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Geosyntec consultants

Geosyntec Consultants of Michigan

Transportation Resilience for Northeastern Illinois

IAFSM 2024

March 12, 2024

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Agenda

1. Project overview
2. Vulnerability assessment
3. Flood exposure analysis
4. Looking ahead

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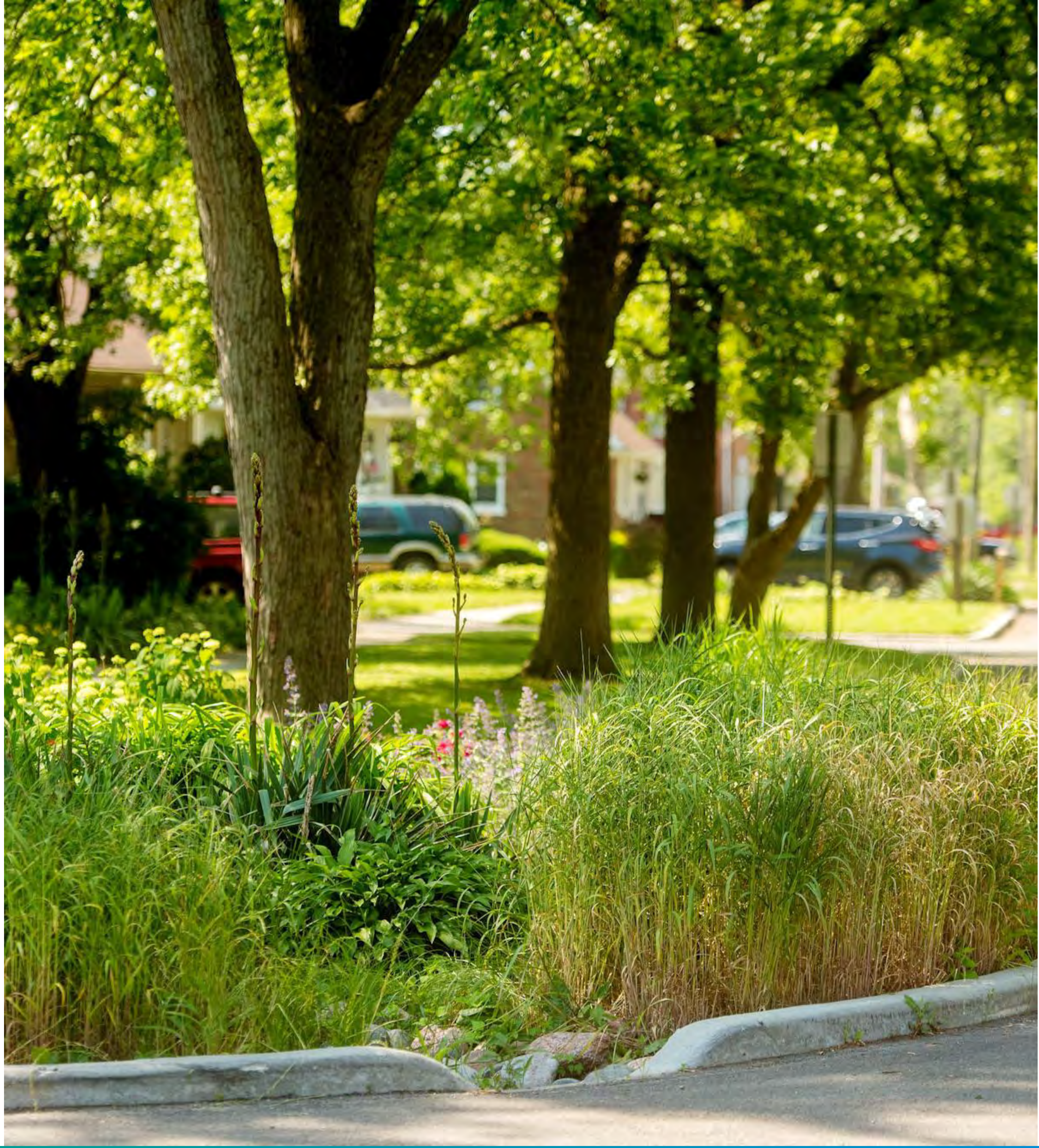
Transportation resilience improvement plan

Identify opportunities to improve the resilience of the transportation network to extreme weather and climate change.

Timeline: Feb 2023 – Dec 2025

Consultants: ICF, Geosyntec, High Street



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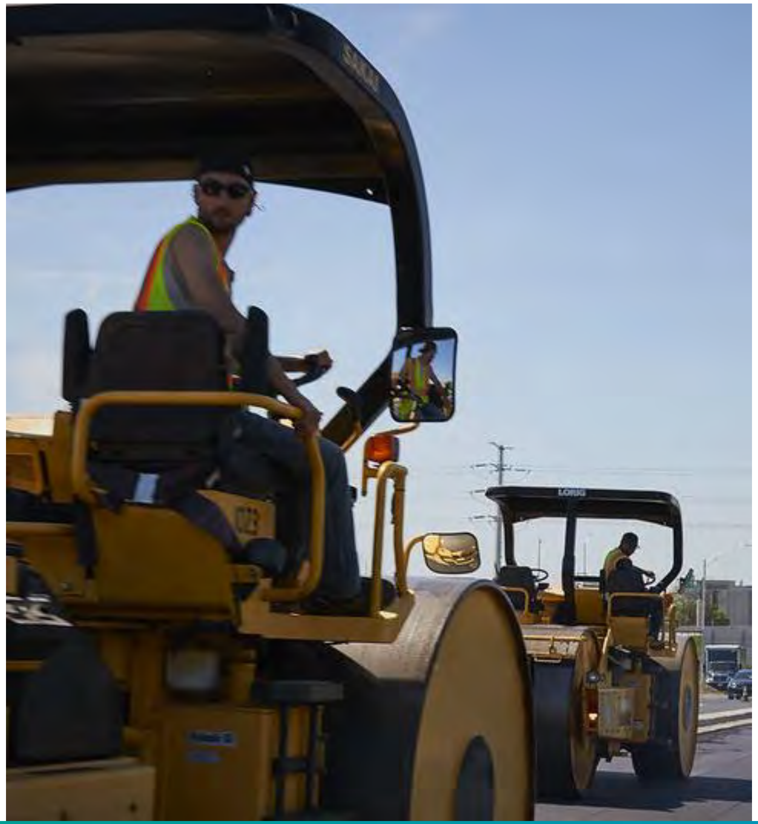
What is the transportation network?

Physical infrastructure

Service operations

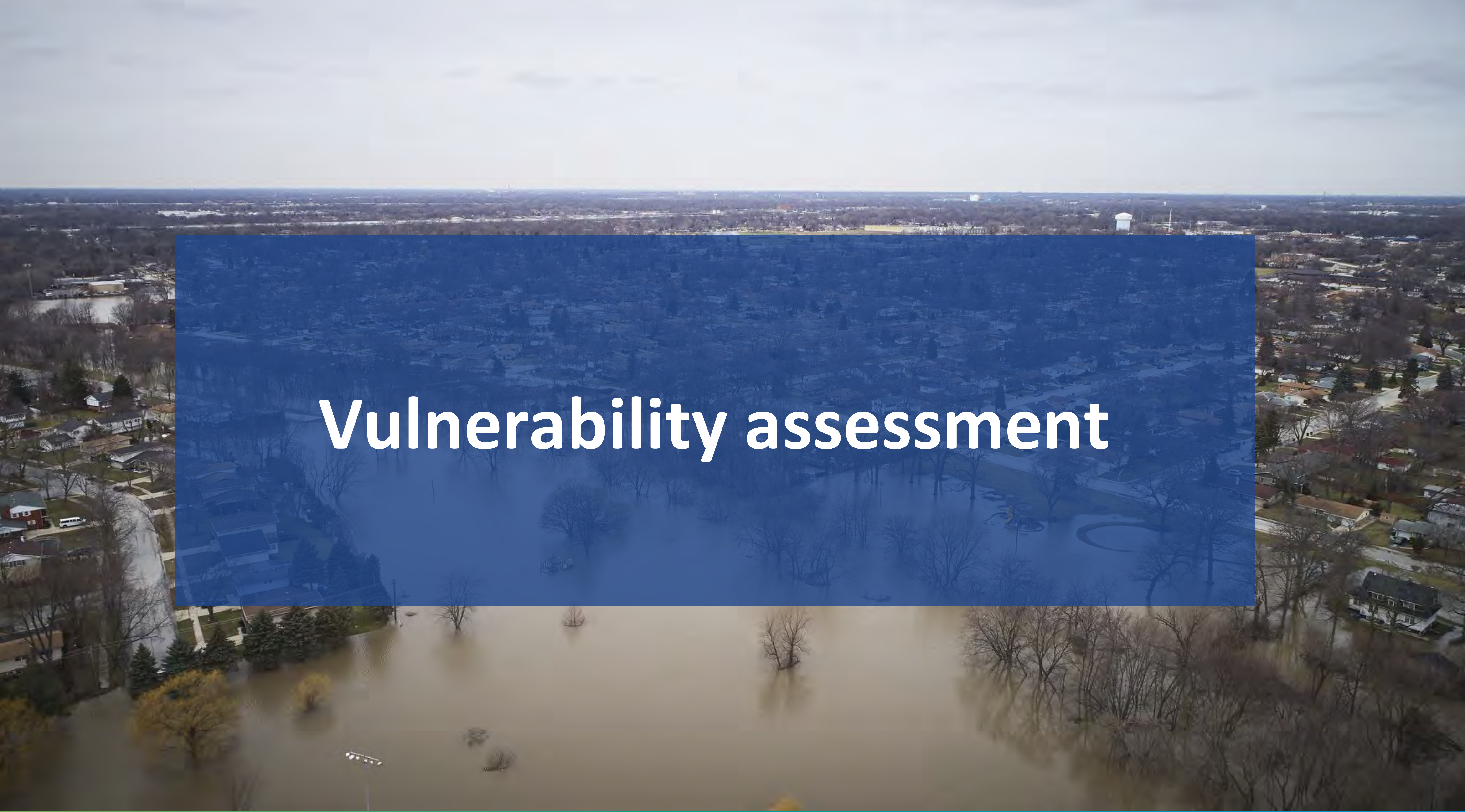
User experience



How will we increase resilience?

1. Identify and prioritize major vulnerable transportation assets.
2. Identify and prioritize investments to build resilience and reduce climate risks.
3. Propose equitable and inclusive resilience investments.
4. Inform transportation planning and decision-making.

Vulnerability assessment



Priority hazards and transportation impacts

1 Flooding

2 Extreme heat

3 Severe storms

Roads, bridges, culverts, rail tracks & stations, and bicycle and pedestrian facilities as well as all users

Rail tracks, transit riders, bicyclists and pedestrians

Transit users, bicyclists, and pedestrians

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What we're hearing

Stormwater departments would benefit from knowing where roads flood

Access to critical facilities, like hospitals, is important

Water on the road is better than in people's basements

Transit agencies don't have control over the streets they rely on

Underpasses are the first to flood

Must keep rural roads passable for emergency vehicles

Transit-dependent riders are inconvenienced most (older adults and people with disabilities)

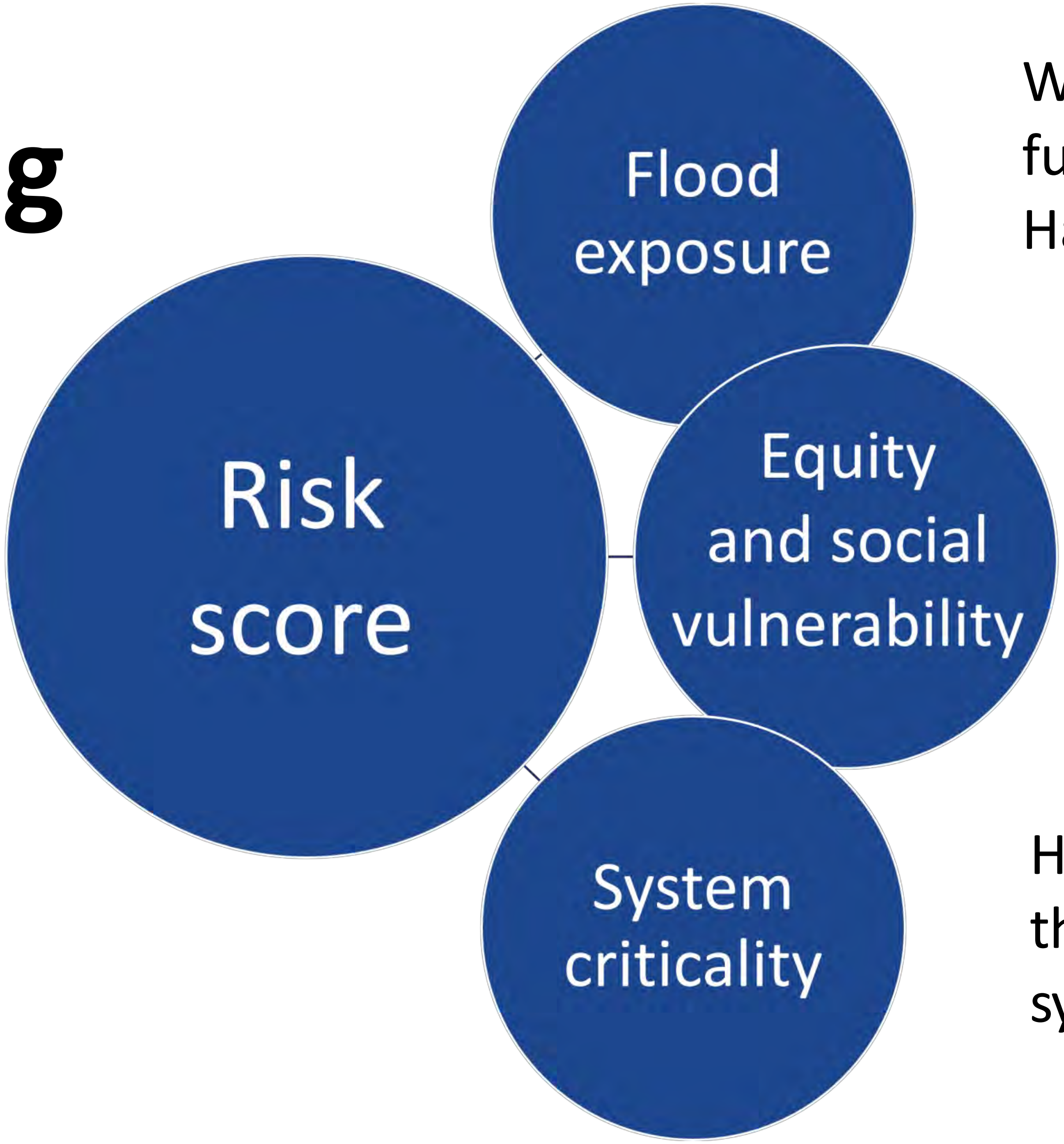
Culverts shouldn't be overlooked – lots of deferred maintenance

Roads are a significant source of runoff and cause stream levels to spike

What we're seeing

Photo credit: Chicago Tribune, July 2, 2023.

Prioritizing locations



What is the asset's current and future exposure to flooding? Has it flooded in the past?

Who does the asset serve? Who is impacted by disruptions?

How important is the asset to the regional transportation system?

Flood exposure analysis

Flooding risks due to climate change

Problem Statement: What areas in the region are at greatest risk of increased flooding due to climate change in the year 2050?

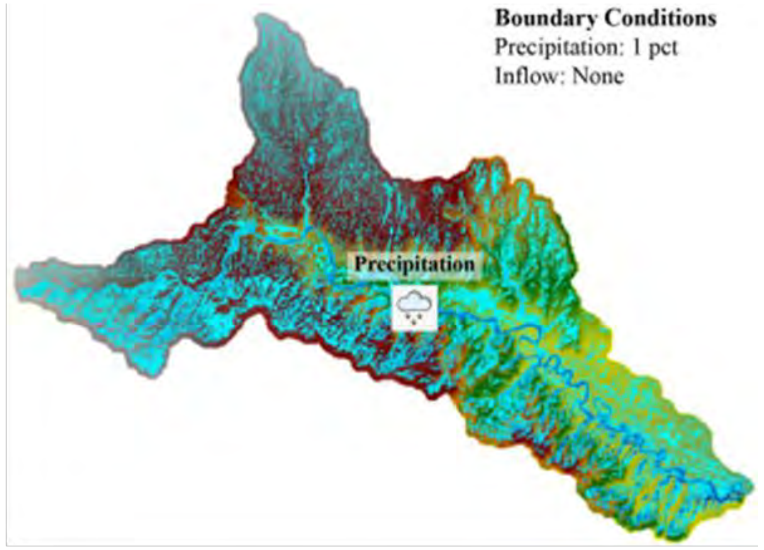
Objective: Identify highest risk areas to help prioritize locations for further assessment

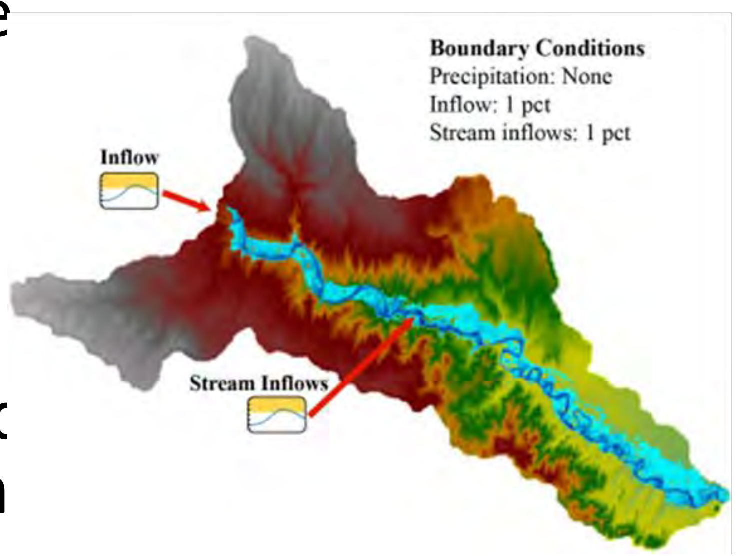
- Cost and data limitations to pursue traditional approach of developing individual hydrology & hydraulic (H&H) models
- Innovative approach was sought to develop a comprehensive model that integrates H&H at a regional scale to quantify changes in inundation.

HEC-RAS 2D Rain-on-Grid to identify potential impacts

HEC-RAS 2D with Rain-on-Grid (RoG) integrates hydrology and hydraulics into a single model

- Uses high-resolution LiDAR topography to directly represent the underlying terrain to perform the hydraulic computations while accounting for spatial variability in the rainfall across the landscape
- Provides a seamless transfer of precipitation to calculate runoff and perform hydraulic computations to map flood inundation
- Provides means to compare two sets of data to understand the potential climate change risks to critical transportation infrastructure in northeastern Illinois





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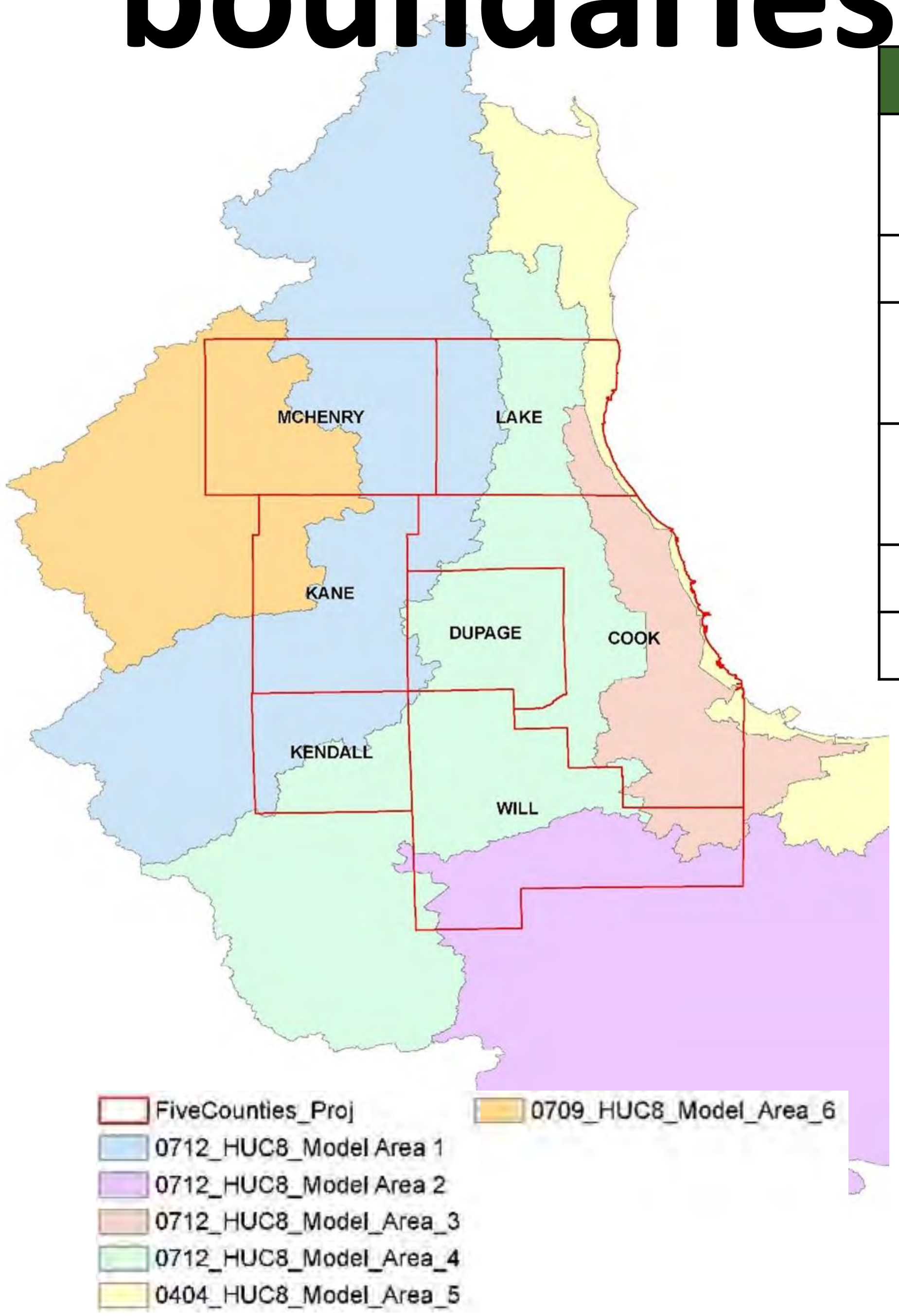
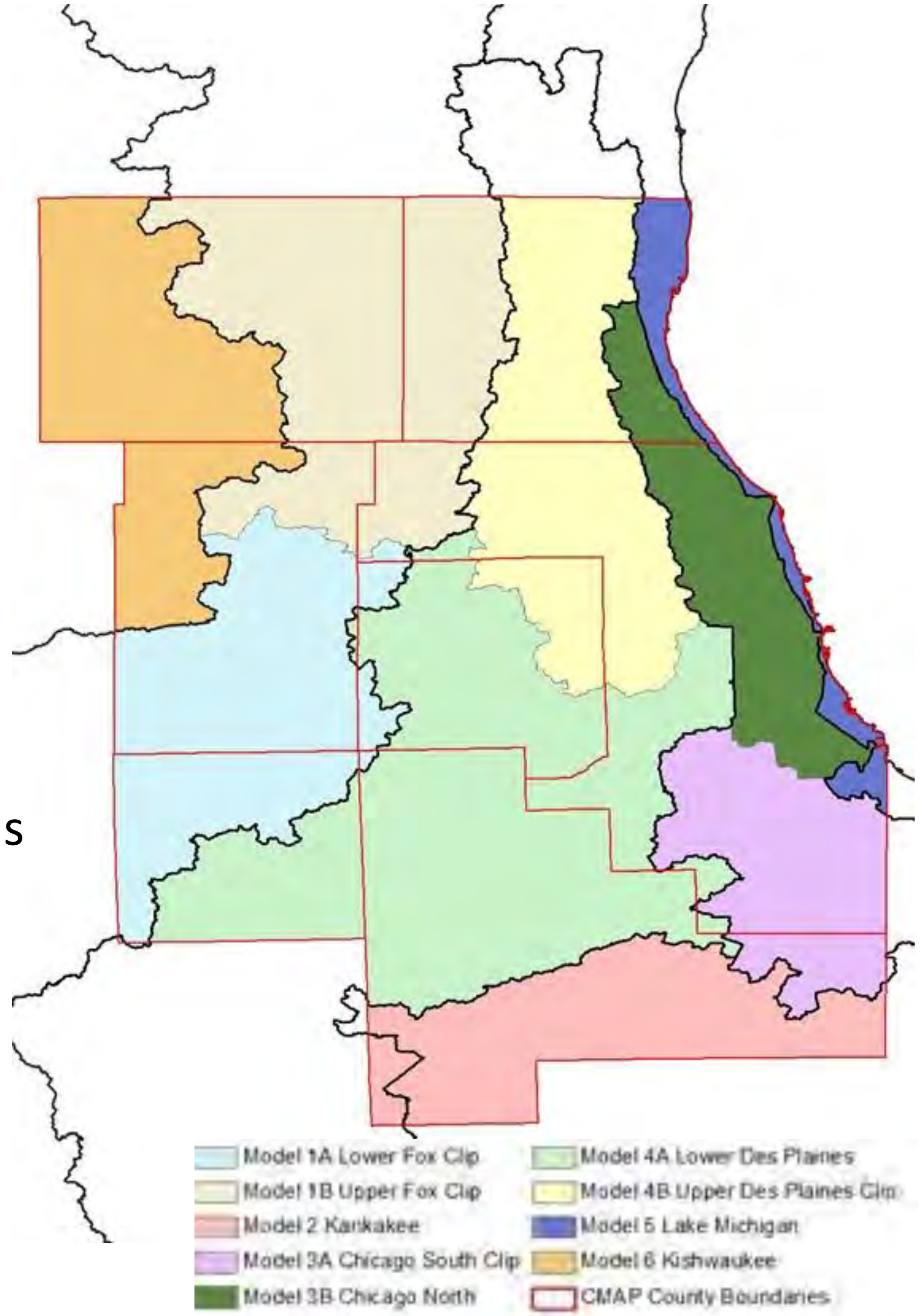
Building the model – defining model boundaries



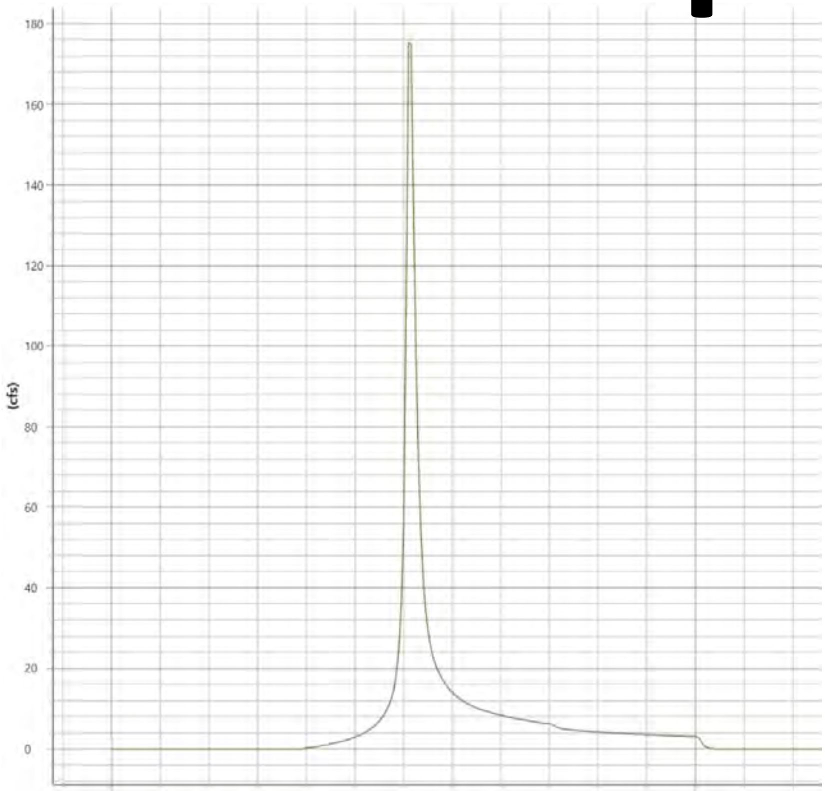
Model Domains	Subdivided 2D Modeling Areas	Area (ac)
Model Area 1	Model 1A Lower Fox	325,254
	Model 1B Upper Fox	395,228
Model Area 2	Model 2 Kankakee	236,257
Model Area 3	Model 3A Chicago South	190,758
	Model 3B Chicago North	171,543
Model Area 4	Model 4A Lower Des Plaines	619,107
	Model 4B Upper Des Plaines	319,685
Model Area 5	Model 5 Lake Michigan	63,285
Model Area 6	Model 6 Kishwaukee	283,774

Developing more manageable modeling areas

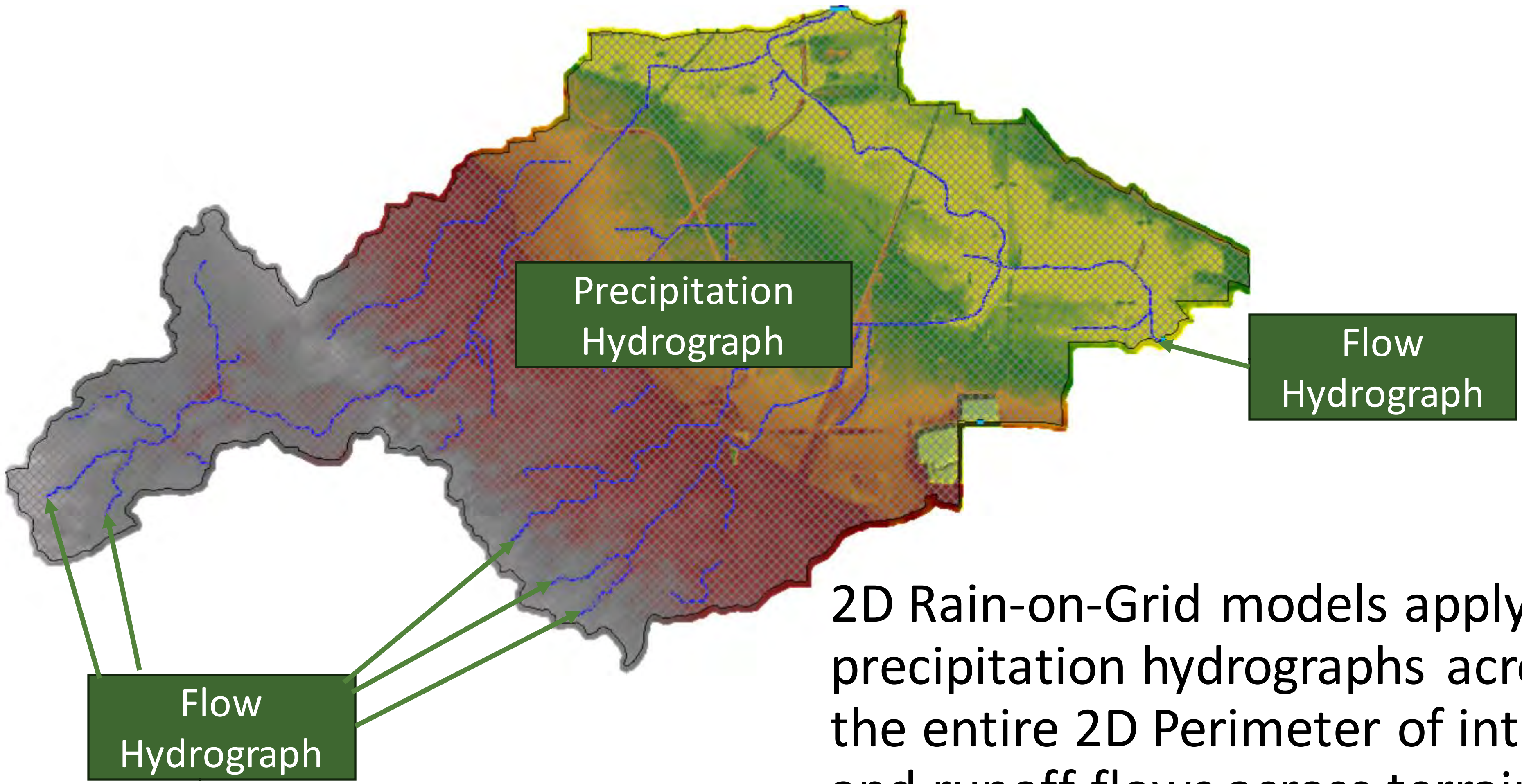


Building the model – model inputs

Scenario	100-year Rainfall Depth (in)	500-year Rainfall Depth (in)
Existing Condition	8.57	11.24
2050 RPC 8.5	9.10	11.93



2D Riverine Models apply boundary conditions with flow hydrographs for defined riverine systems



2D Rain-on-Grid models apply precipitation hydrographs across the entire 2D Perimeter of interest and runoff flows across terrain

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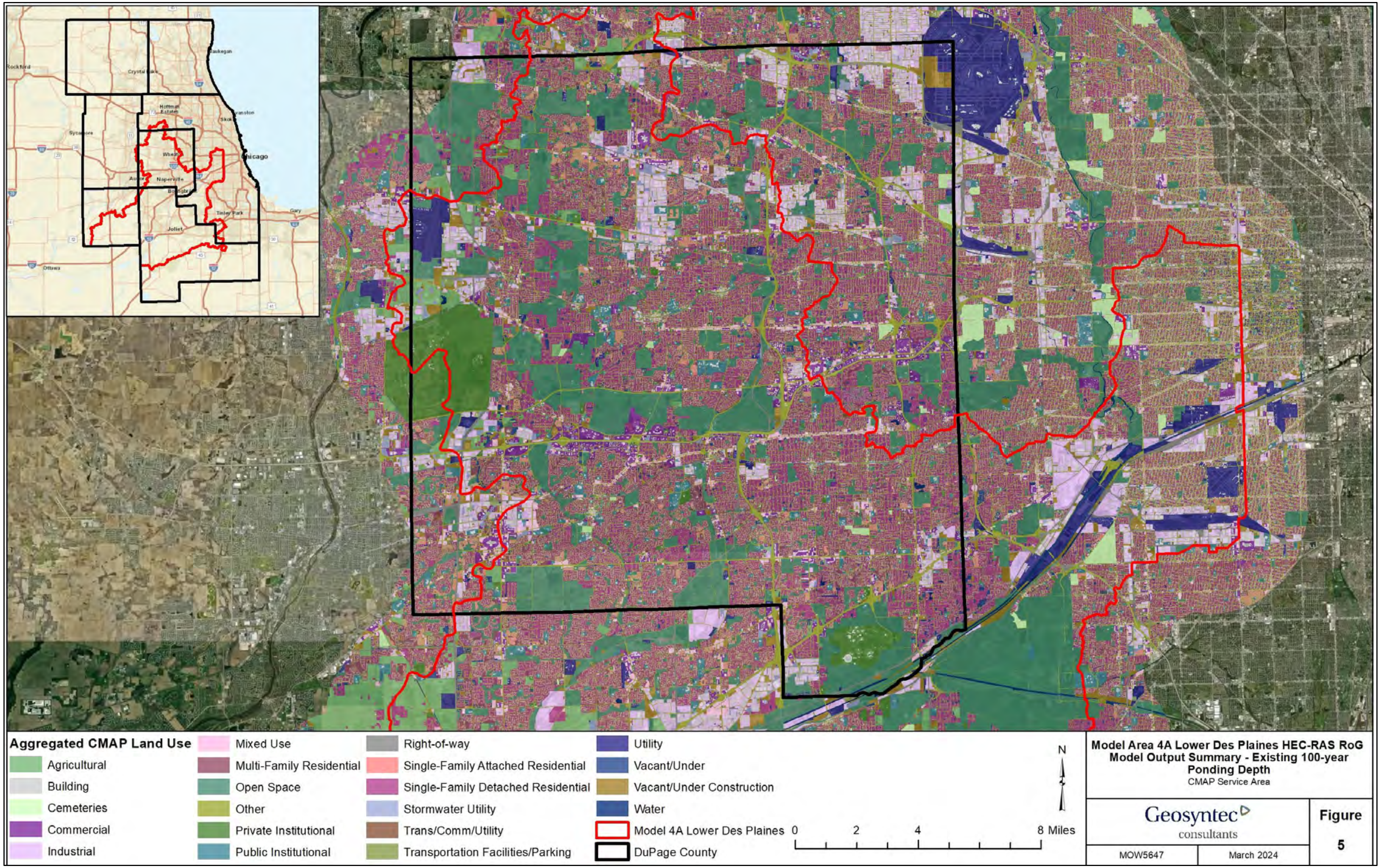
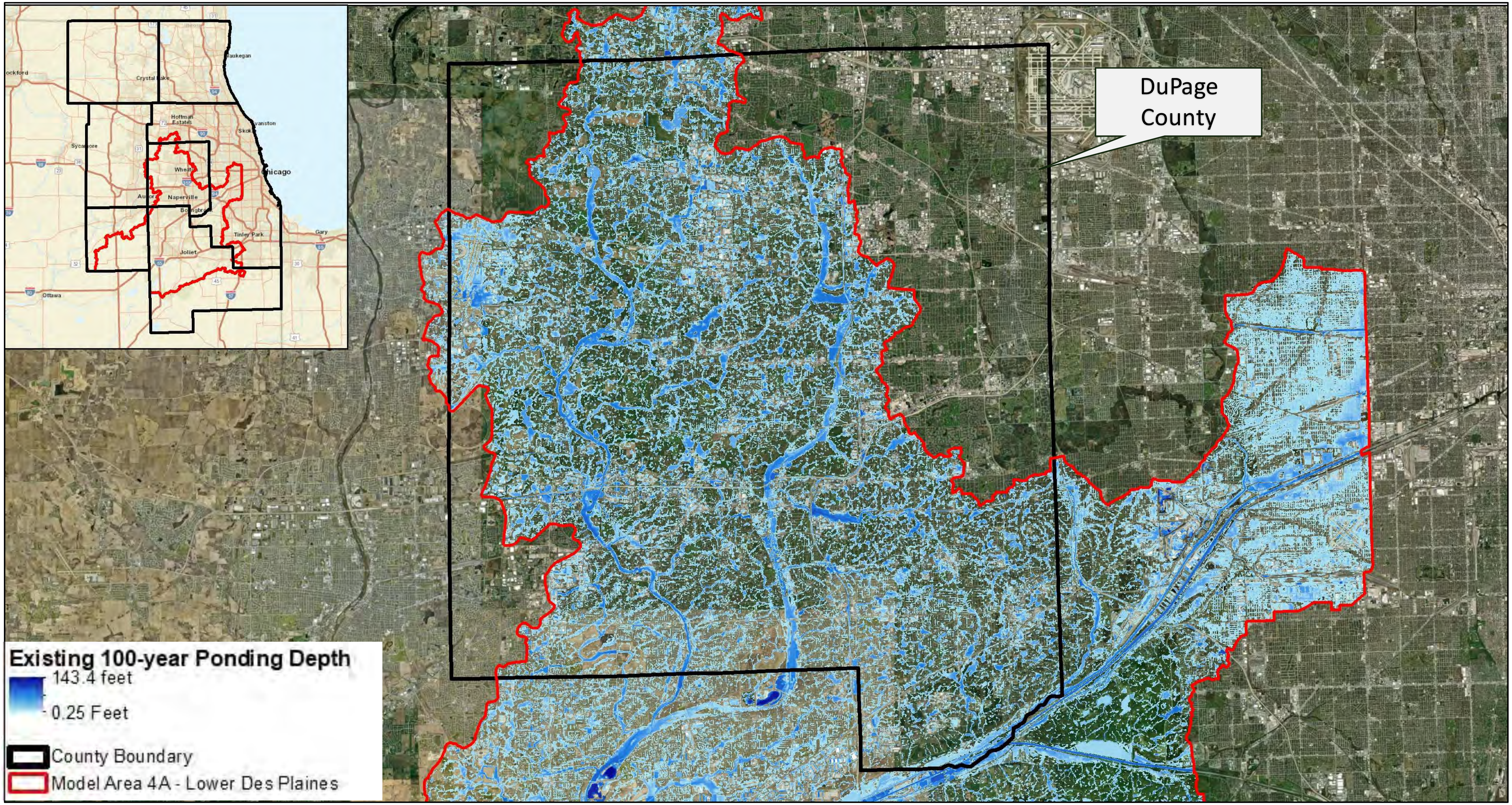
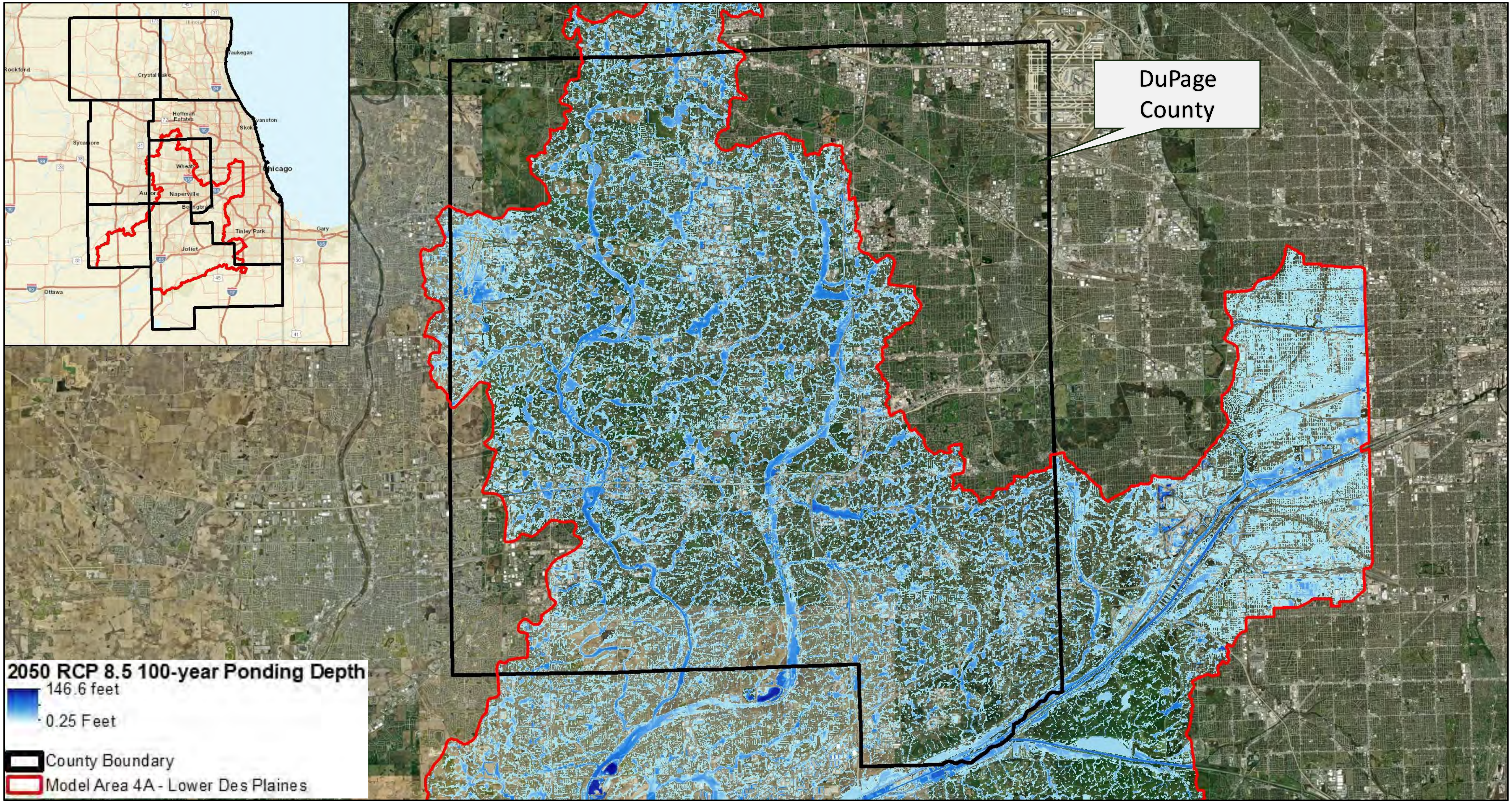
Building the model - land cover and infiltration



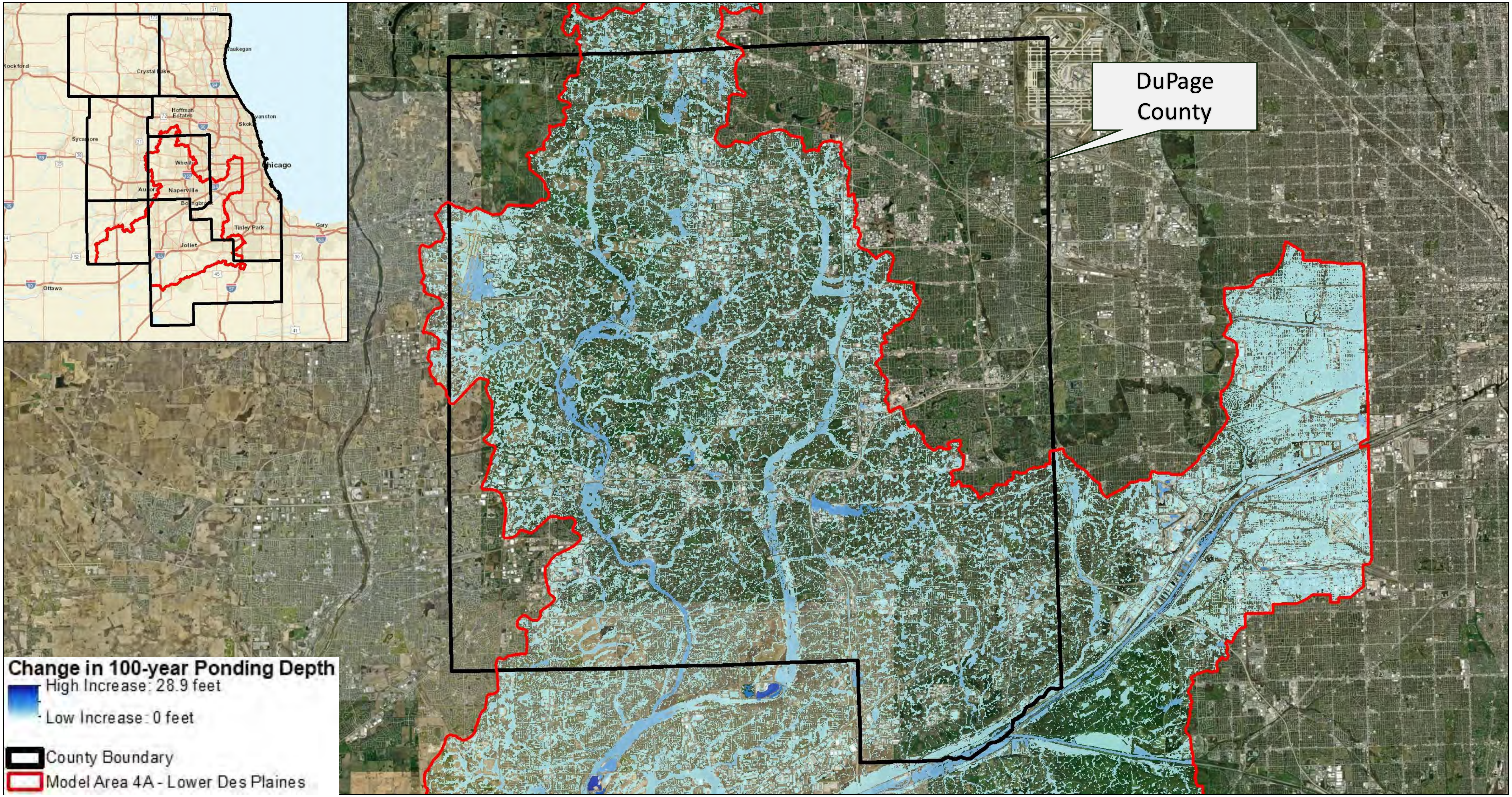
Modeled existing 100-year (max depth)



Modeled climate change RCP 8.5 100-year (max depth)



Potential flooding impacts on infrastructure

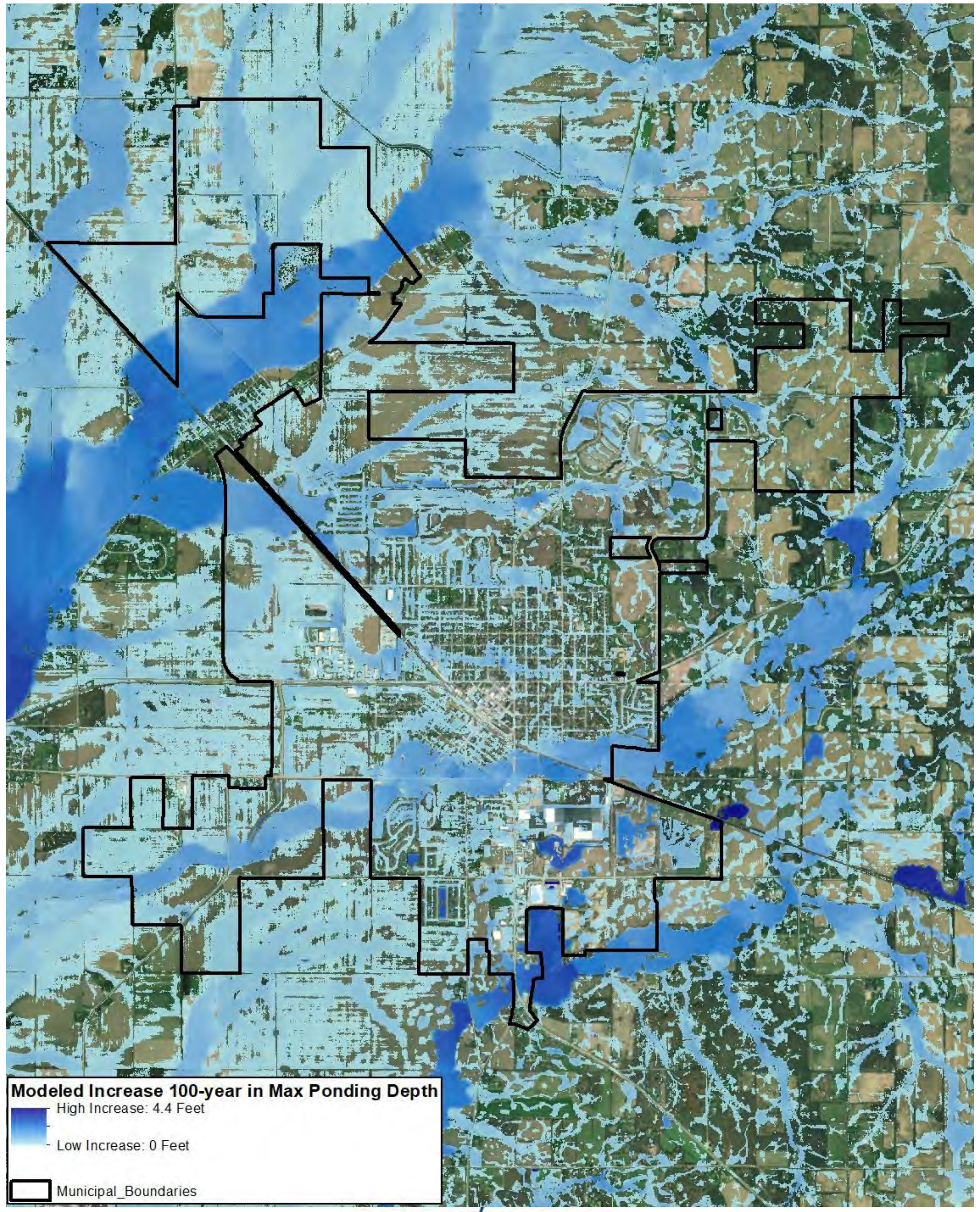


Limitations of model and areas for improvement

Terrain – model terrain was not hydraulically corrected (i.e., streams were not burned into the DEM and sinks were not filled)

Complex waterways – hydraulic structures (bridges and culverts) were not modeled within the riverine system

Sewer system capacities – modeling analysis did not include existing separate and combined sewer system infrastructure



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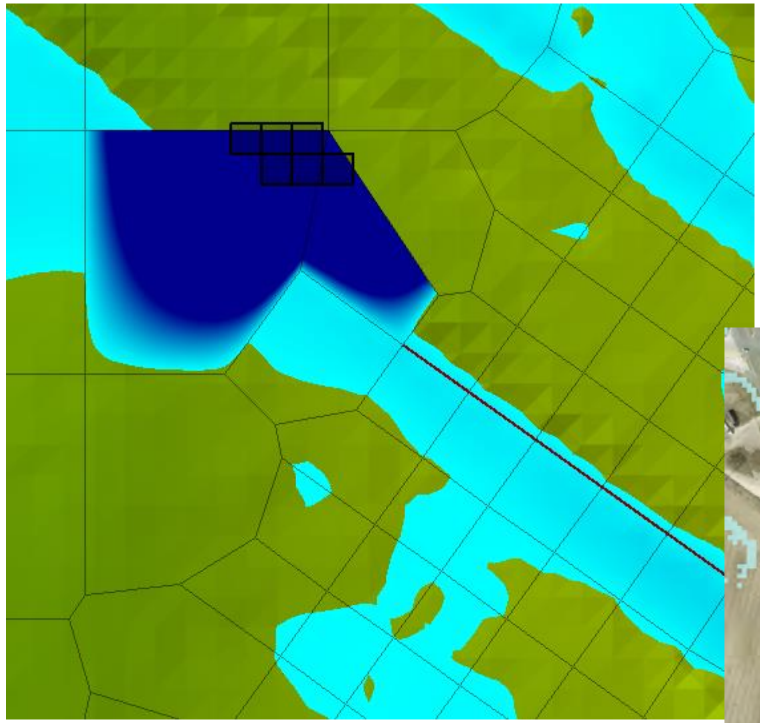

Isolated model instability – isolated instances across the modeling area where the sudden tranition from later 2D mesh cell sizes to smaller sizes causes higher-than-expected waters depths based on the number of faces for the given cell

Model boundaries and major tributaries – model boundaries and major tributaries were cut at county and state boundaries where the HUC boundary cross the 7-county region

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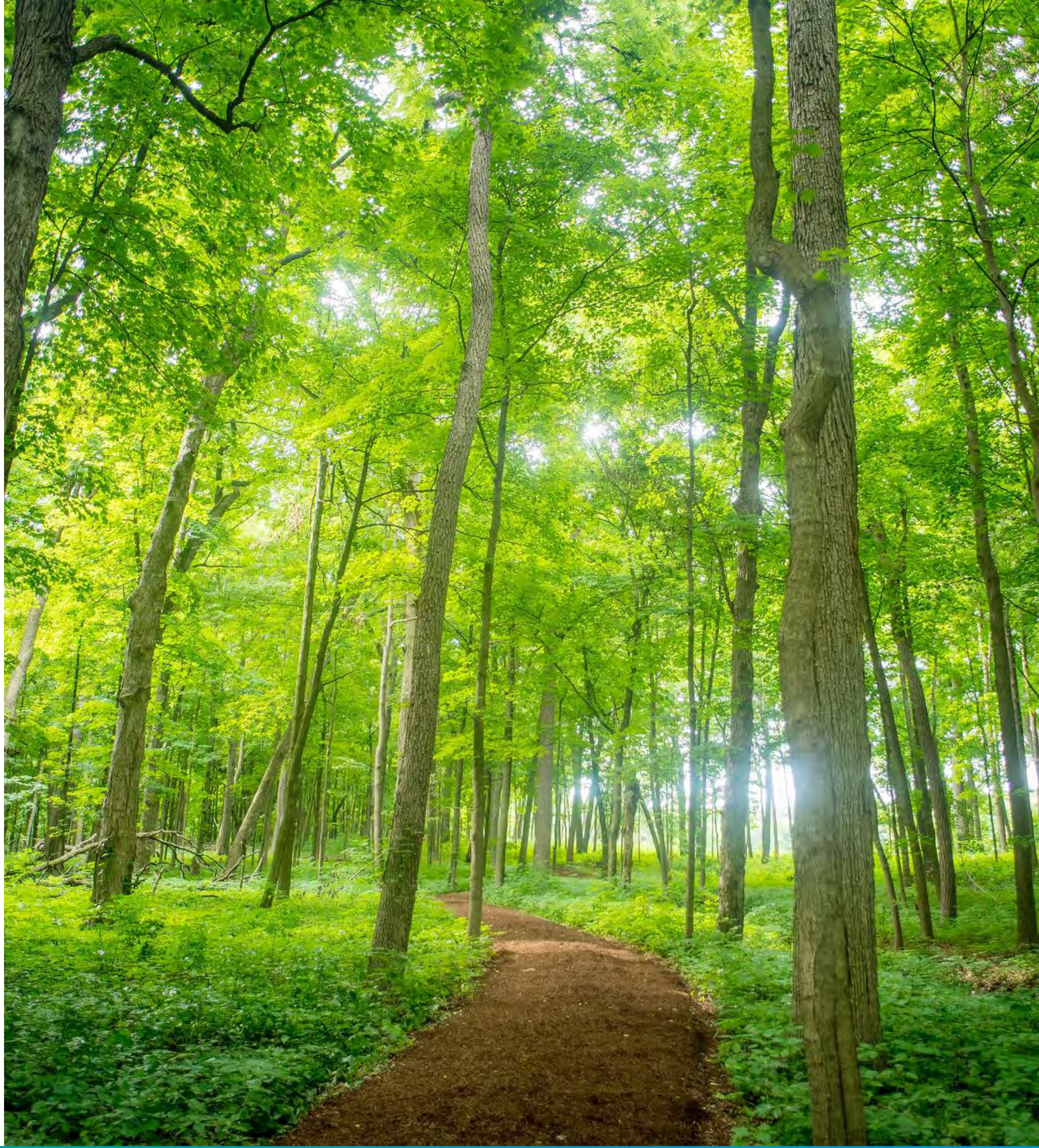
Looking ahead

Data

- Publish risk scores (Summer 2024)
- AGOL dashboard and/or StoryMap (TBD)
- Explore use of flood analysis data for planning efforts

Coordination

- Increase resilience benefits of transportation improvements
- Collaborate on funding opportunities



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Thank you

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