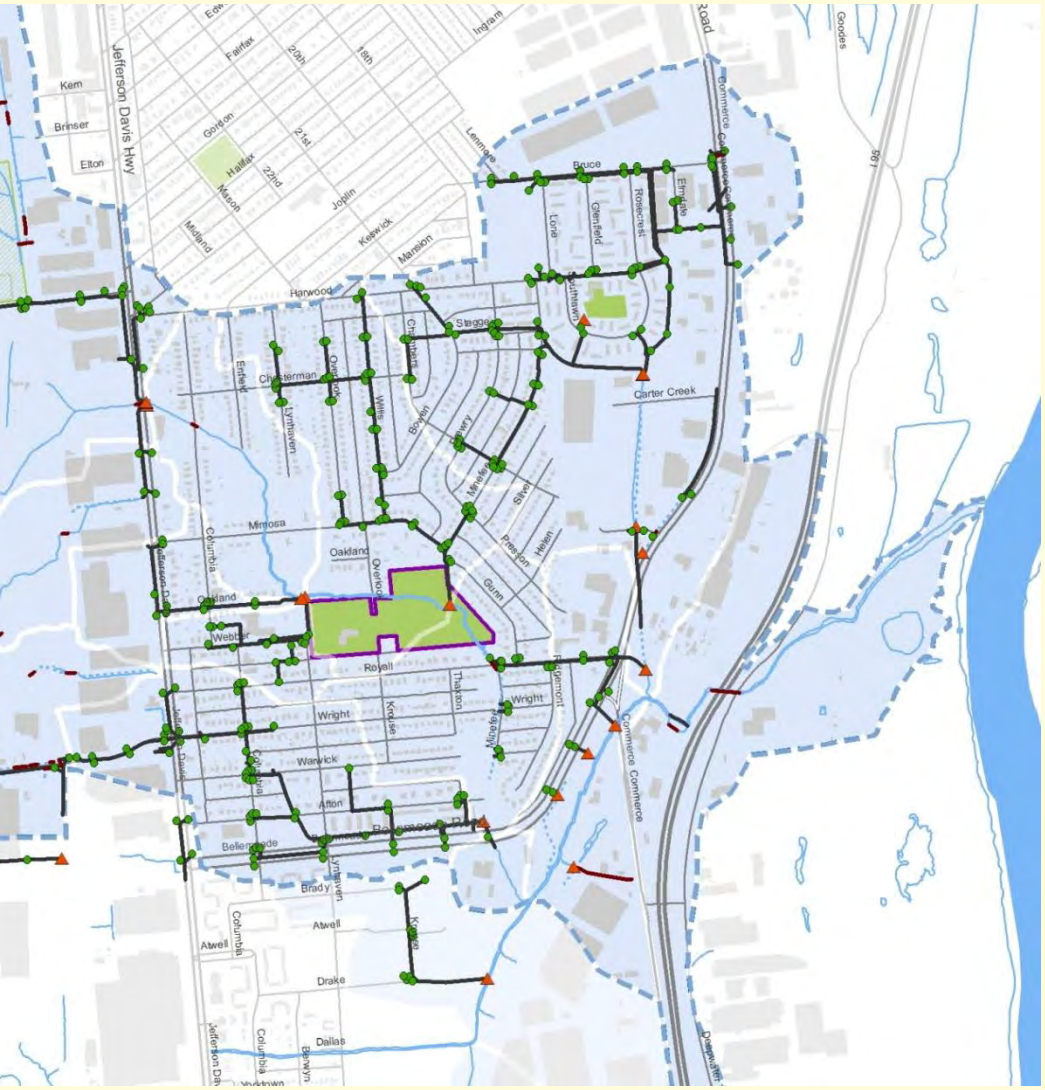


Watershed (dashed boundary) shows the land that drains upper Goodes Creek

Goodes Creek drains into the James River

Model for other city watersheds

Urban Watershed



- Storm system carries water through the watershed
- Inlets or storm drains (green circles)
- Outfalls (orange triangles)

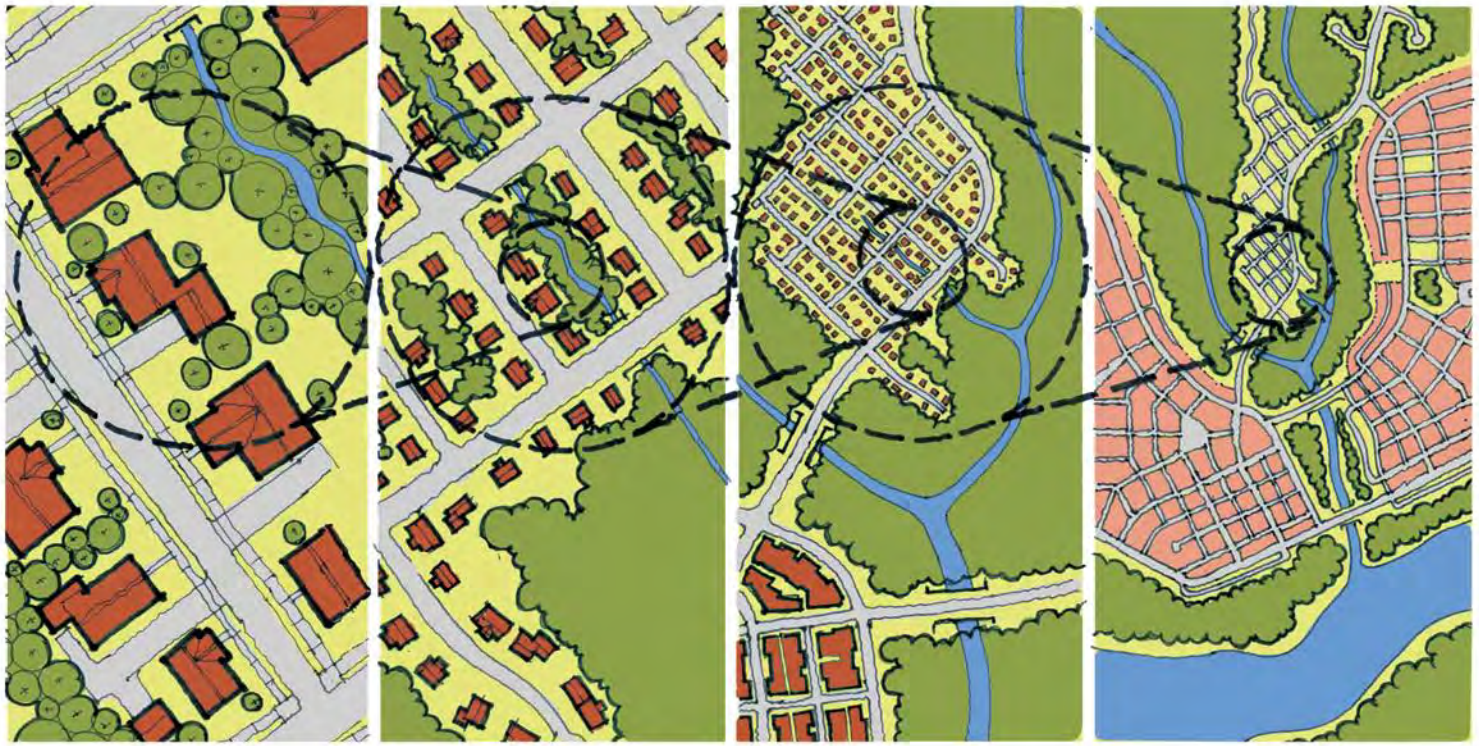
Water flow strategies

How do we make this…

function like this?

Site Scale

Sites change focus, but still need to connect to larger scales. May include restoration.



Smaller scales …

Trees and woodlots

Habitat patches

Streams and wetlands

Trails and smaller parks

Still can connect to larger networks …

Site Scale: Green Infrastructure Toolkit

Urban Water

- Vegetated swales/bioswales
- Rain gardens/bioretention areas
- Vegetated filter strips
- Stormwater wetland

Community Spaces

- Pocket park
- Informal recreation
- Meadow/native habitat
- Outdoor classroom
- Community garden

Site Planning

- Green street design
- Reducing impervious surfaces
- Vegetated landscaping
- Urban forestry
- Urban stream restoration
- Riparian buffers

Community Stewardship

- Green space grant programs
- Land banking
- Mow-to-own
- Adopt-a-block

The community developed ideas for a walkable watershed in December 2011.

There are new plans for the creek and park and new sidewalks planned.

Some of these ideas need implementation.

CONCEPT PLAN

goals

Building on input from the community workshop and public open house, the Watershed Concept Plan includes six main goals. Each goal has a series of strategies outlined below, illustrated on the concept plan (adjacent page) and then described in detail on following pages.

1. Connectivity p. 6

Green Streets
Create green streets on primary school routes.

Regional Connector
Connect to regional trails and to the James River.

Creek Crossings
Improve creek crossings at Overlook and Minafee.

Culvert Crossings
Add sidewalks, creek signage and overlooks to culvert improvements.

2. Safe Passage p. 7

Sidewalk Improvements
Provide sidewalks on primary routes.

Street Lighting
Improve lighting along routes.

Bicycle Access
Install bike-friendly paths along primary routes.

Safe Intersection
Design and construct safe intersections.

3. Water + Environment p. 8

Street Plantings
Install plantings to slow and clean rain water.

Stream Stabilization
Restore stream banks and channel.

Creek Bed Restoration
Restore creek corridor.

Stormwater Infiltration
Infiltrate rain water along trails and in parks.

4. Open Space p. 9

Neighborhood Park
Provide community access and amenities.

Pocket Park
Promote community activity along school routes.

Regional Park
Support regional park and infiltration opportunities.

Designated Paths
Connect paths for walking and exercise.

The strategies highlighted in the park property above reflect community priorities for creating a neighborhood center of activity and watershed stewardship.

5. Education + Awareness p. 10

Nature Trails
Develop watershed trails with signage.

Outdoor Classrooms
Provide outdoor learning activities for students.

Wooded Views
Retain wooded views for classrooms.

Community Garden
Promote community gardening for school and community.

6. Activities + Programs p. 11

Events and Activities
Encourage outdoor activity and promote a sense of community through stewardship.

Education and Recognition
Celebrate and learn about the neighborhood and the environment.

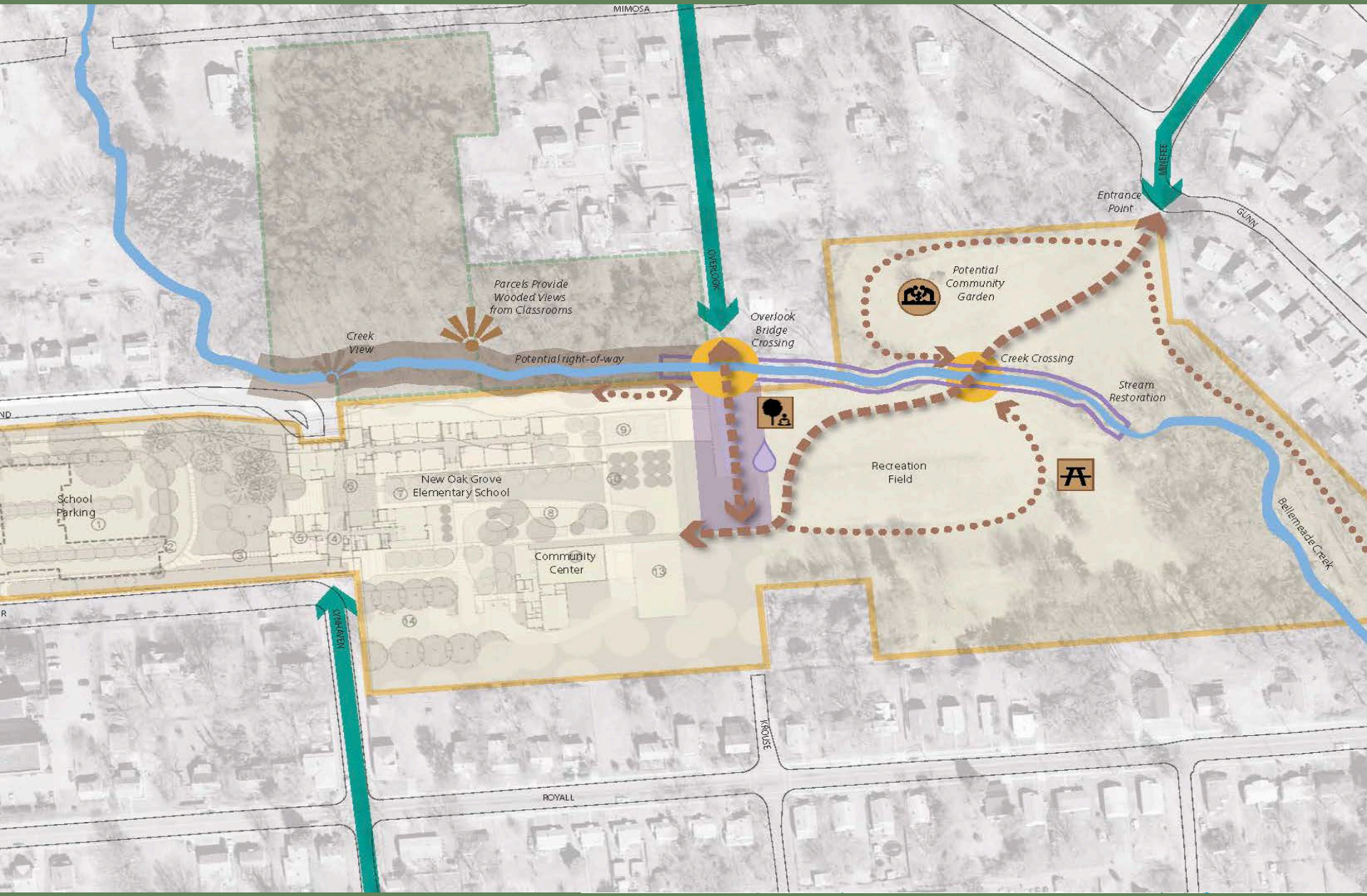
Demonstration Projects

City Owned Land Adjacent to A New Green School

- ✓Restore the stream channel and in-stream habitat
- ✓Convert a concrete ditch into a stepped bioswale
- ✓Replant the understory and stream buffer
- ✓Remove invasive species
- ✓ Increase accessibility

Upper Goodes Creek

GREEN INFRASTRUCTURE CENTER



GREEN INFRASTRUCTURE CENTER

Park Concept Plan

Bellemeade Neighborhood - Richmond, VA

0 50 100 200 300 400 Feet

N

Implementation Project: Stepped Bioswale

Dimensions

Inclined concrete channel length: 62 ft.

Flat concrete channel length: 474 ft.

Total length: 536 ft.

Width: 10 ft.

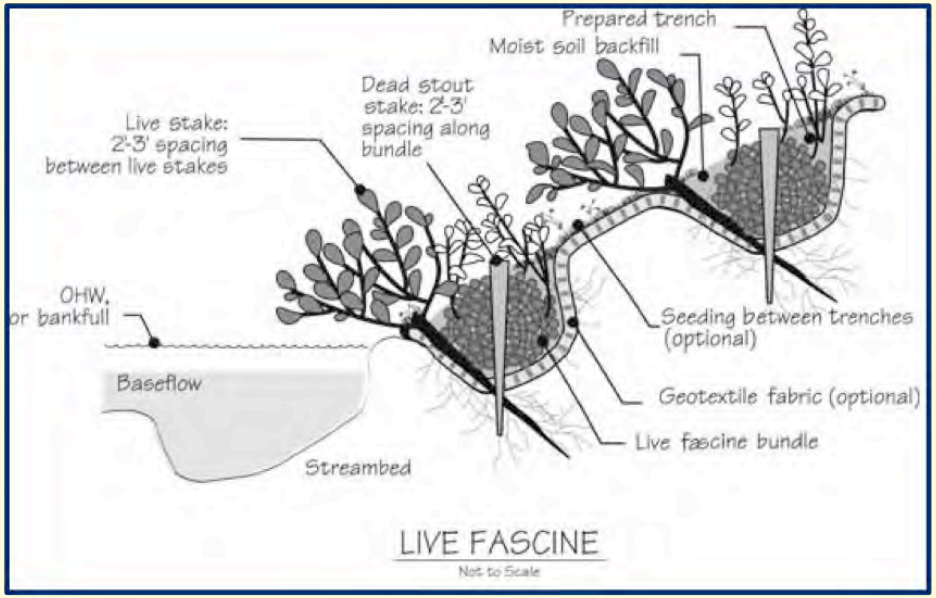
Total Approximate Area for Retrofit: 5,360 ft.

Implementation Project: Stepped Bioswale

Implementation Project: Bioengineering

Strategy

1. Remove steep slope on banks
2. Mobilize community members to plant bundles of woody plant cuttings into trenches parallel to the creek.
3. Stabilize severe erosion areas with log or other structures, especially the corner near football field.
4. Plant trees along the stream for shade and stability.



Implementation Project: Creek Restoration

Eroding Creek

Current Creek in Park

Creek Bioengineering

Example from a Moore's Creek here = restored creek with plants, riffles and accessibility.

Partnerships Are Key

- Richmond government can not take on and solve watershed problems alone.
- Partnerships with nonprofit groups, businesses and community members are key to achieving goals to clean our waters.
- We formed a Watershed Coalition to make partnerships work!

Watershed Coalition Formed to Clean up the Streams and Create a Healthy Safe Community

Consists of members and partner agencies.

Members

Bellemeade Neighborhood
Oak Grove Neighborhood
Hillside Court
Jefferson Davis Neighborhood
Green Infrastructure Center*
James River Association
Alliance for Chesapeake Bay
Citizen Members at Large
Youth Representatives
Oak Grove Bellemeade School
Gene's Supermarket
Trinity United Methodist Church
Mayor's Participation Action and Communication Team

Partner Agencies

Richmond Dept. of Public Utilities, Stormwater
Richmond Dept. of Public Works
Richmond Grows Gardens Initiative
Fire Department
Dept. of Parks, Recreation and Community Facilities
City Council
Police Department 2nd Precinct

GIC coordinates the coalition. More info at http://www.gicinc.org/projectbellemeade.htm

Watershed Coalition Focused On:

Clean Environment and Healthy Waters

Green Streets

Safe Walkable Communities

Blight to Beautification

Parks and Green Spaces

Urban Forest

Trash Cleanups

Alliance for the Chesapeake Bay

Storm Drain Labeling & Rainbarrels

RIVER HERO HOME
JAMES RIVER ASSOCIATION

Green Infrastructure Center

Community Tree Planting

GIC Coordinated building the nature trail, replanting buffers