Floodplains by Design:

Floodplain and ecosystem services mapping in the IA-Cedar Rivers Basin.

Kris Johnson & Jan Slaats

April 8th, 2013

The Nature Conservancy

Protecting nature. Preserving life.™

Floodplains by Design

Safer communities

Healthier rivers

Cost-effective management

Current decision-making

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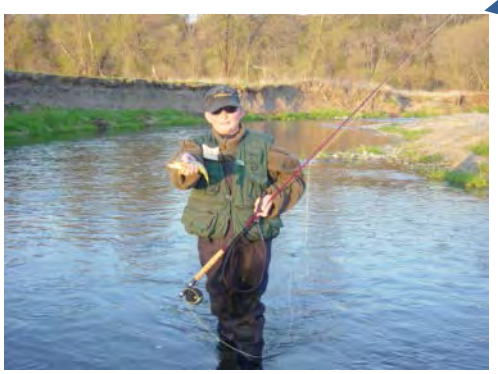


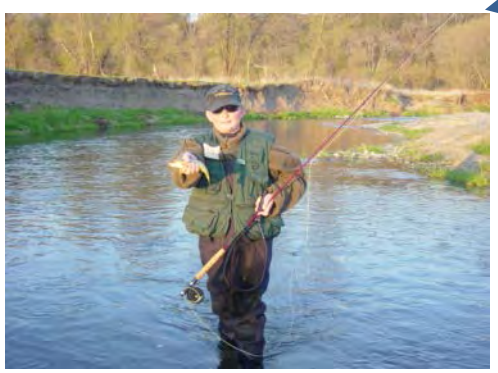
Decision-making valuing ecosystem services

drinking water

flood mitigation

recreational opportunities

biodiversity



Floodplains by Design

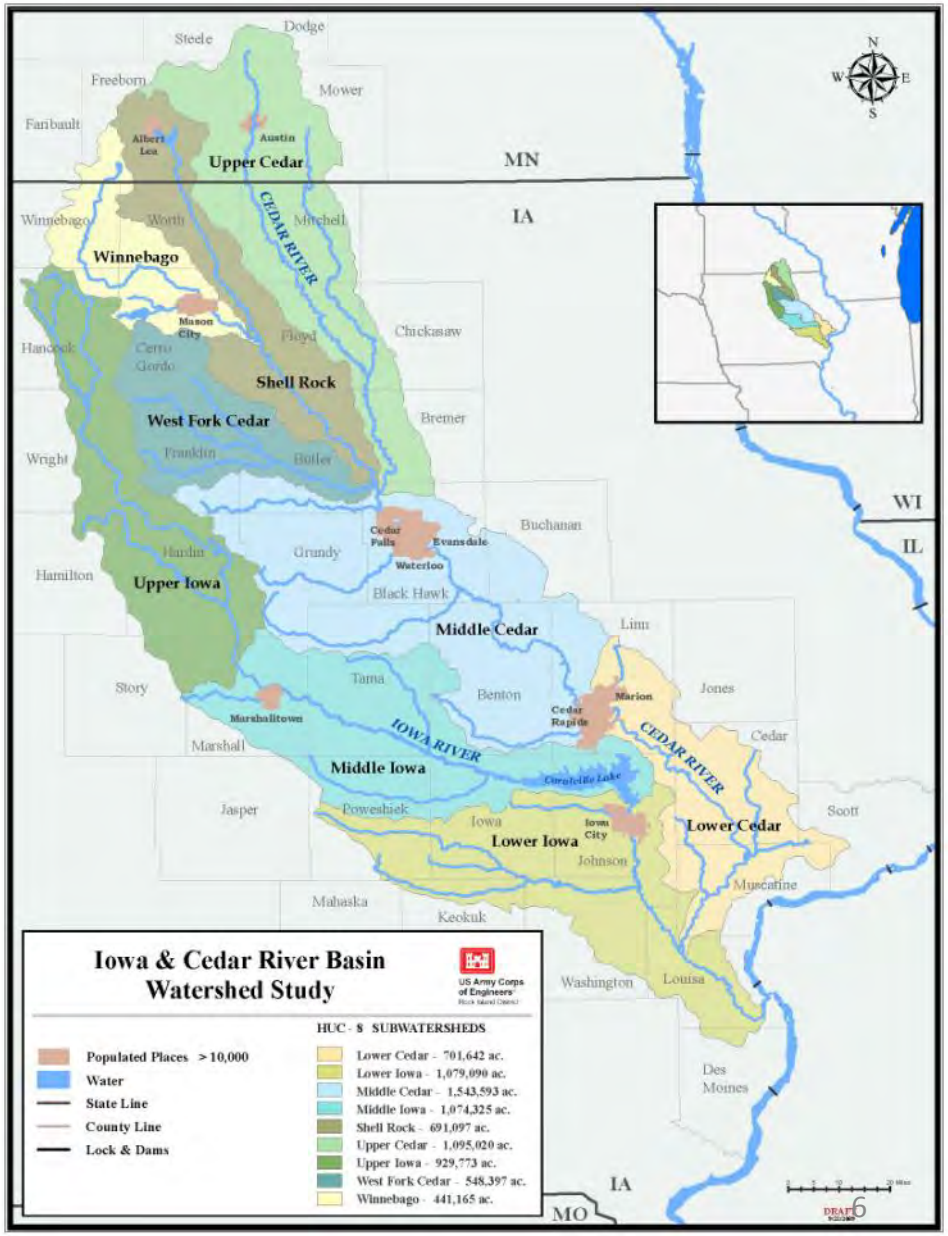
Iowa-Cedar Rivers

Puget Sound

Connecticut River

Iowa & Cedar Rivers Basin

- 12,620 mi² (~8 million Acres)
- population ~ 1 million



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Iowa-Cedar Watershed
INTERAGENCY COORDINATION TEAM

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Iowa Cedar Watershed is located within the **Mississippi River Basin**

Welcome to Iowa-Cedar Rivers Basin

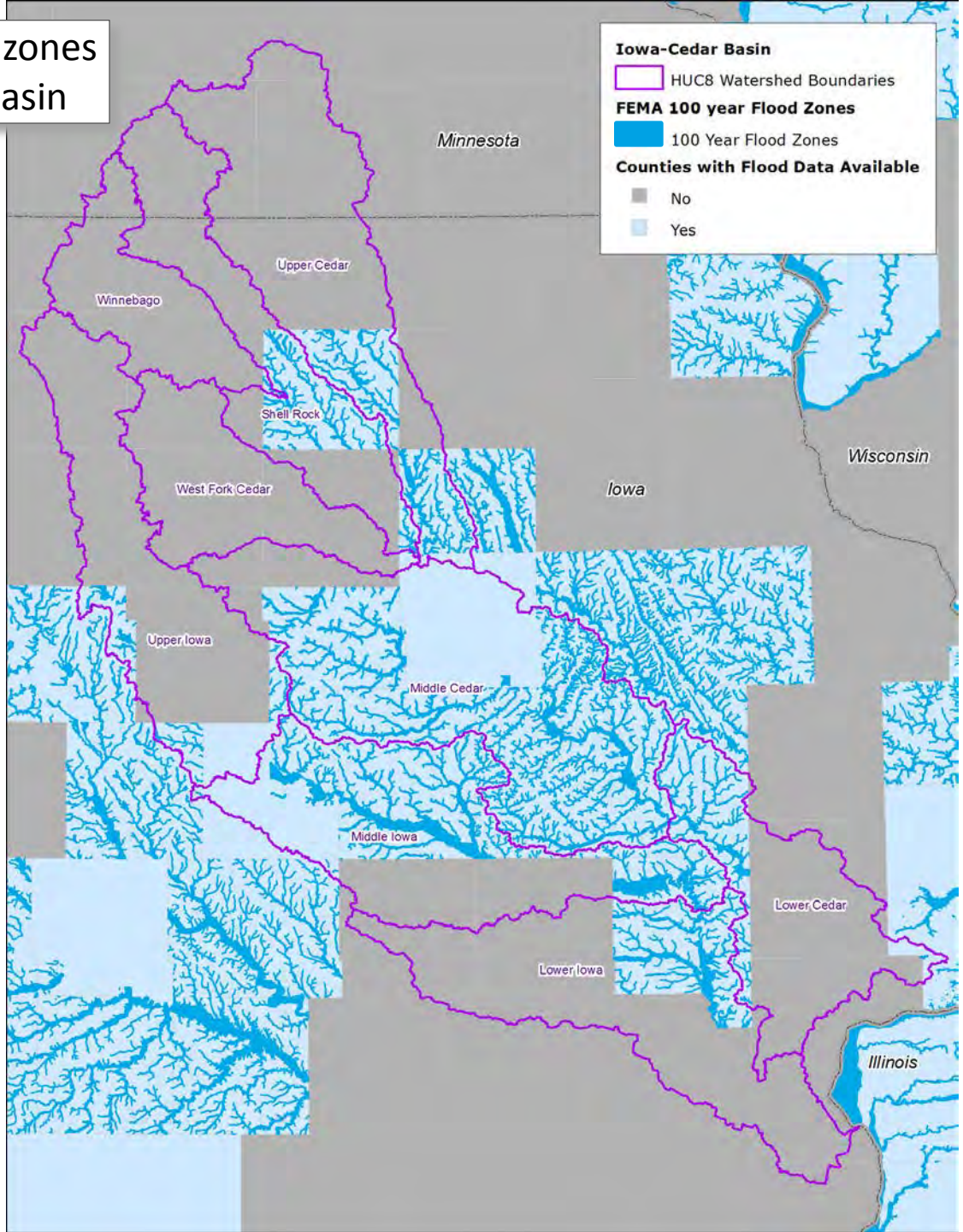
The Iowa-Cedar Rivers Basin is a 12,620 mi² (32,686 km²) mixed-use basin with a vibrant agricultural sector for crop and livestock production, major manufacturing and high tech industries, and three major growing urban centers. The basin population is about 1 million. In the last several years, the changes in the landscape and in the hydrologic regime of the rivers have increased stress on fresh water sustainability leading to crises such as the Gulf hypoxia (due to excessive export of nutrient loading into the Mississippi River) and epic flooding (notably, the floods of 1993 and 2008). Water agencies, the public and the academia are increasingly partnering to face these crises by forging actionable interagency partnerships, building capacity and infrastructure, and mobilizing the local intellectual resources toward addressing and solving the pressing societal problems related to sustainable water resources.

About Us

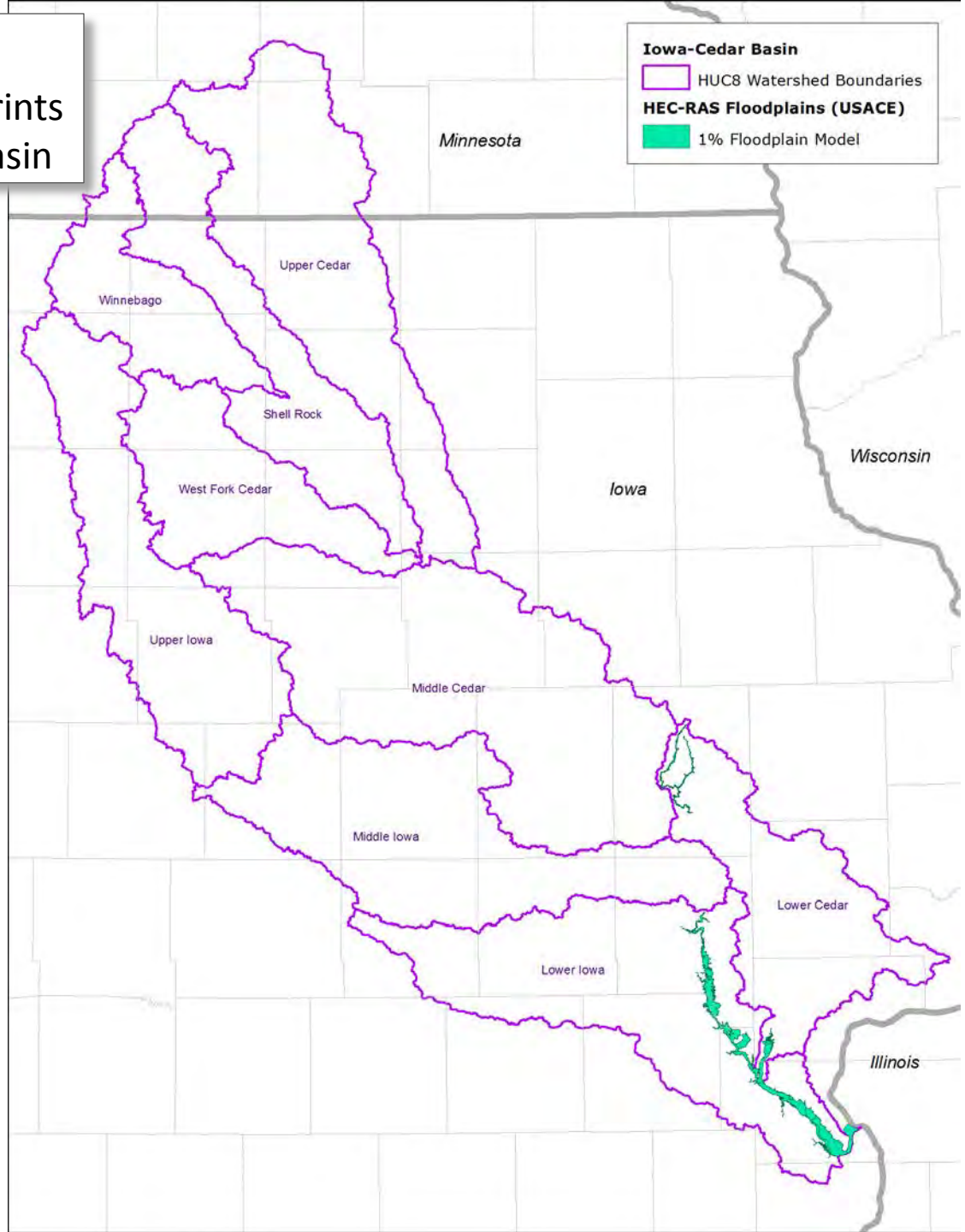
In 2009, the Iowa-Cedar Watershed Interagency Coordination Team was initiated to provide a comprehensive watershed plan and process for interagency collaboration and public participation to address water resource and related land resource problems and opportunities in the Basin in the interests of increasing social and economic value, increasing ecological integrity, and managing risk. **Factsheet**

US Army Corps of Engineers | USDA | FSA | National Weather Service | American Rivers – Thriving By Nature | NRCS Natural Resources Conservation Service | UNESCO | HELP | USGS science for a changing world | CUAHSI | DNR | Iowa Department of Transportation | Iowa Water Center | The Nature Conservancy | IIHR Hydroscience & Engineering | JFC | Iowa Department of Agriculture and Land Stewardship

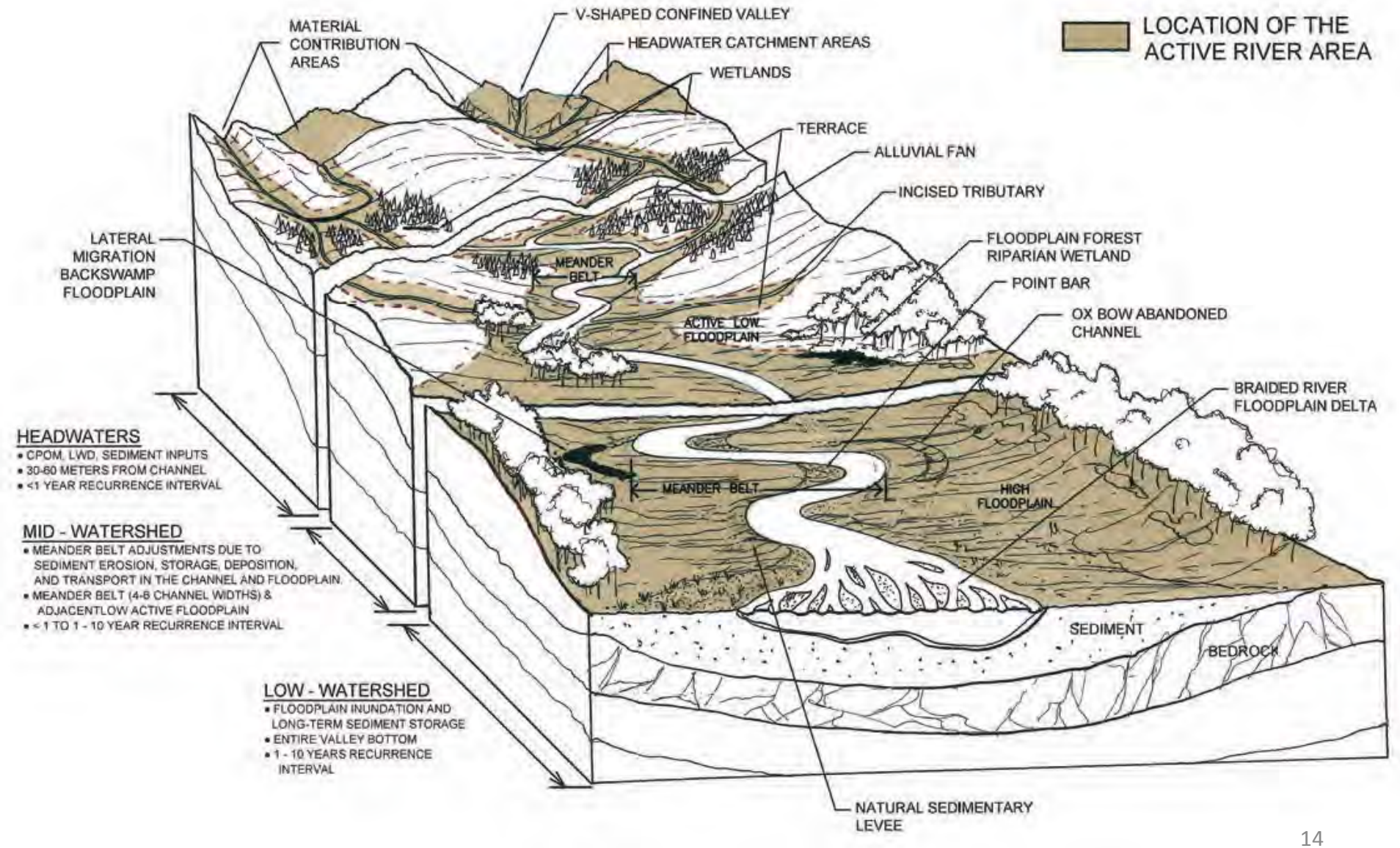
FEMA 100-year flood zones in the Iowa-Cedar Basin



HEC-RAS
1% inundation footprints
in the Iowa-Cedar Basin



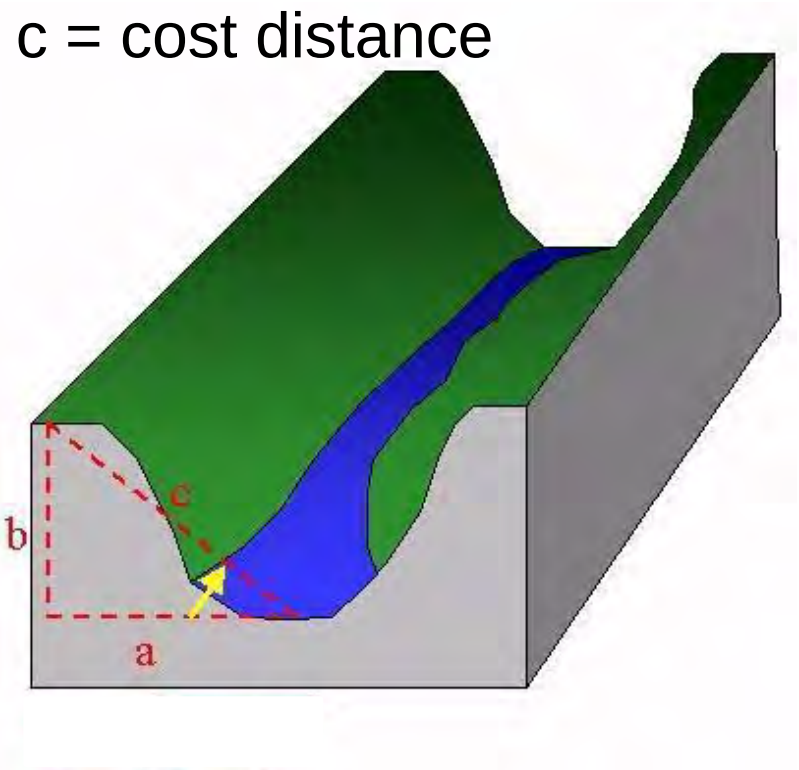
Floodplain Mapping: Active River Area



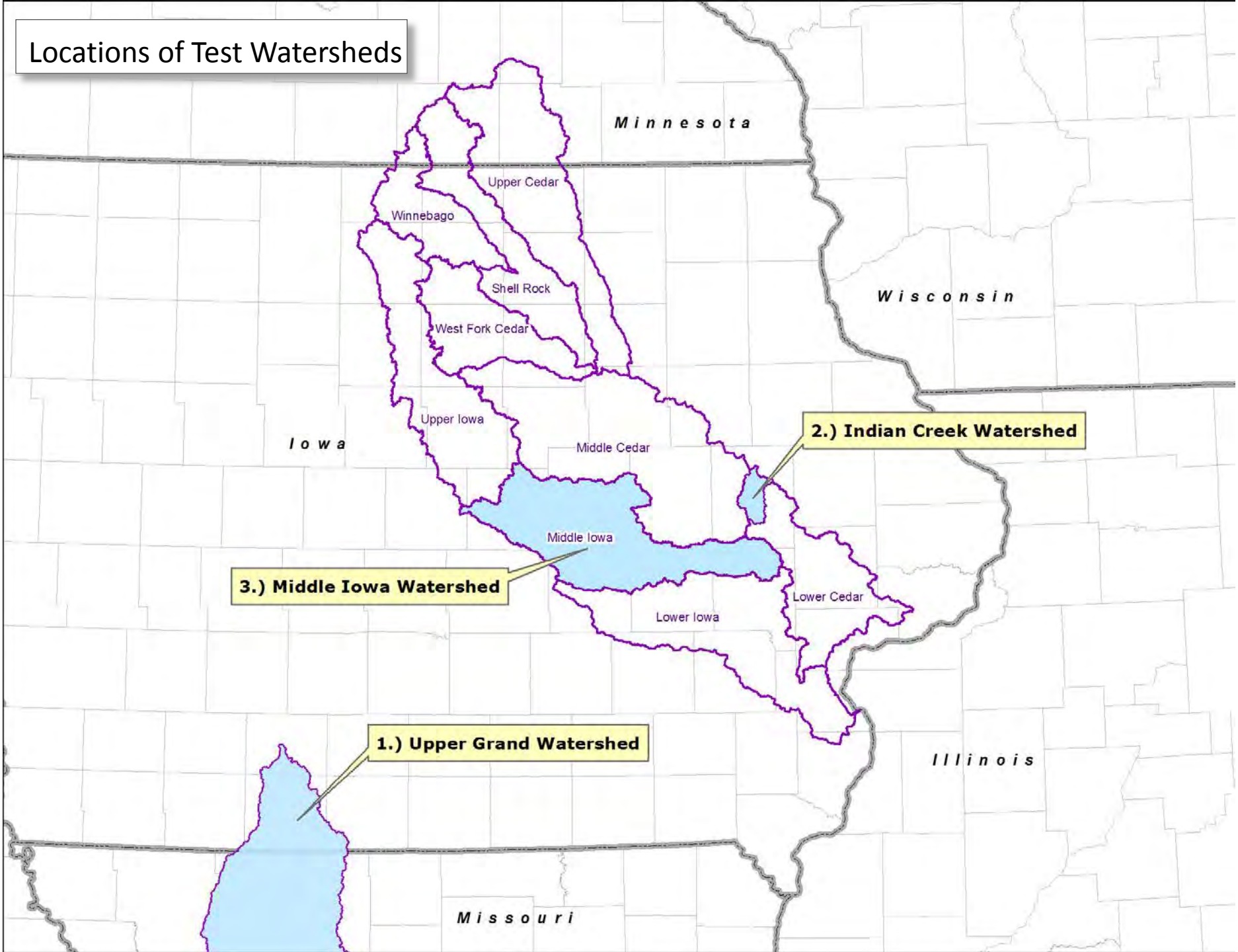
Floodplain Mapping: Active River Area

- GIS-based approach using topography and stream channels
- Uses ArcGIS ArcToolbox based Models
- For more info: http://www.floods.org/PDF/ASFPM_TNC_Active_River_%20Area.pdf

Analie Barnett: abarnett@tnc.org



(modified from Strager et al 2000)


Locations of Test Watersheds
Minnesota
Upper Cedar
Winnebago
Shell Rock
West Fork Cedar
Wisconsin
Upper Iowa
Iowa
Middle Cedar
2.) Indian Creek Watershed
Middle Iowa
3.) Middle Iowa Watershed
Lower Cedar
Lower Iowa
1.) Upper Grand Watershed
Illinois
Missouri

Active River Area: Methodology

- Prepare Stream Data
- Prepare Lakes Data
- Prepare LiDAR DEM surface
- Create Cost Distance Surfaces (non-filled DEM)
- Create Moisture Index and “wetflats”
- Generate Non-headwater Material Contribution Zones

Active River Area: Input Datasets

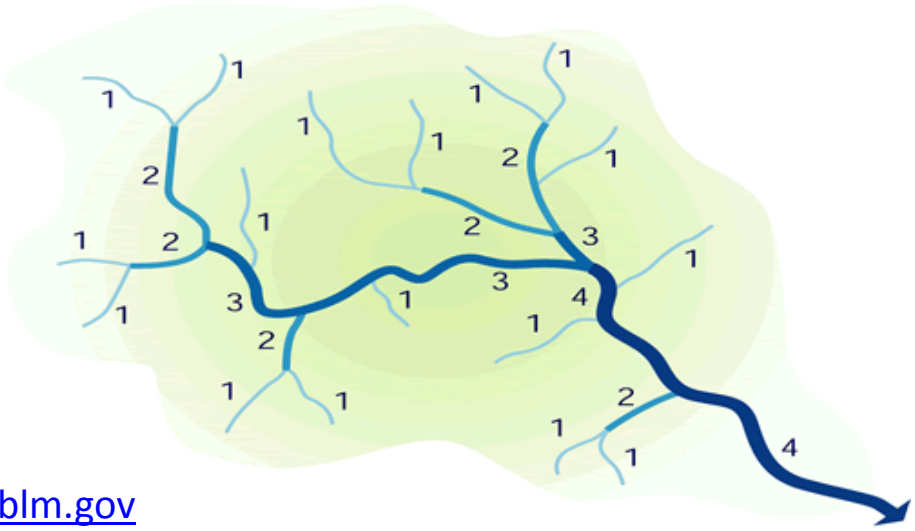
- High Resolution NHD Plus v. 2.1 (1:24,000 to 1:12,000)
  ftp://nhdftp.usgs.gov/DataSets/Staged/SubRegions/FileGDB/HighResolution/NHDH0708_931v210.zip
  - NHDFlowlines
  - NHDWaterbodies
  - Hydrologic Unit Boundaries (HUC-8)

- LiDAR DEM (1m pixel, aggregated to 3m pixel)
  - Source: IA-DNR and MN-DNR
  - Derived from DEM in GIS:
    - Flow Direction model
    - Flow Accumulation model
    - Slope model

Active River Area: Methodology

Strahler Stream Order classification

- High resolution NHD does not contain stream order data
- Automated Python script to assign Strahler Stream orders 1 – 8



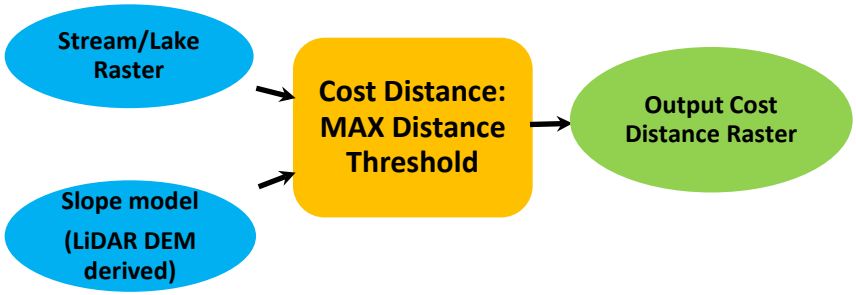
For more information, contact: gstevens@blm.gov

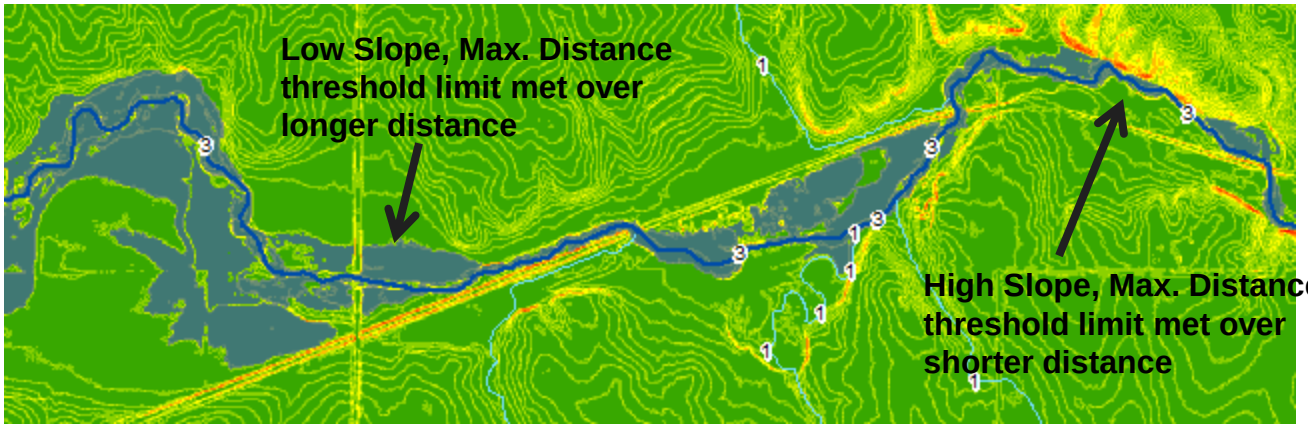
Active River Area: Cost Distance Analysis

Cost Distance Surface simulates floodplain extent

- Input Raster version of Streams and intersecting Lakes
- Input Slope model (LiDAR 3m, unfilled DEM)
- Input Maximum Distance thresholds, by Strahler Stream class

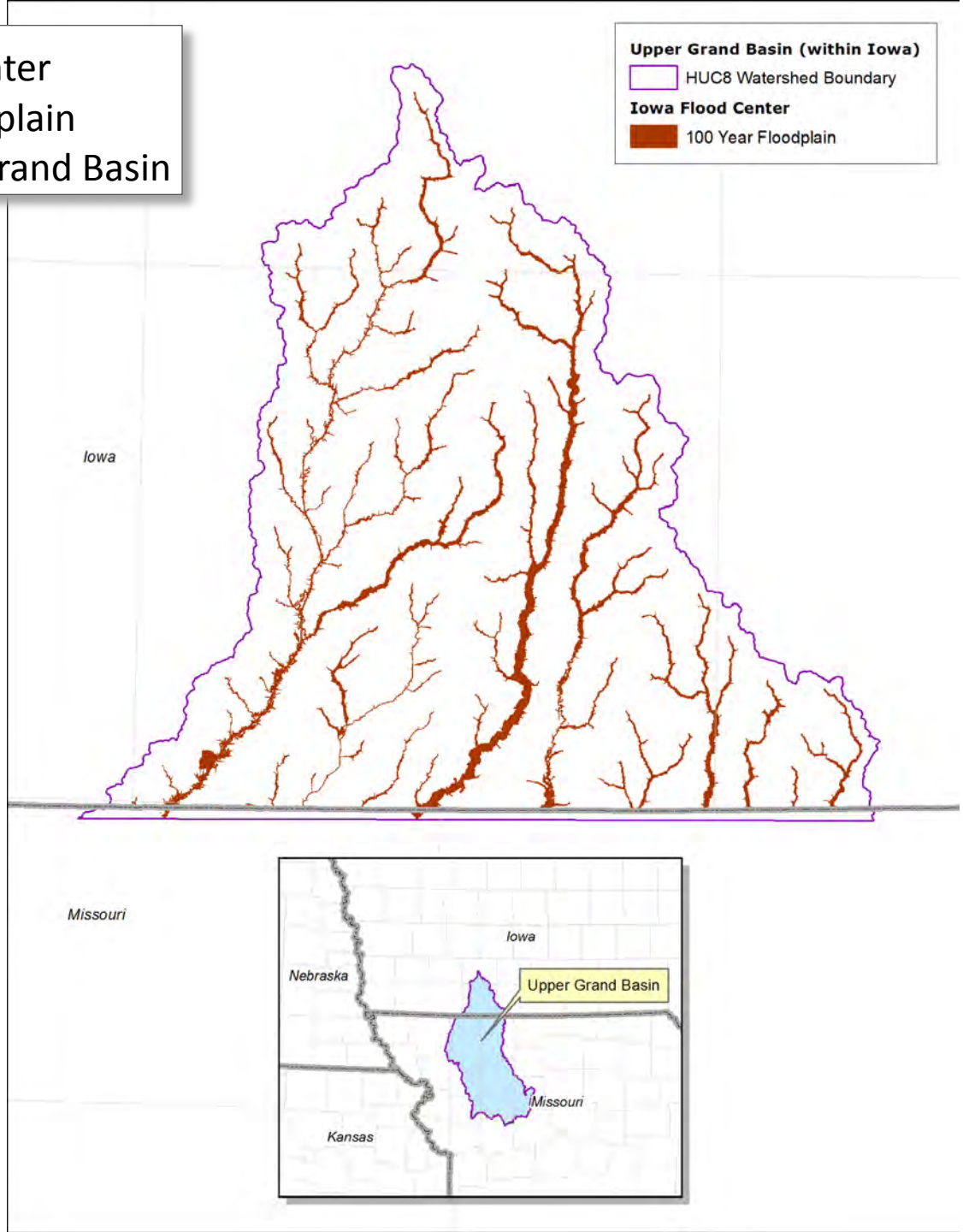
Strahler Stream Order Class	1	2	3	4	5	6	7	8
Cost Distance Maximum Distance Threshold	NA	10	50	100	200	250	300	350



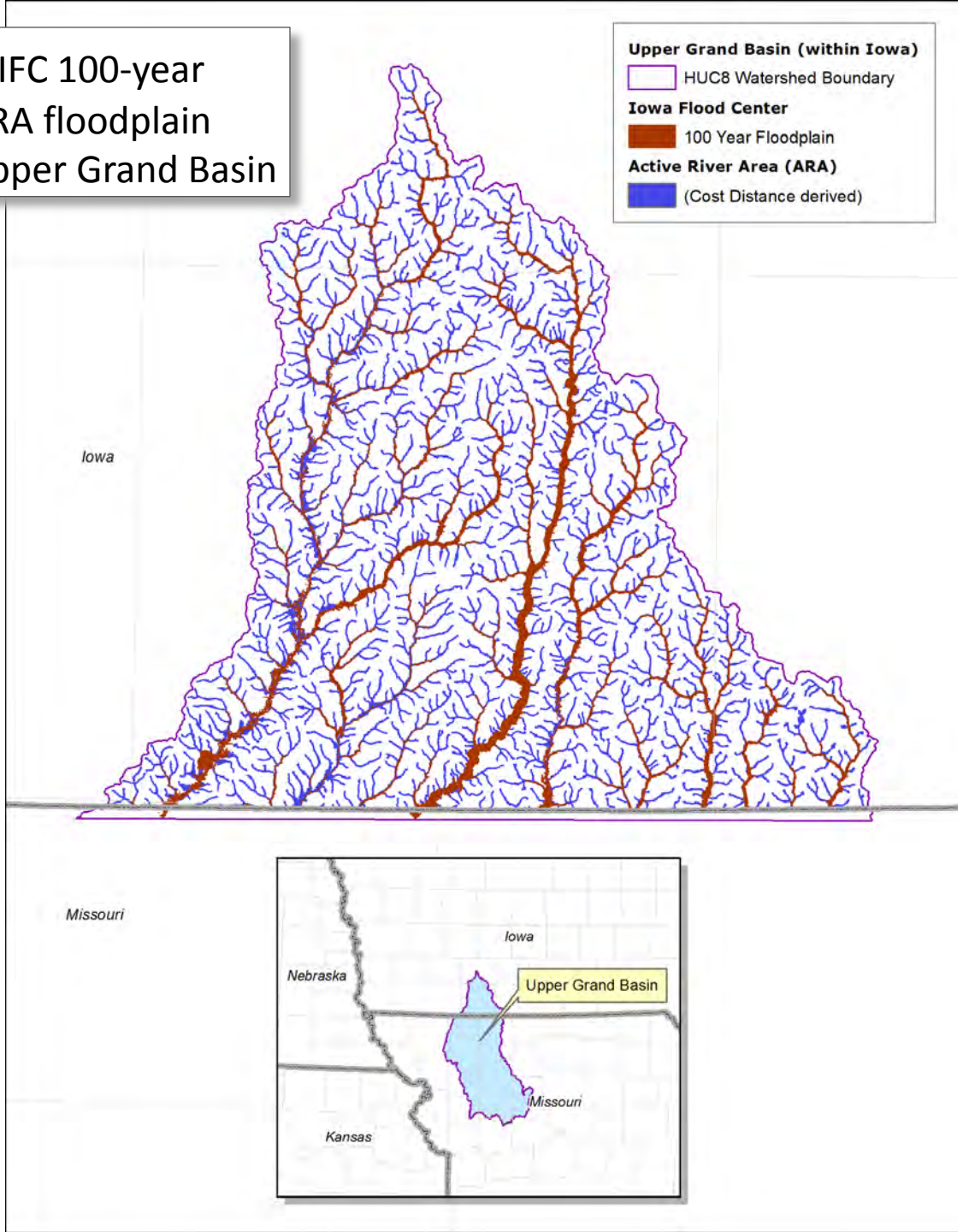


Locations of Test Watersheds

Iowa Flood Center
100-year floodplain
in the Upper Grand Basin

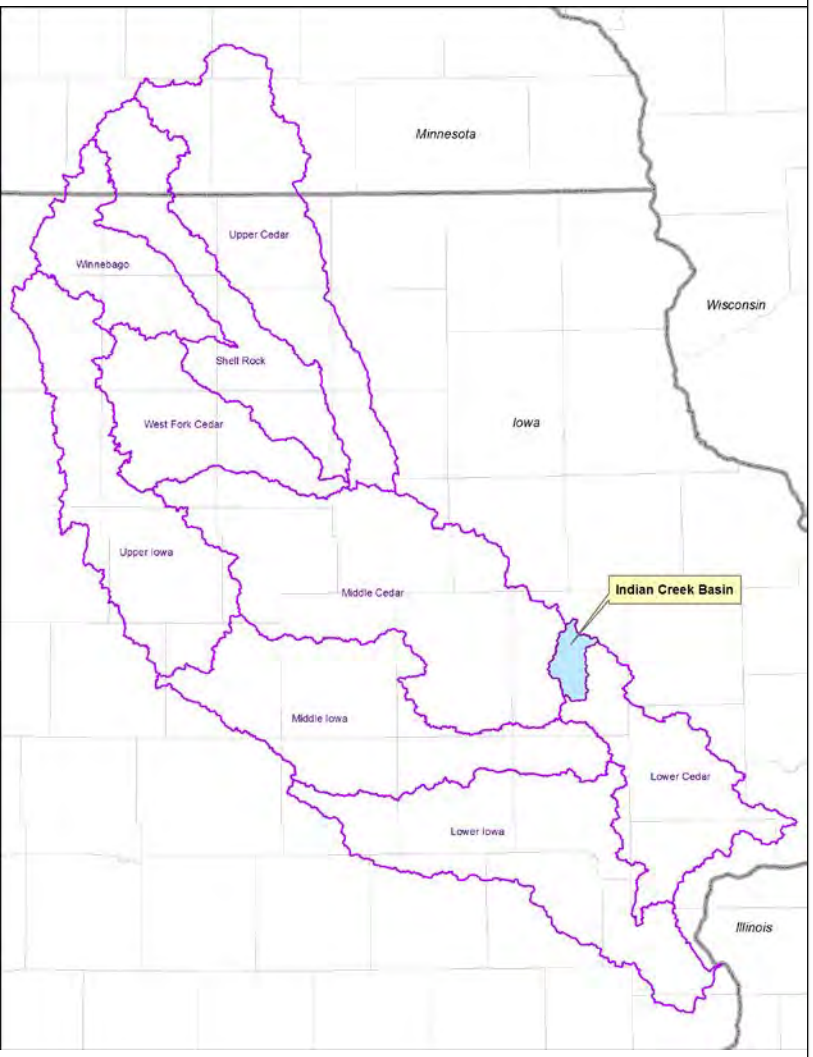


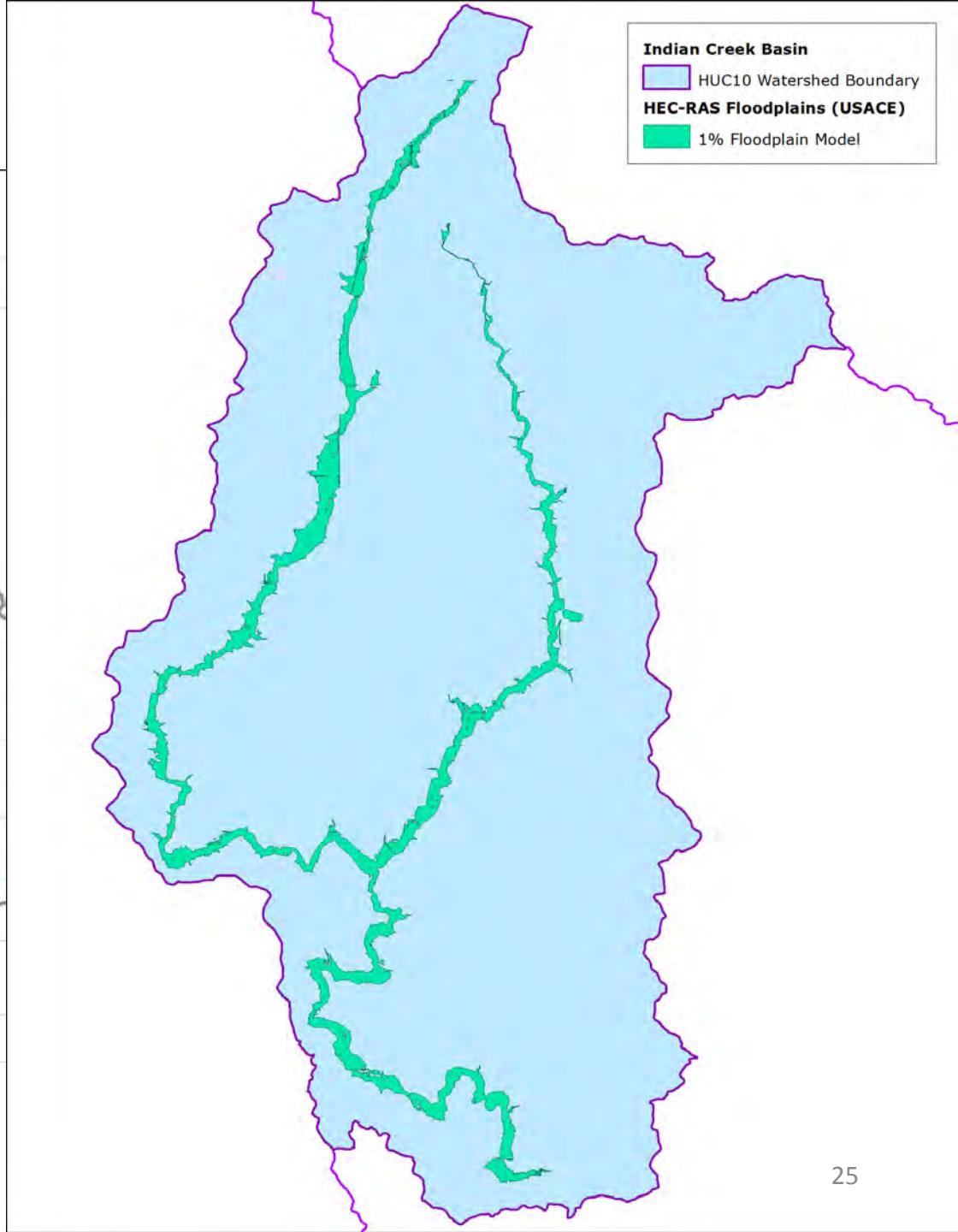
Comparison of IFC 100-year floodplain to ARA floodplain model in the Upper Grand Basin



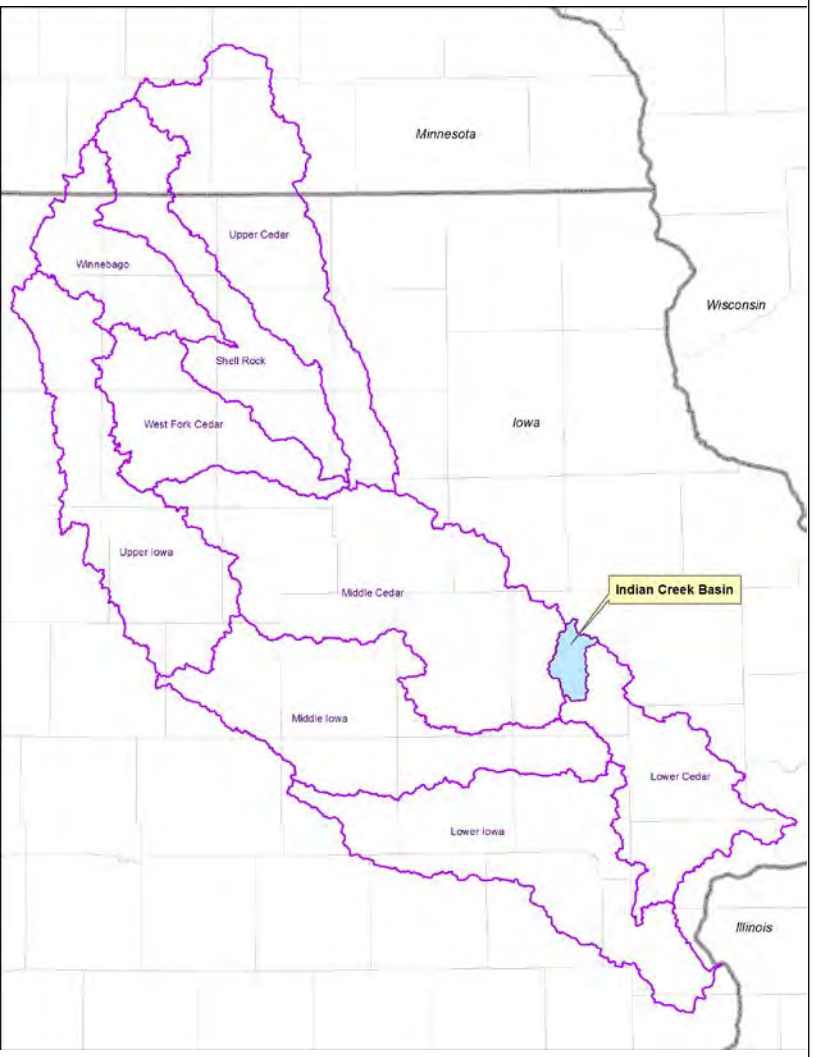
Locations of Test Watersheds

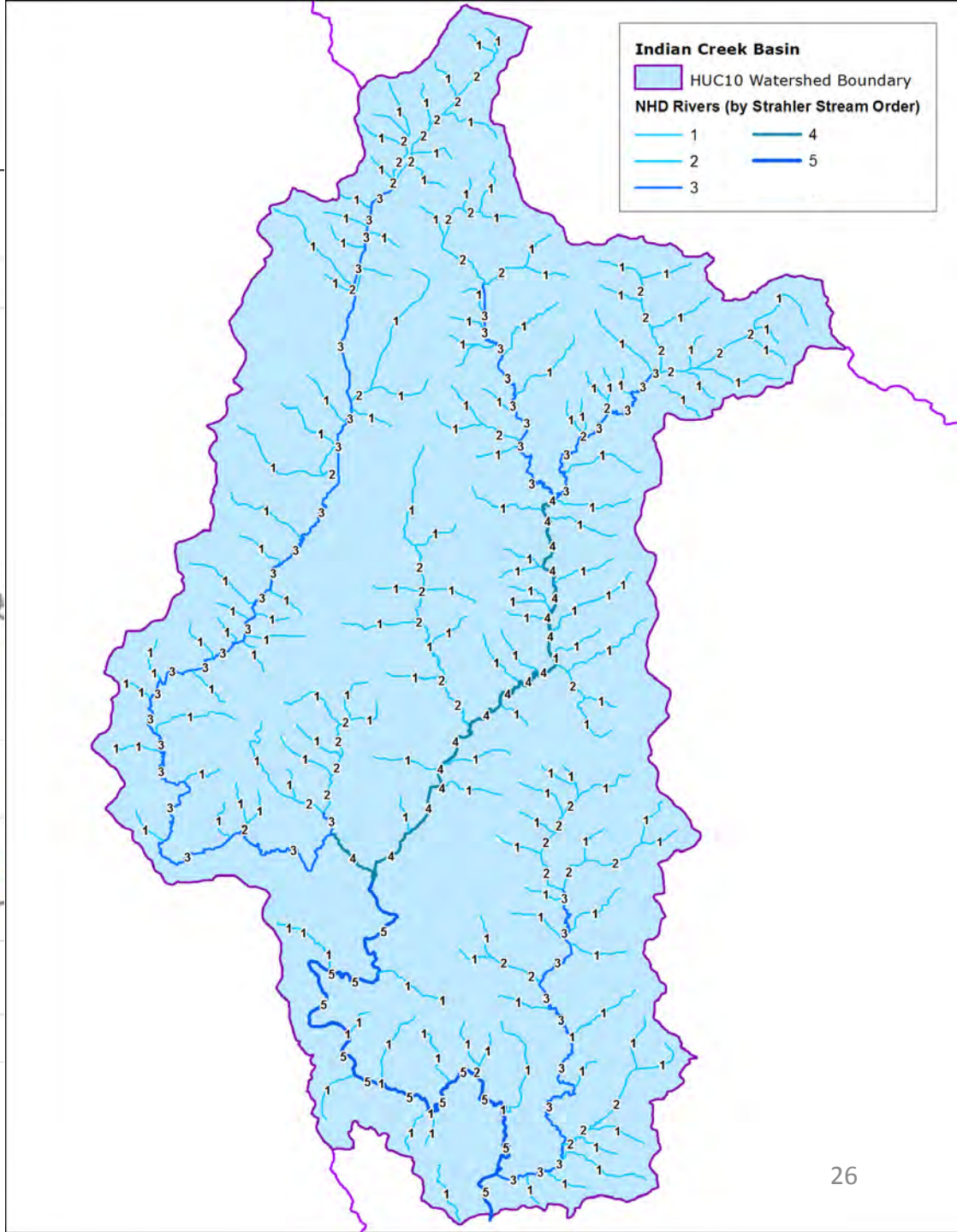
HEC-RAS 1% flood model within the Indian Creek Basin



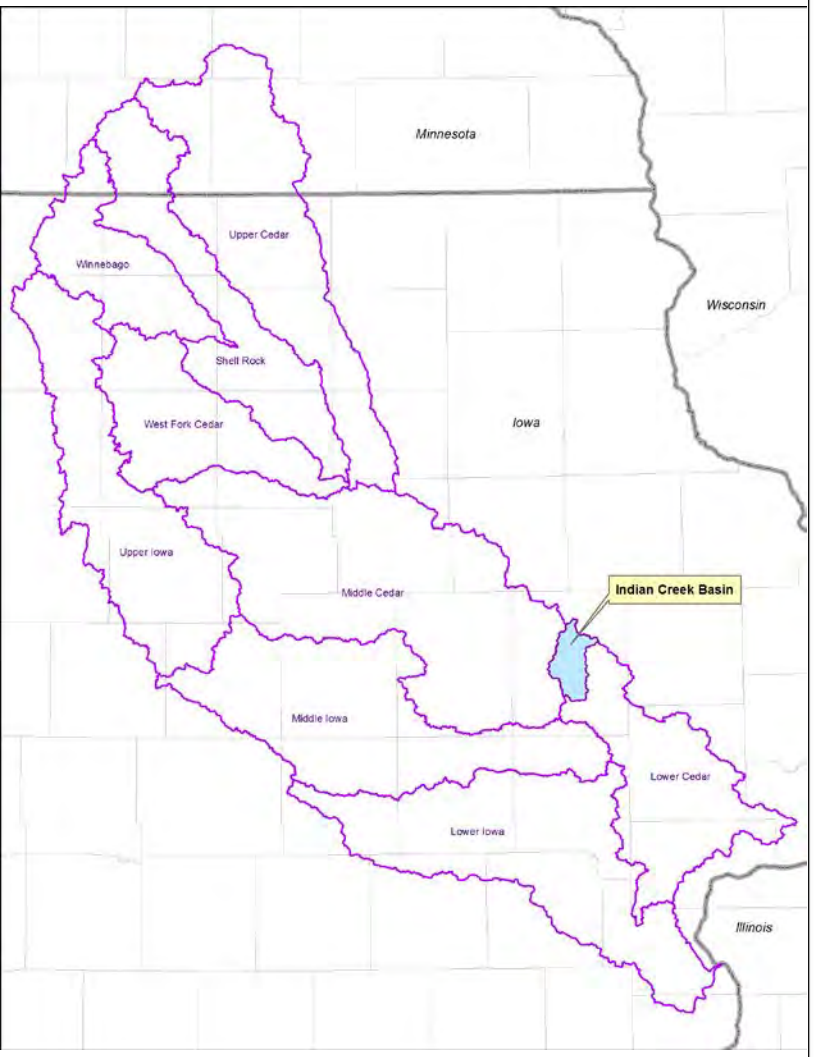


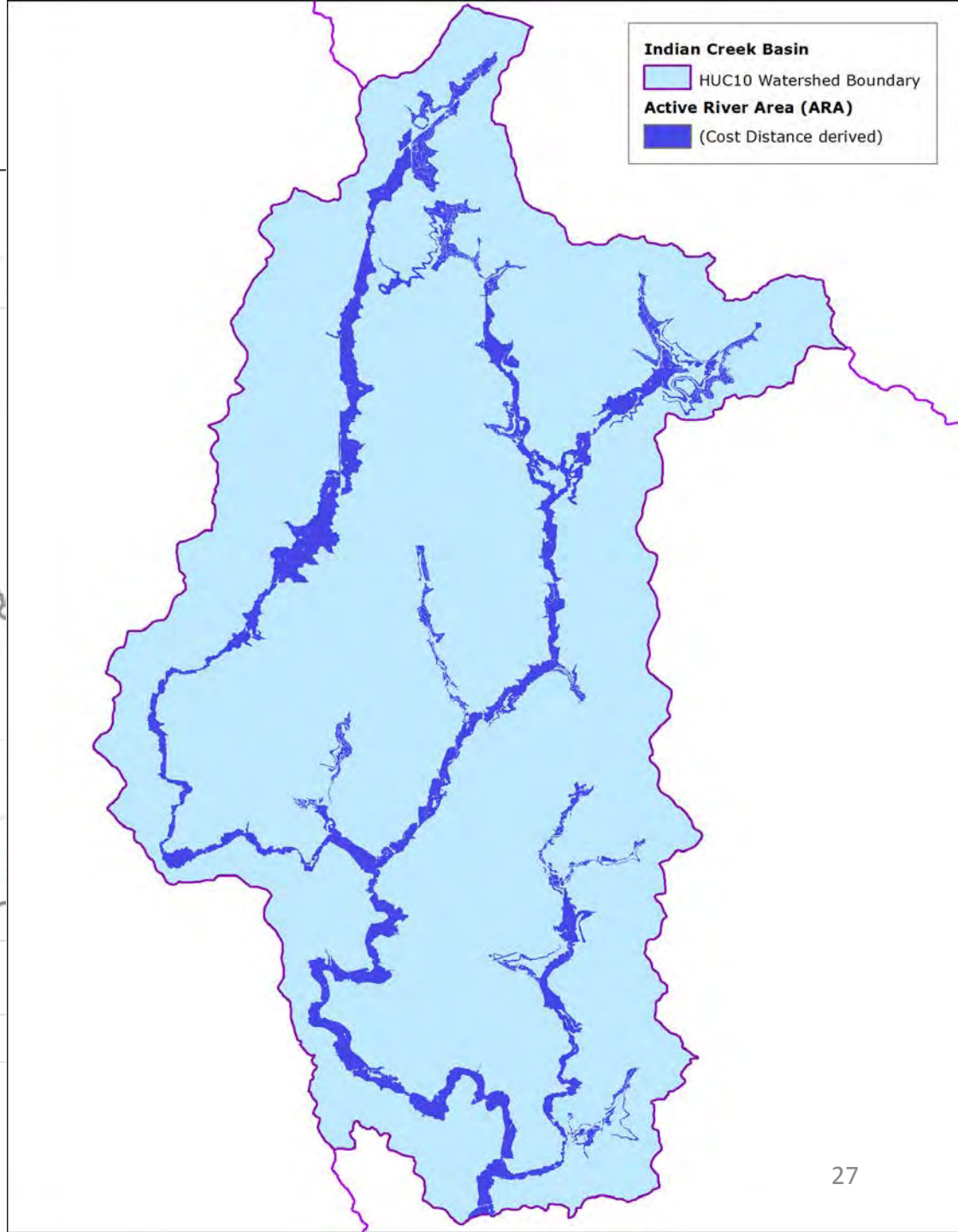
NHD Rivers with Strahler stream order within the Indian Creek Basin





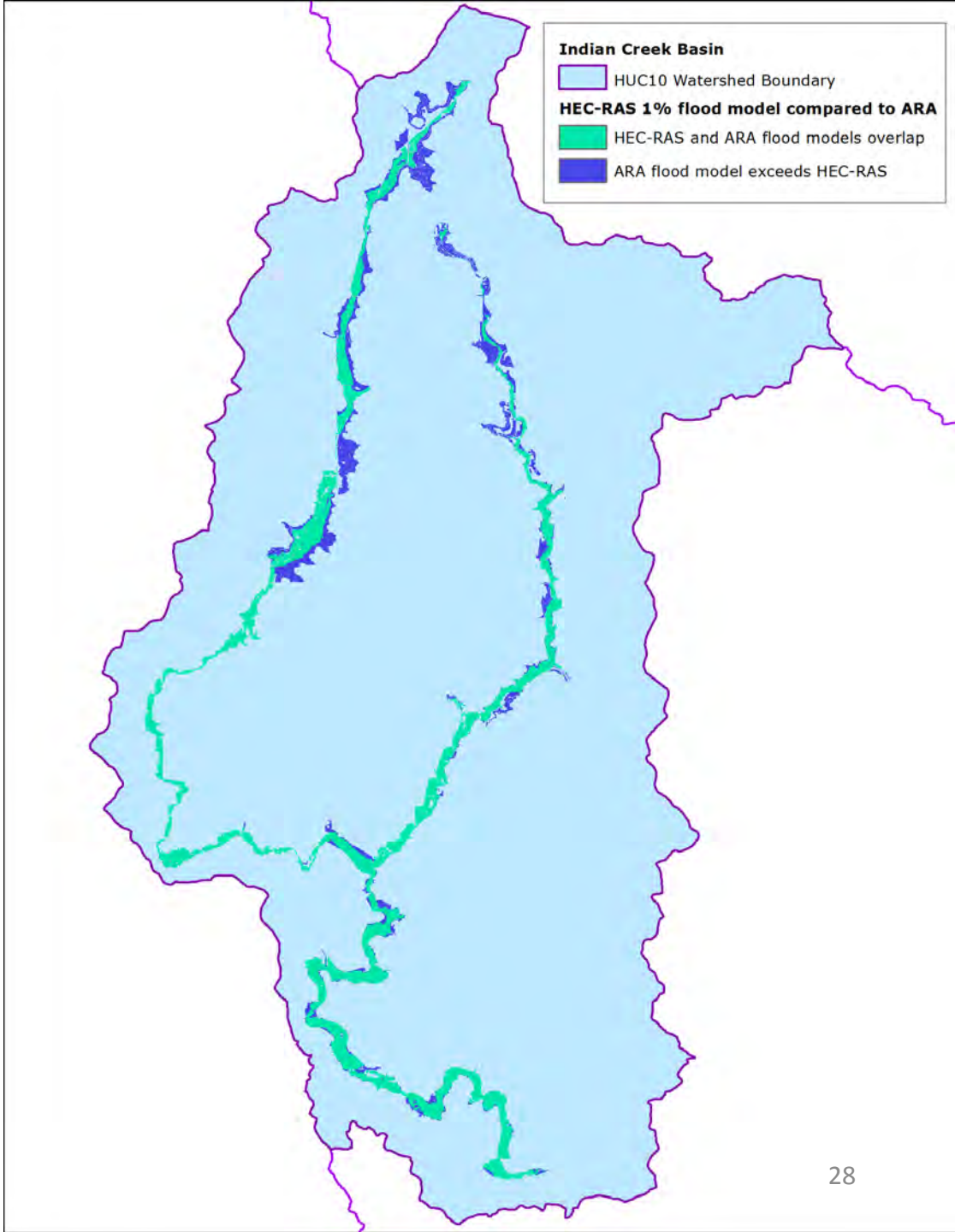
ARA flood model within the Indian Creek Basin



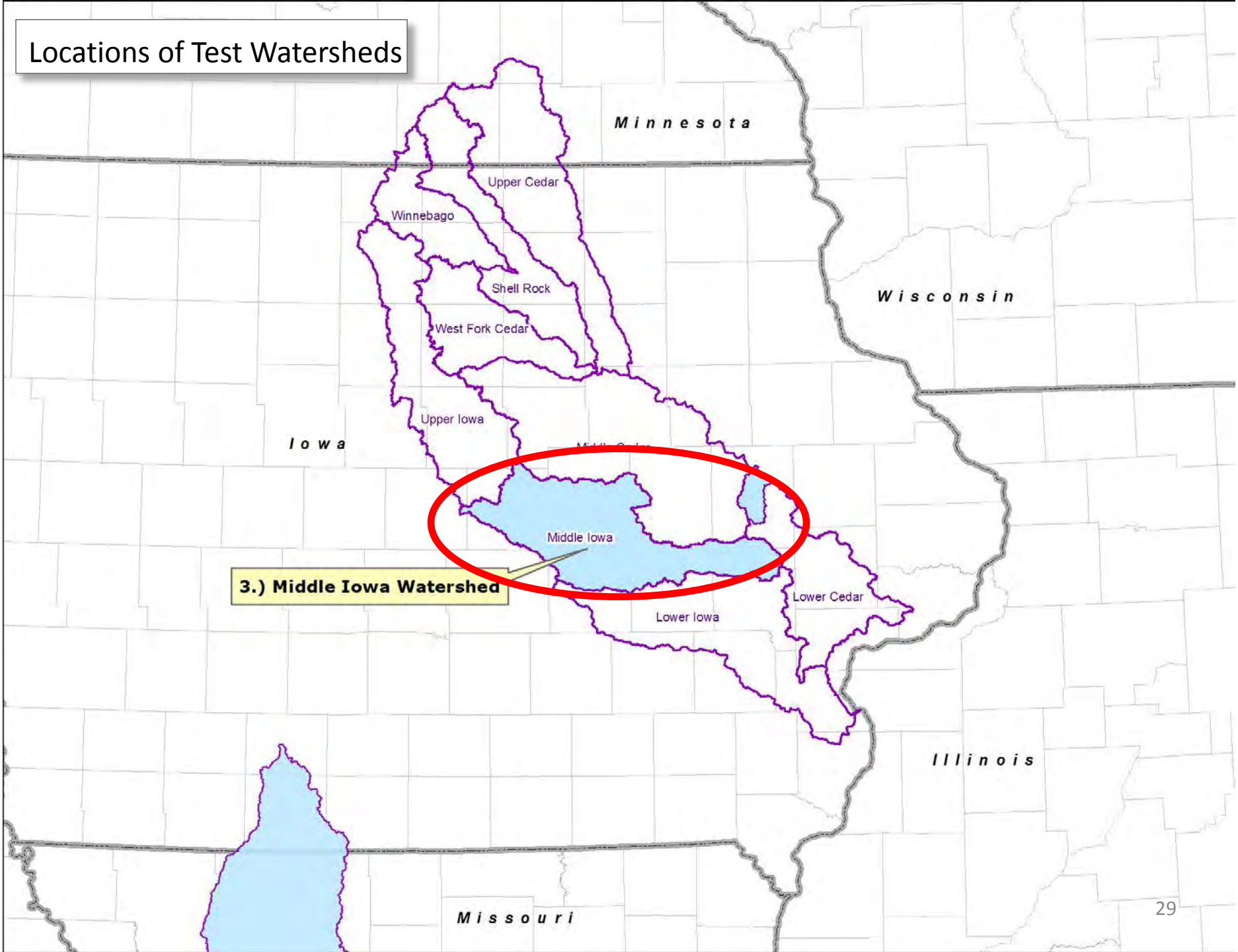


HEC-RAS and ARA

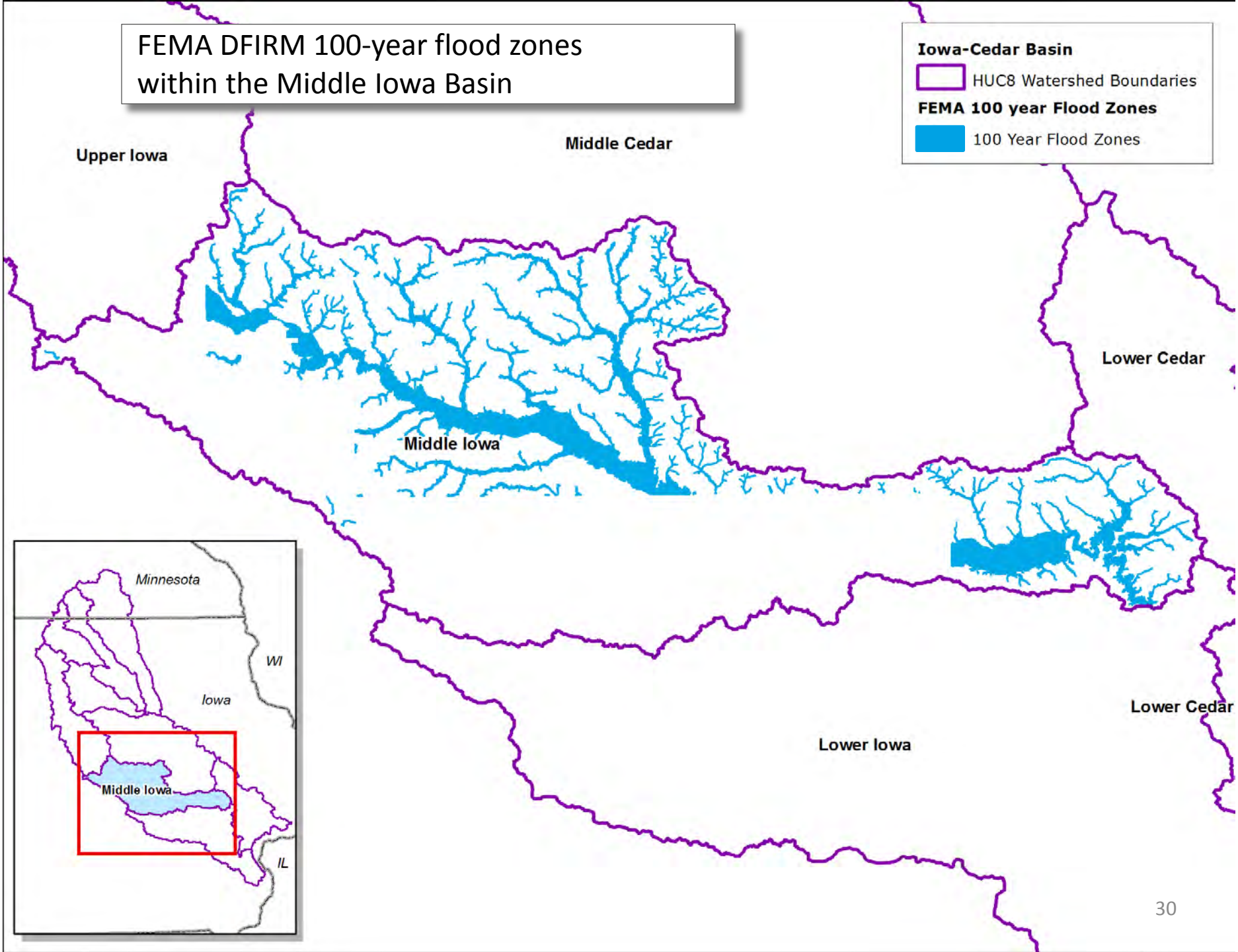
- Within the Indian Creek Basin:
  - 70.25 % of ARA area overlaps with HEC-RAS 1% floodplain
  - 29.75 % of ARA area exceeds HEC-RAS 1% floodplain

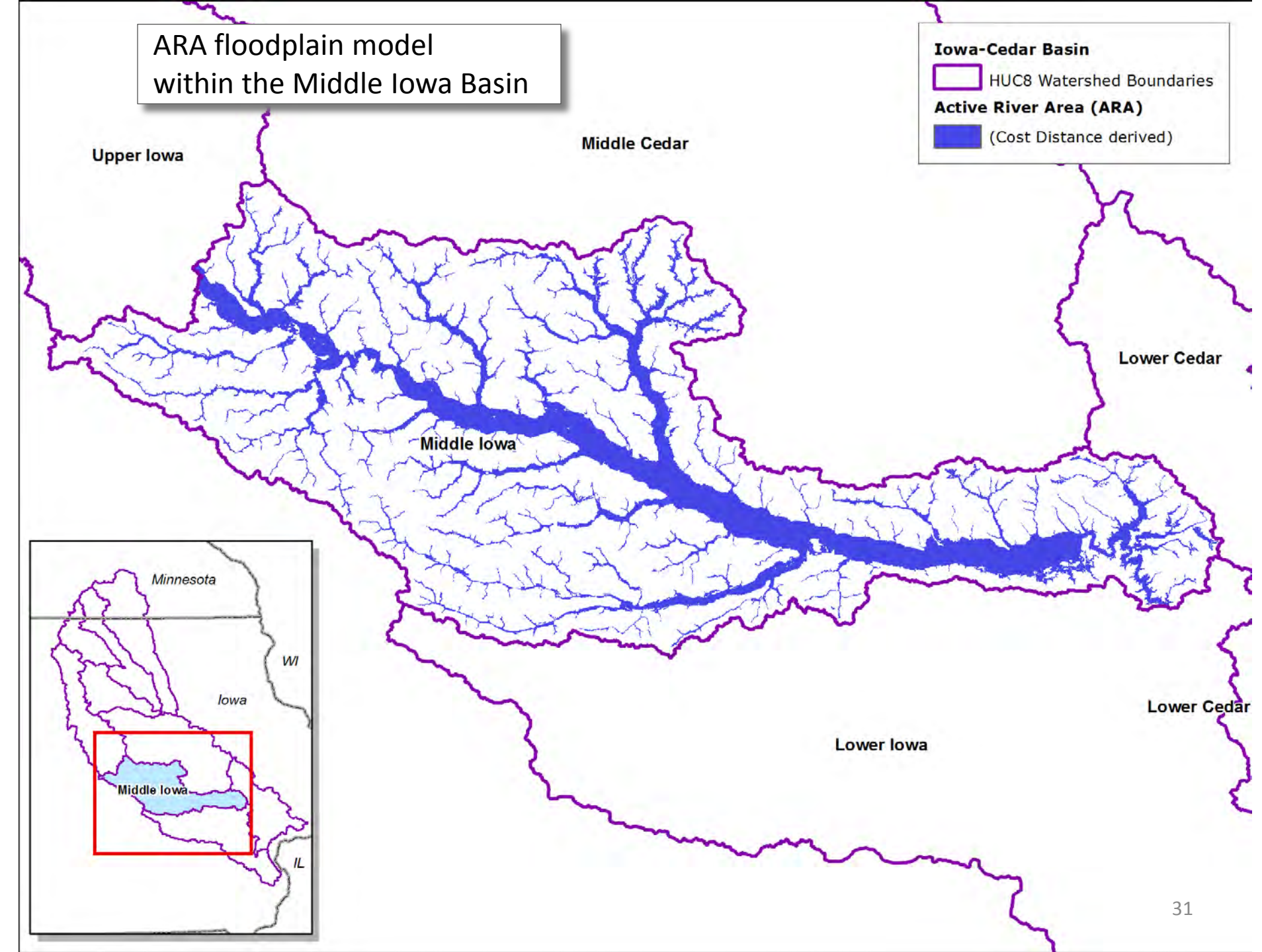


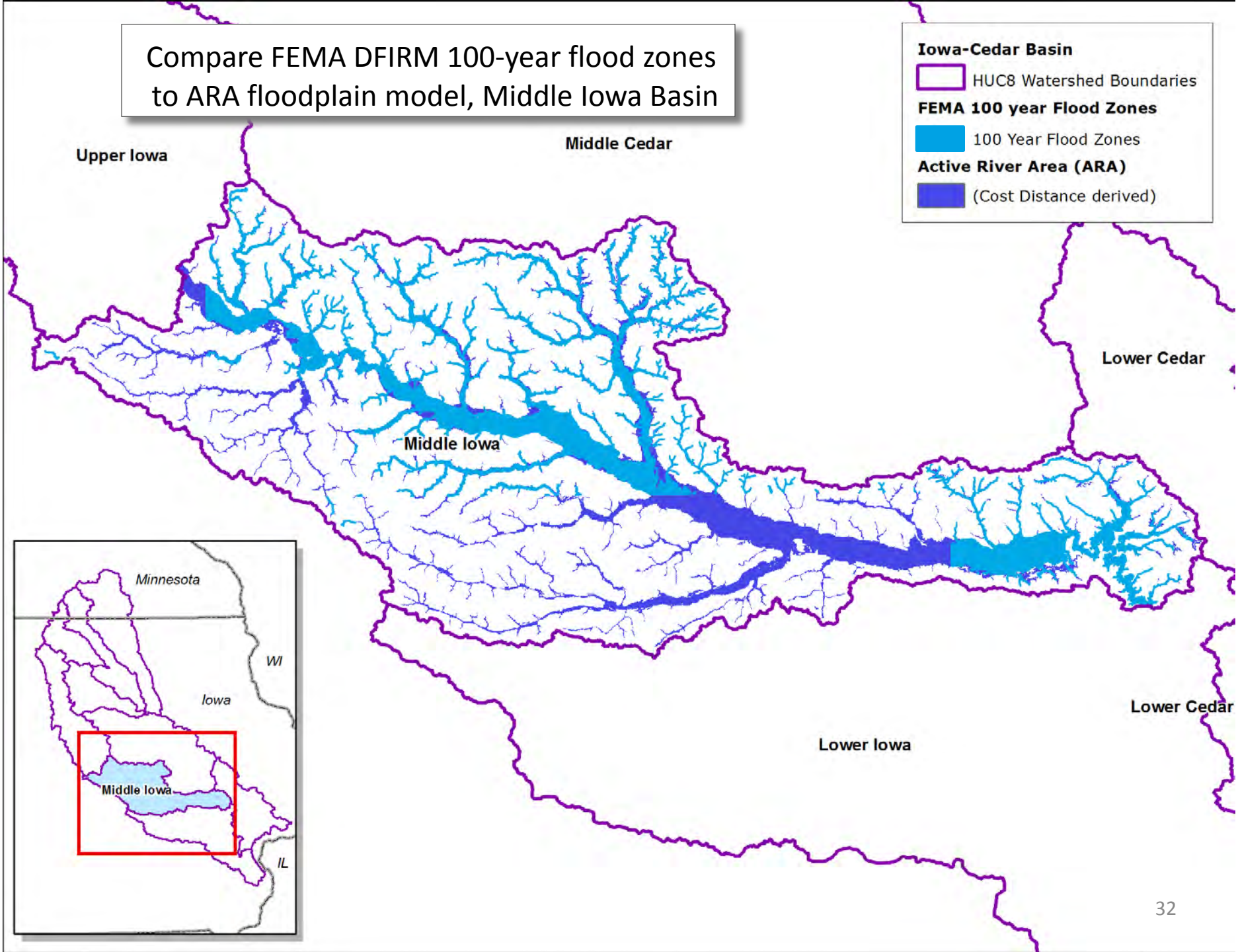
Locations of Test Watersheds



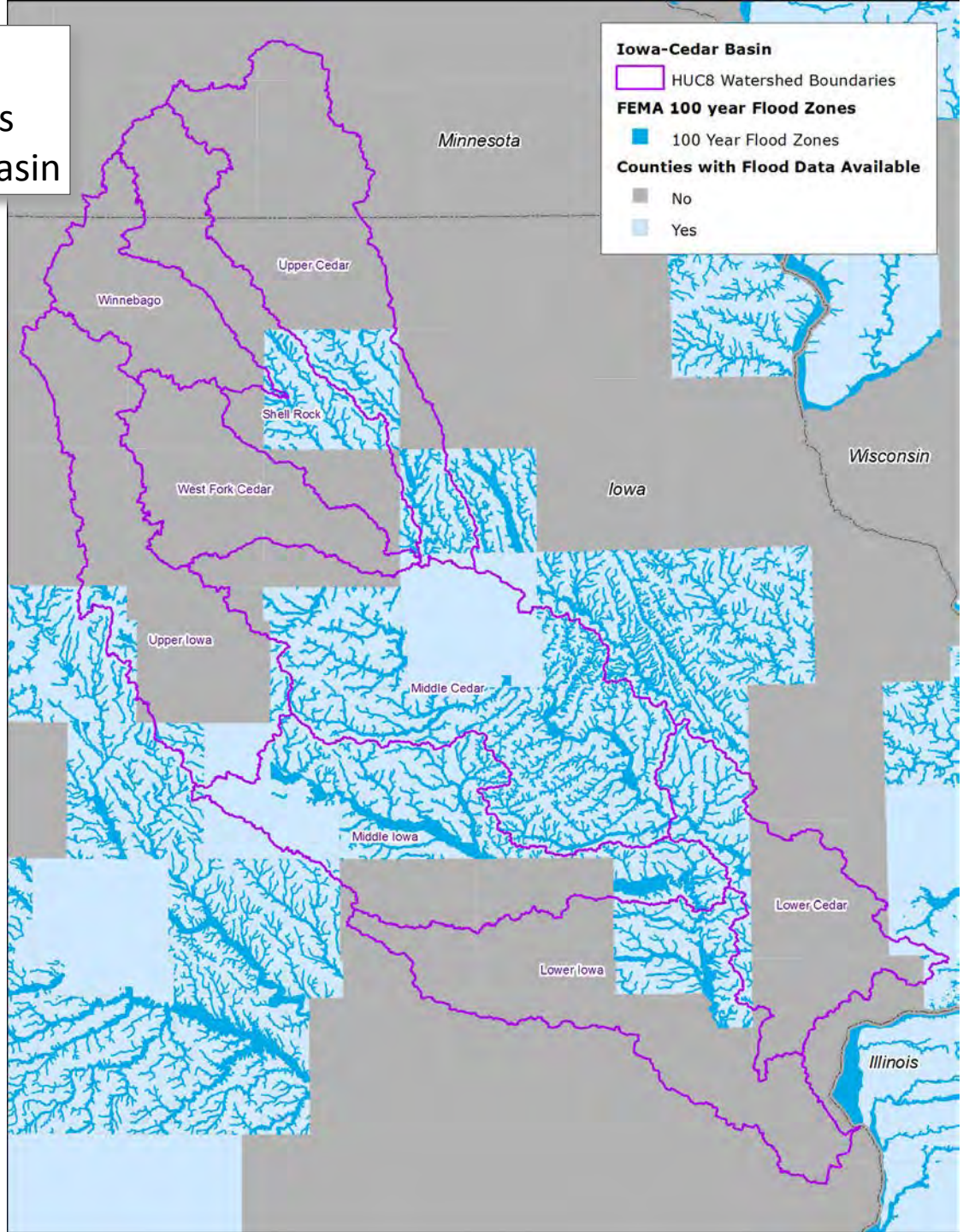
FEMA DFIRM 100-year flood zones within the Middle Iowa Basin



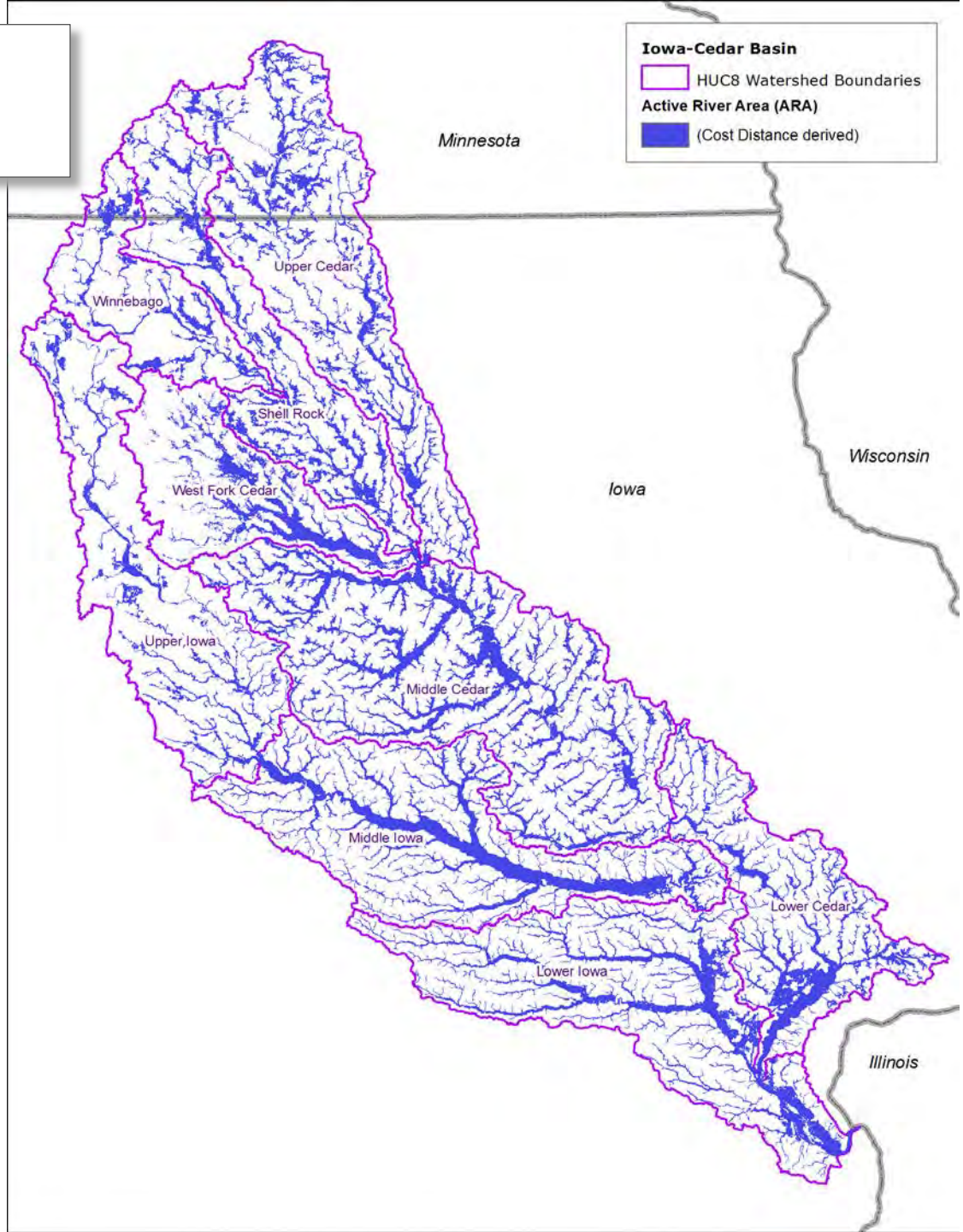

ARA floodplain model
within the Middle Iowa Basin
Iowa-Cedar Basin
HUC8 Watershed Boundaries
Active River Area (ARA)
(Cost Distance derived)
Upper Iowa
Middle Cedar
Lower Cedar
Middle Iowa
Lower Iowa
Lower Cedar
Minnesota
WI
Iowa
Middle Iowa
IL


Compare FEMA DFIRM 100-year flood zones to ARA floodplain model, Middle Iowa Basin
Iowa-Cedar Basin
HUC8 Watershed Boundaries
FEMA 100 year Flood Zones
100 Year Flood Zones
Active River Area (ARA)
(Cost Distance derived)
Upper Iowa
Middle Cedar
Lower Cedar
Middle Iowa
Lower Iowa
Lower Cedar
Minnesota
WI
Iowa
Middle Iowa
IL

FEMA
100-year flood zones
in the Iowa-Cedar Basin



ARA flood model
in the
Iowa-Cedar Basin



Multiple Benefits Mapping

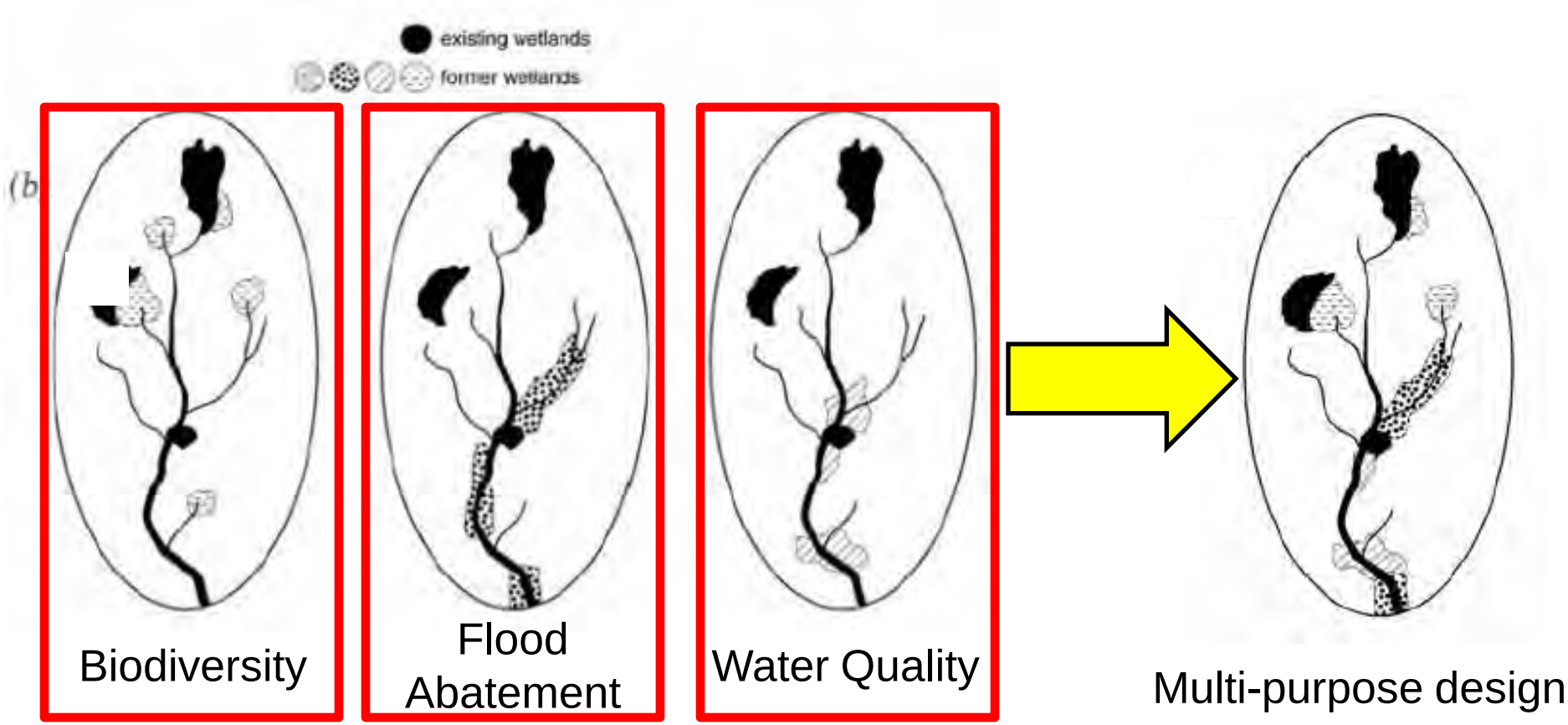


Figure modified from: Zedler, J.B. 2003. Wetlands at your service: reducing impacts of agriculture at the watershed scale. *Frontiers in Ecology and the Environment* 1: 65-72.

Multiple Benefits Mapping in the Iowa-Cedar

Flood risk reduction

Multiple Benefits Mapping in the Iowa-Cedar

Nutrient Filtration
& Water Quality
Improvement

Multiple Benefits Mapping in the Iowa-Cedar

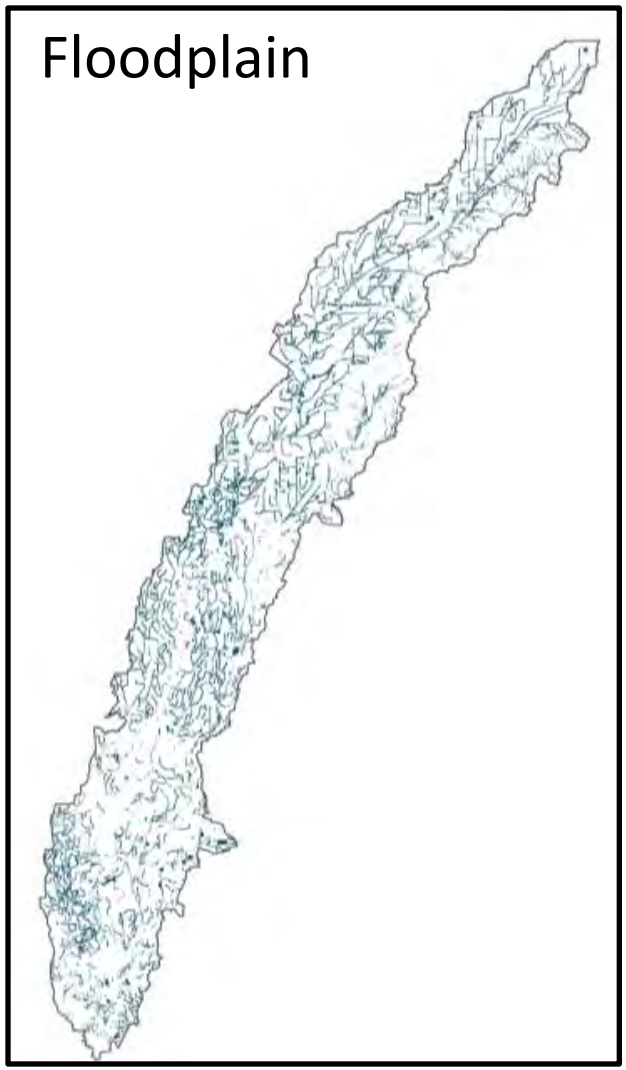
Soil Retention &
Reduced Erosion

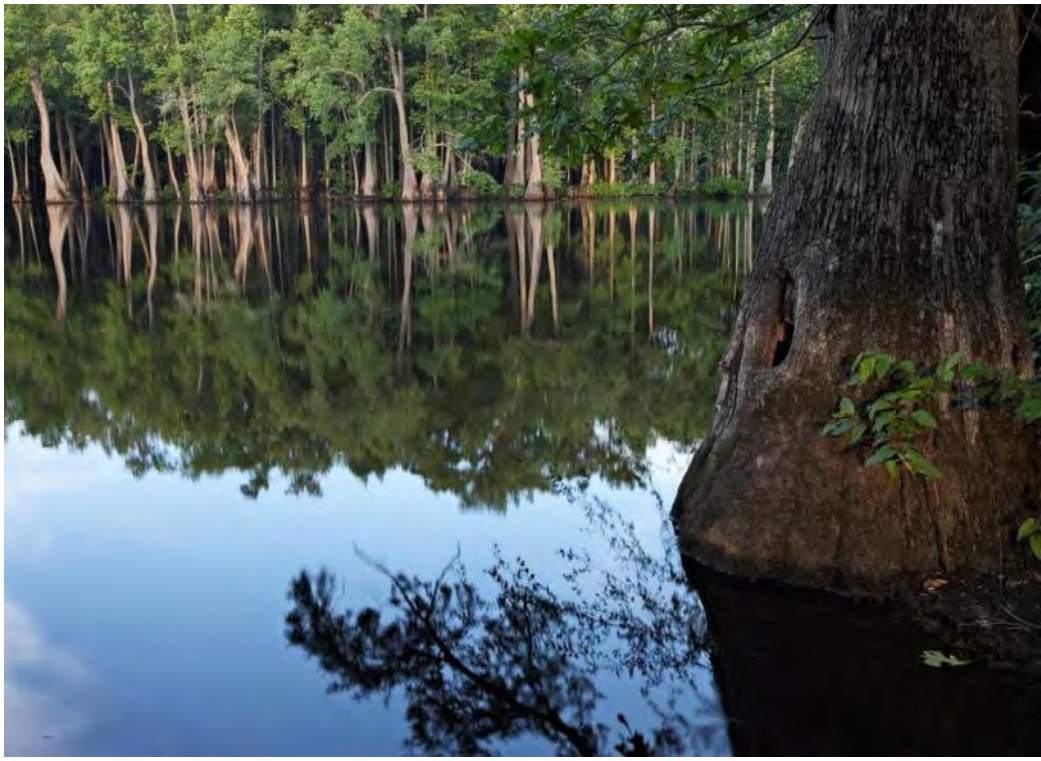
Multiple Benefits Mapping in the Iowa-Cedar

Provision of Habitat

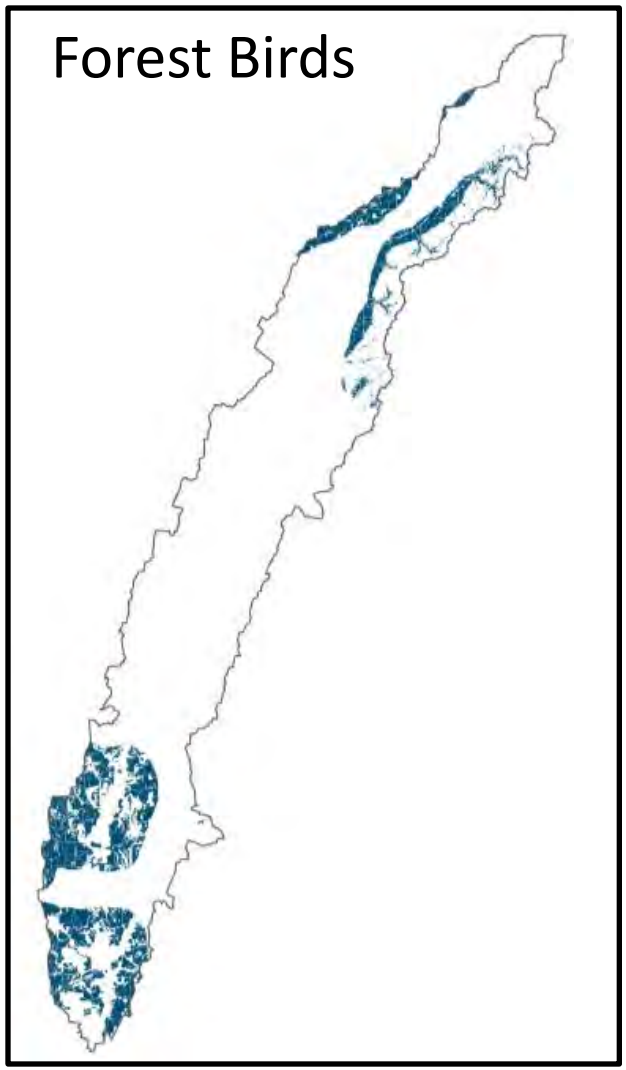
Multiple Benefit Mapping:

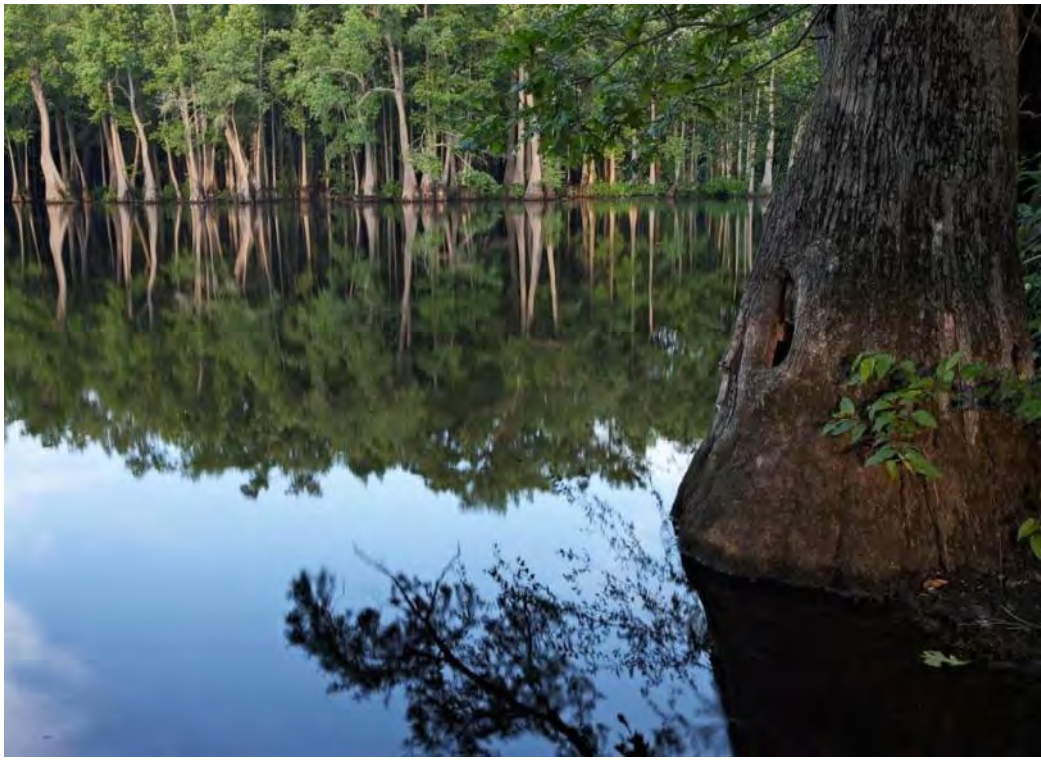
Lower Mississippi Alluvial Valley example



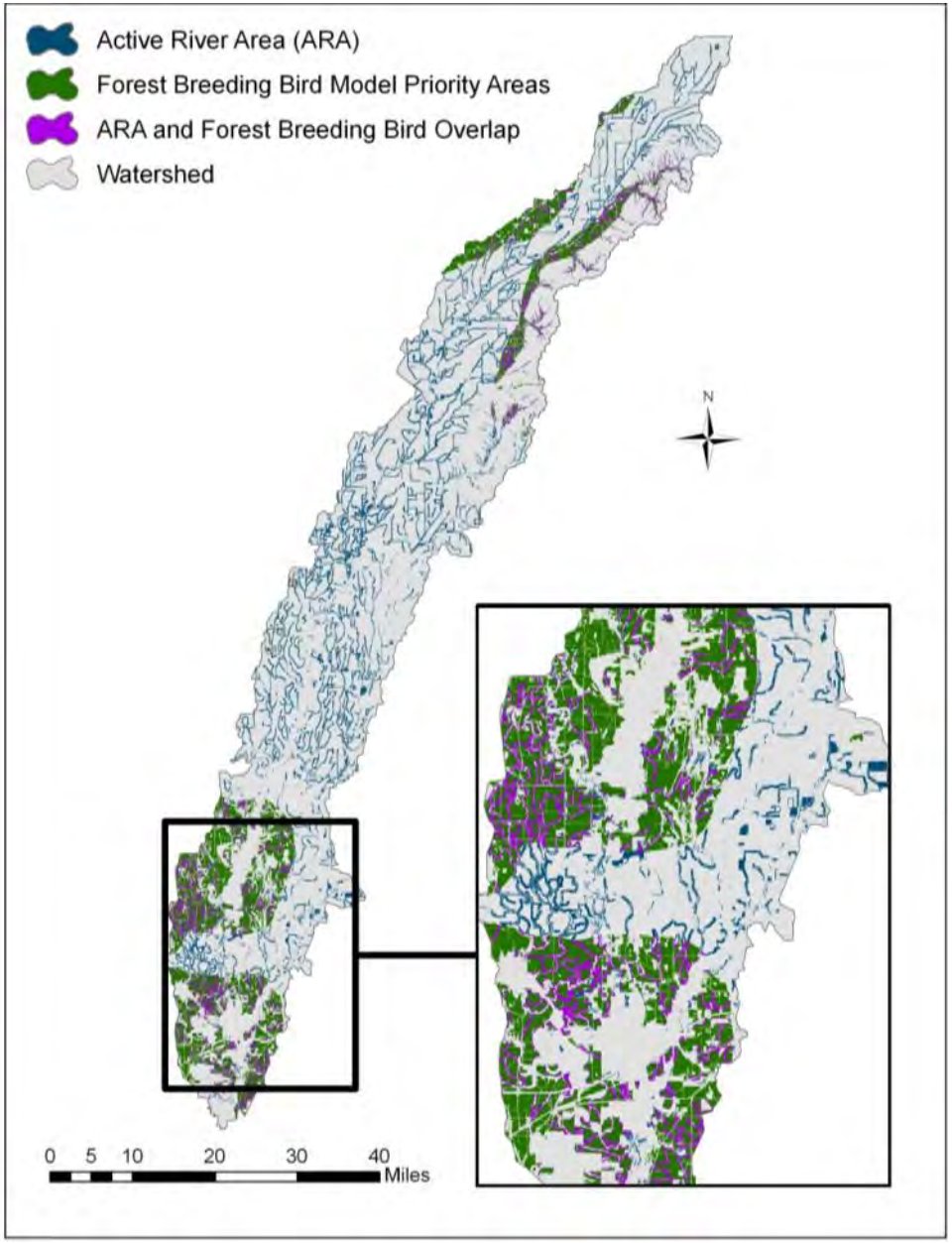


Multiple Benefit Mapping: LMAV example





Multiple Benefit Mapping: LMAV example



QUESTIONS?

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