

AI in Action - Enhancing Hamilton County's Mapping and Geospatial Initiatives



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An aerial, artistic rendering of a city and rural landscape. The top right shows a modern city with skyscrapers. The top left shows a rural landscape with fields and a winding road. The bottom half shows a historical scene with a large bell, a steam engine, and other vintage machinery. A laptop is overlaid in the center, displaying a map and a color wheel. The text is overlaid on the image.

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All **Title Slides and Images** generated by ChatGPT and DALL-E from the Hamilton County 2024 Project Planning Document

About Hamilton County, Indiana

- Located in Indianapolis Metropolitan Statistical Area.
- Population: 347,467 (2020 Census).
- Fastest growing county in Indiana, 10th nationally.
- Strong local government support for economic development.
- Home to four of Indiana's largest cities: Carmel, Fishers, Noblesville, and Westfield.



Charting Hamilton County's Mapping Evolution

Analog Mapping

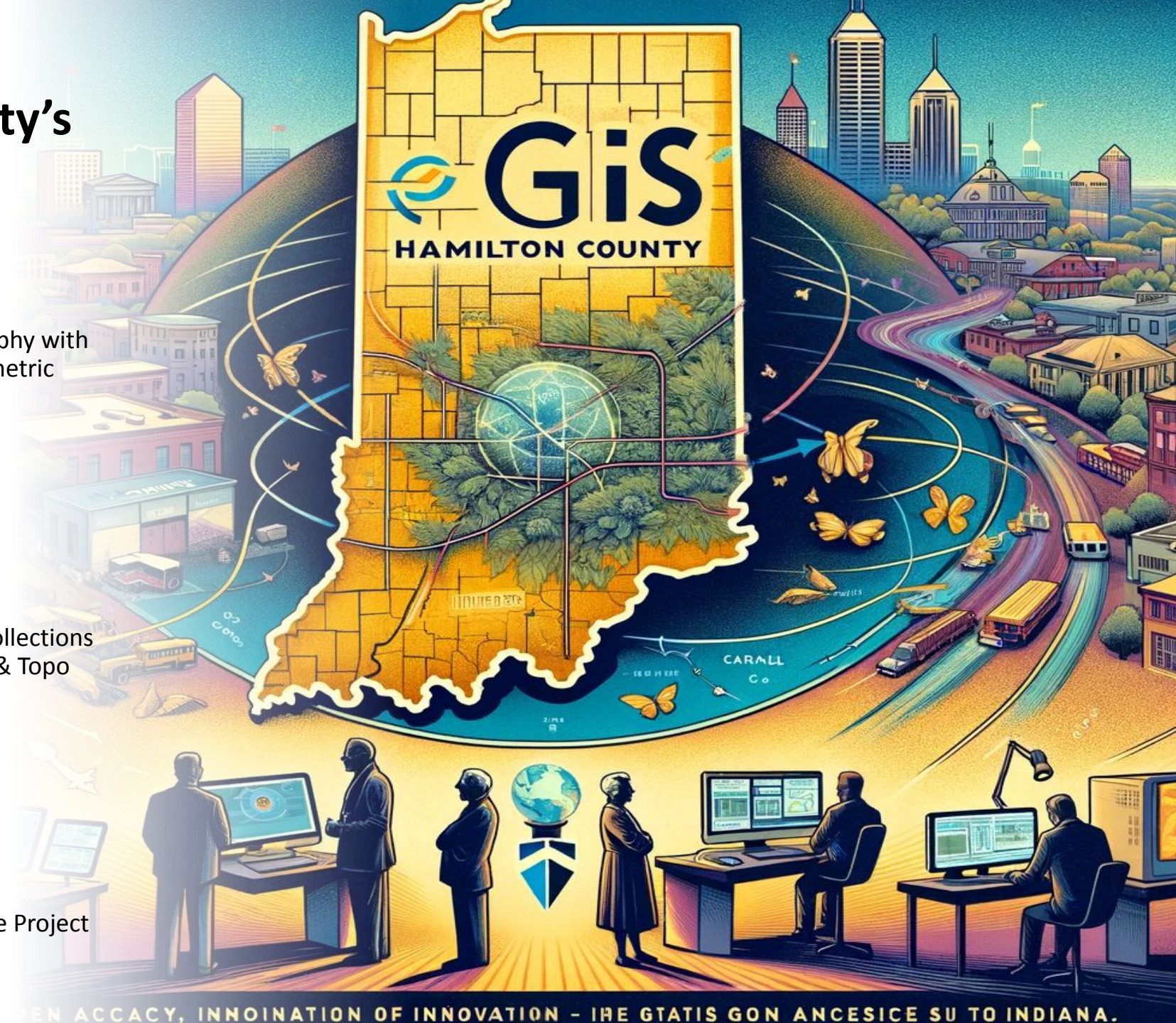
- **1996 – 2001** Film-based Aerial Photography with Planimetric and Topographic Photogrammetric Updates

Digital Mapping

- **2004** – Original Lidar Acquisition
- **2005** – Original 6" inch Orthos Acquired
- **2006 thru 2023** - Annual Digital Ortho collections with Quadrennial Photogrammetric Plan & Topo updates
- **2017** – 3' inch Digital Orthoimagery Buy-up

GeoAI

- **2024** - Ortho-Lidar and Basemap Update Project



2024 Orthophotography and Lidar Basemap Project

- Upgrade overall base mapping accuracy from 1"=100' scale to 1"=50' scale
- Acquisition of 3-inch pixel 4-band Orthoimagery
- Acquisition of 3DEP QL1 Lidar data
- Generate AI/ML-driven Planimetric 2D & 3D Land Cover Mapping from 3-inch orthos
- Generate 3D Elevation-Derived Hydrography from QL1 Lidar



2024 Project Team



Dewberry Engineering:
Prime contractor for
the 2024 project.



Ecopia: Subcontractor
for AI/ML Landcover
data layers.



Phil Worrall: GIS
Project Consultant

Dewberry Engineering's Role

<https://www.dewberry.com/services/geospatial-mapping-and-survey>



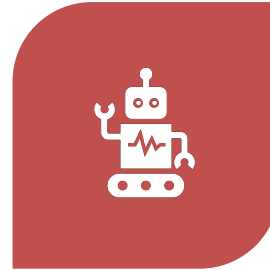
Prime contractor for the 2024 project.

Experience with large-scale geospatial projects.

Expertise in: Orthoimagery, 3DEP Lidar Data, and 3D Hydrography Data Development

Ecopia's Innovative Contributions

<https://www.ecopiatech.com/>



AI/ML TECHNOLOGY
FOR LANDCOVER
DATA.

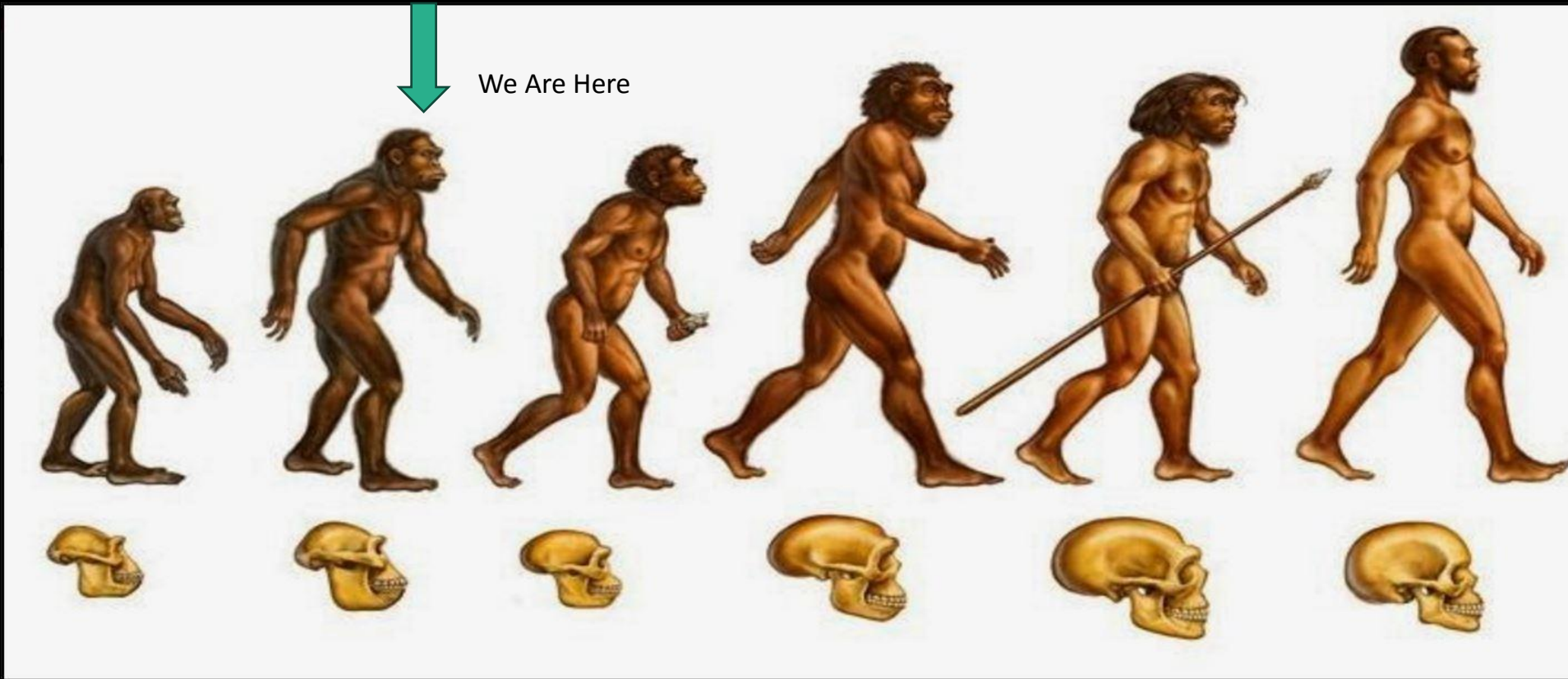


AUTOMATED FEATURE
EXTRACTION FROM
IMAGERY.



SCALABLE SOLUTIONS
FOR LARGE AREAS.

The Evolution of AI in Geospatial (**GeoAI**)



GeoAI Integrated into Hamilton County's GIS

- **Digital Photogrammetry** – Aerotriangulation, Auto-Correlation, Imagery Analysis, etc...
- **AI/ML** - AI/ML Land Cover Mapping versus Manual Digital Photogrammetry Planimetric Mapping
- **LLMs and GPTs** – Hamilton County GeoHUB Custom GPT BETA

Digital Photogrammetry – Aerotriangulation, Auto-Correlation, Imagery Analysis, etc...

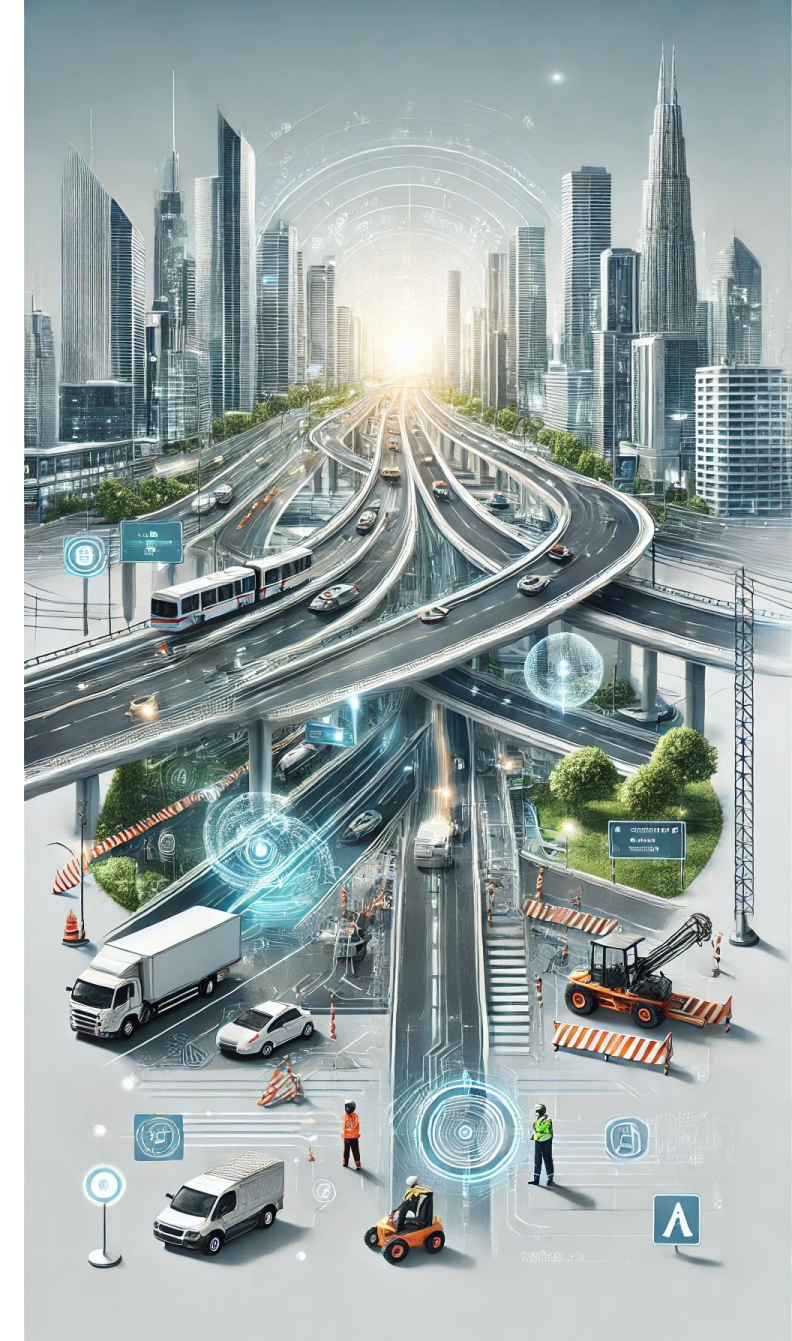
- AI is already entrenched into digital photogrammetry - Computer Vision and Pattern Recognition techniques supported by AI Machine Learning and Deep Learning training
- Today, these photogrammetric data processing pipeline consistently solves several problems (1) geometric processing, (2) object labeling, (3) topology reconstruction and (4) change detection, but there is much more to do, and ...

...While many components of the photogrammetric data processing pipeline already work automatically, **there is still substantial manual involvement required to obtain reliable, high-quality, and cost-effective results.**



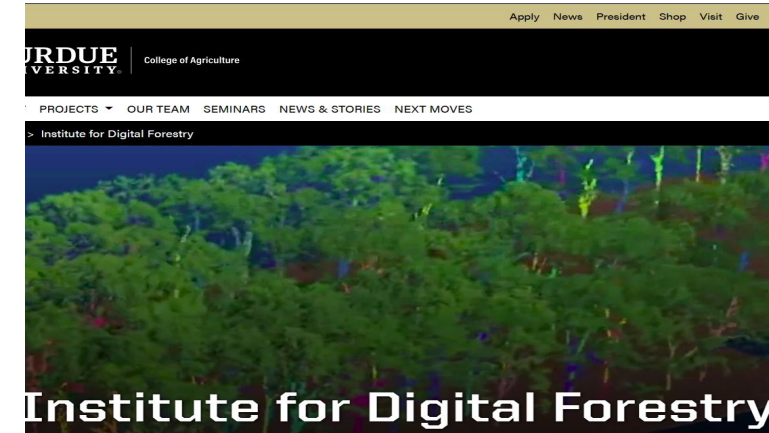
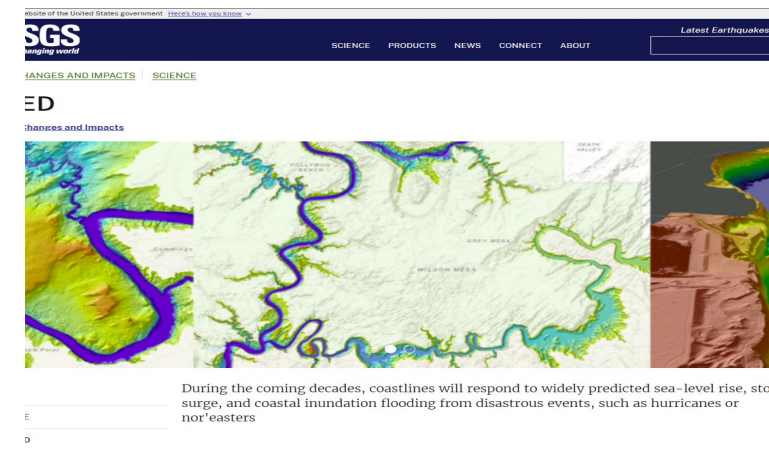
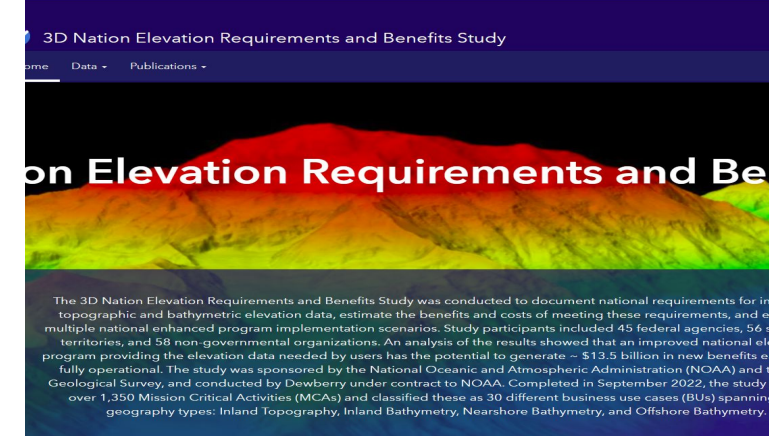
Orthoimagery Data Applications

- ChatGPT Prompt – “**What are some examples of how states are utilizing aerial imagery that they collect? Can you site the states that are doing these activities?**”
- Change Detection
 - **CA** : Point-in-time homelessness count over X # of years
 - **AK** : Where is development displacing agricultural economies?
- Environmental Monitoring
 - **WA** Dept of Ecology: Detection of Pollution sources
- Transportation Planning
 - **IL**: road network planning, traffic management, and infrastructure maintenance



Lidar Data Applications

- 3D Nation Elevation Requirements and Benefits Study [[LINK](#)]
- Some good ones (Mission Critical Activities):
 - Coastal and Stream erosion and inundation
 - Alternate energy siting and development
 - Drainage assessment and water monitoring
 - Forest inventory analysis
 - Open mine volume computations / stockpile analysis



AI/ML Land Cover Mapping

- Automated extraction of 2D and 3D features
- Integration with Orthoimagery and Lidar data

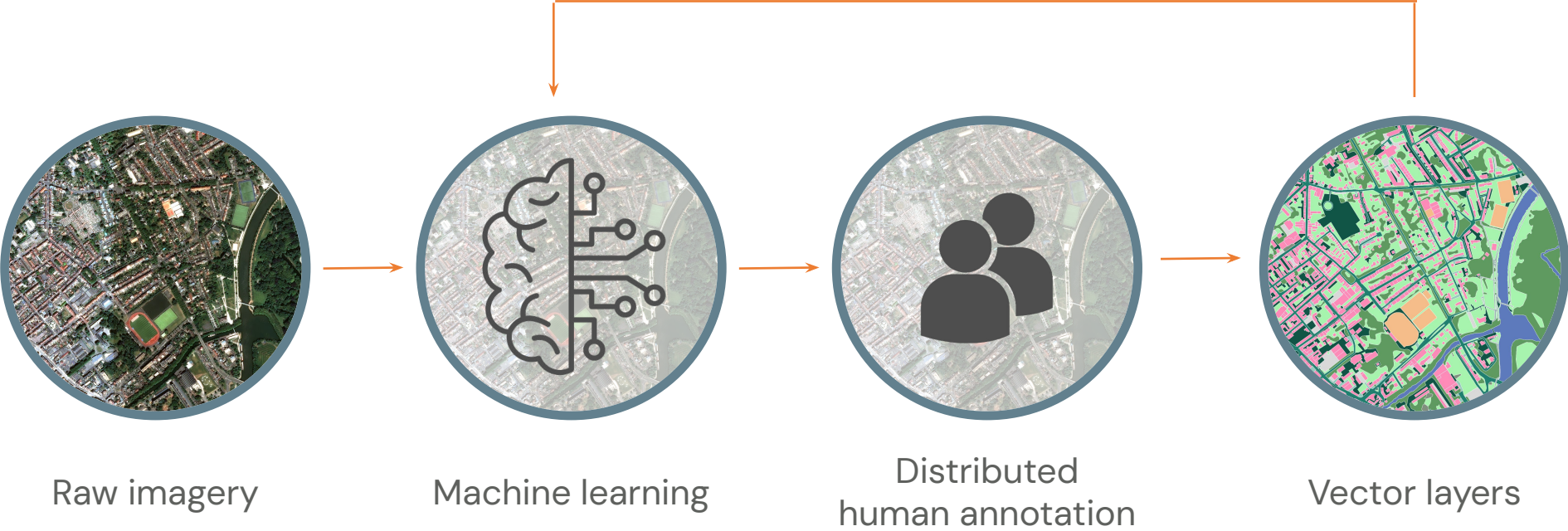
Applications:

- Urban and Environmental planning
- Risk Assessment & Vulnerability Mapping
- Stormwater Infrastructure Planning & Design
- Emergency Response & Preparedness
- Natural Resource Management
- Community Engagement & Awareness

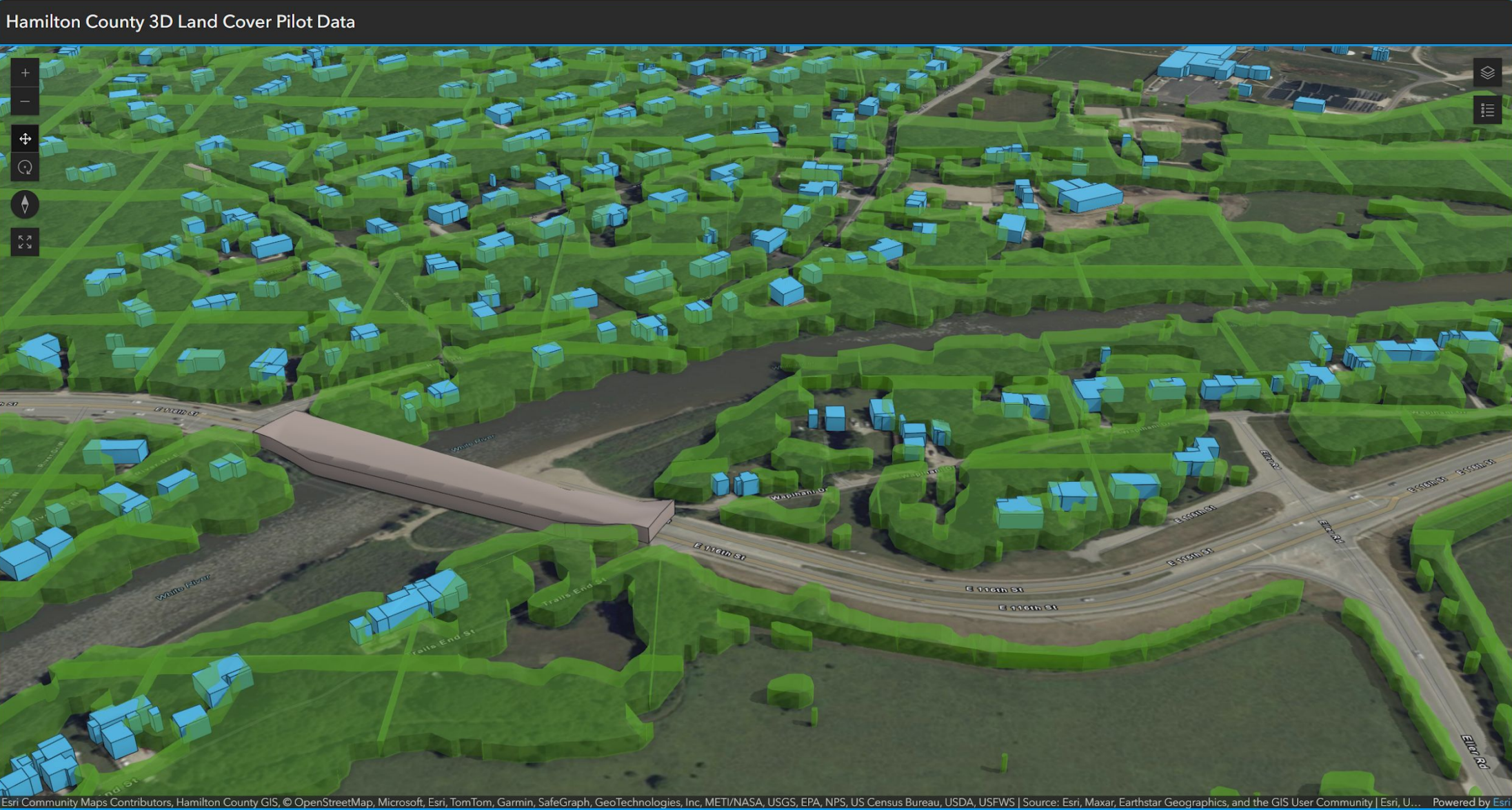


Ecopia's core AI technology is the heart of this process

A distributed, highly scalable, accurate system



AI/ML Land Cover Mapping



Elevation-Derived Hydrography (EDH) Development Process for Hamilton County

+

3D National Topography Model (3DNTM)

Integrates elevation and hydrography datasets to model the Nation's topography in 3D



3D Hydrography Program (3DHP)

- Hydrography derived from/integrated with 3D Elevation Program data
- Connections to groundwater, wetlands, and engineered hydrography
- 3DHP Infostructure for data sharing as part of the Internet of Water

Next Gen 3D Elevation Program (3DEP)

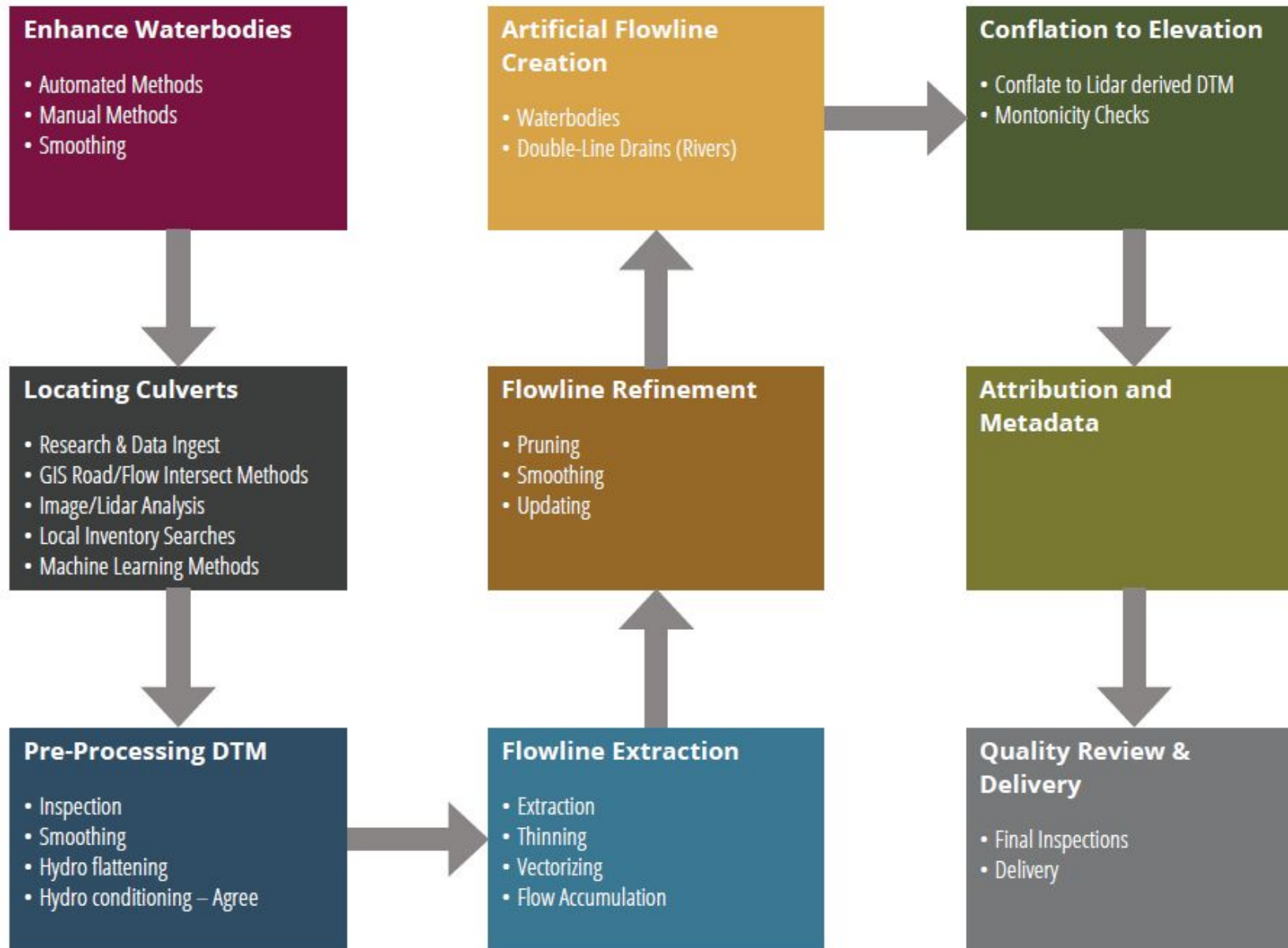
- New quality levels and refresh cycles
- Integration of inland bathymetry
- 3DEP Ecosystem for data and resource sharing
- Continual improvement with new technologies and approaches

Future Integrated 3D Model

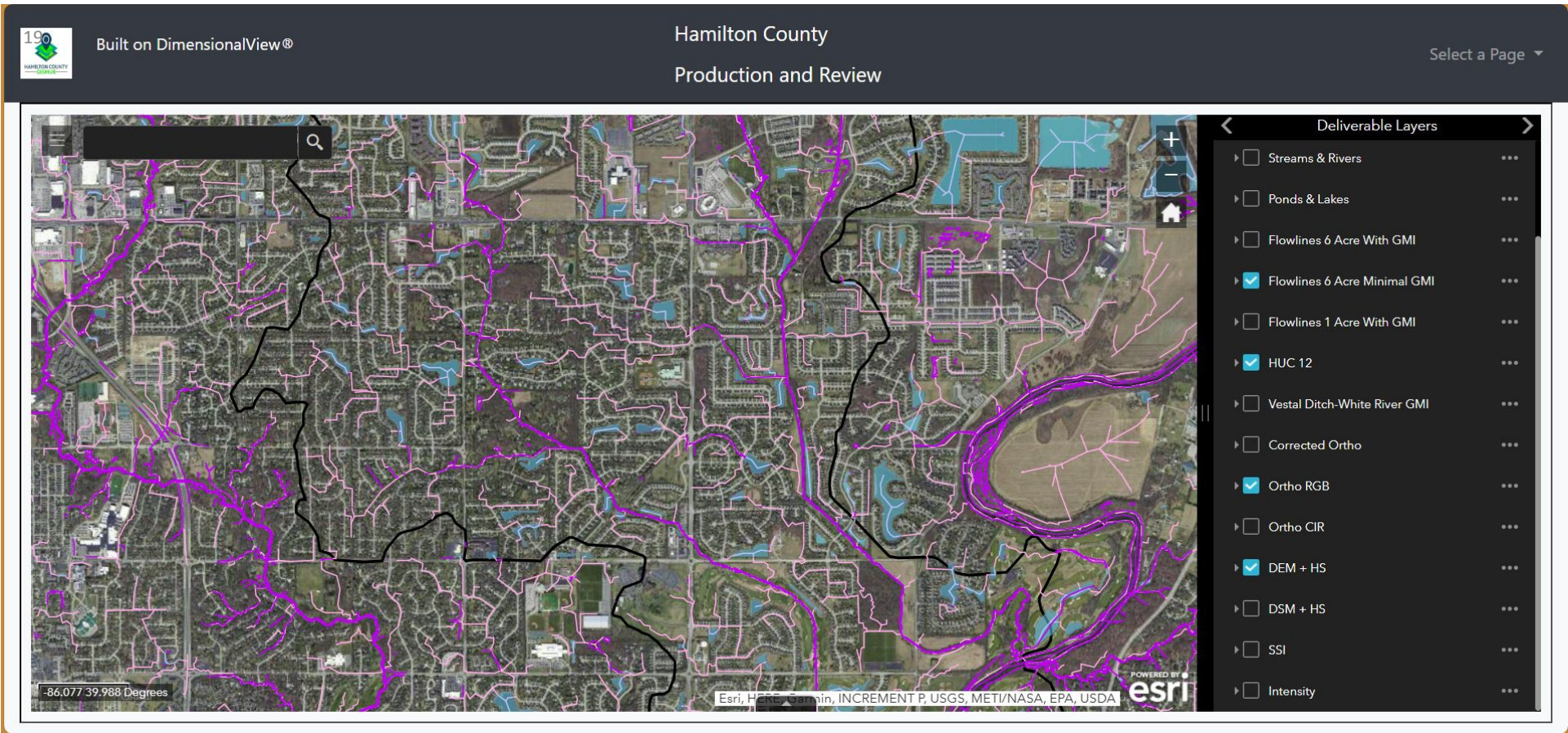
- Research and develop a 3D data model to fully integrate 3DHP and next gen 3DEP
- Integrate other data from The National Map



Elevation-Derived Hydrography (EDH) Development Process for Hamilton County



Elevation-Derived Hydrography (EDH) Development Process for Hamilton County



Key Applications: Flood management, environmental protection, resource management.

Impact of Improved Data: 100% horizontally and vertically integrated 3D Elevation and Hydro Data to support better modeling, decision-making and resource allocation.

The Future: Planning for continuous GIS data and application improvements



- **The 2025 Update Project**
 - participate in the IGIO's Statewide Ortho- & Lidar Data Collection program.
 - 2021-2024 AI/ML Change Detection
- **Continuing the AI Journey**
 - LLM & GPT Integration with Hamilton County GeoHUB
- **Digital Twins, and more**

AI/ML Land Cover Change Detection



Continuing the AI Journey - LLMs and GPTs

How AI can transform raw geospatial data into actionable insights:

- Prompts to interactive geoprocessing “OpenAI’s Data Analyst GPT”

How AI can support geospatial decision-making:

- Custom GPT to support “Hamilton County GeoNavigator”
- Directly Integrated GPT into Esri HUB “HUB Assistant EAP”

Open AI Chat GPT – Custom GPT

Expert Advisor that provides authoritative data information, geospatial support and guidance for using the Hamilton County GeoHUB.

Hamilton County GeoNavigator

What are the main geospatial data resources you support?

The main geospatial data resources supported in Hamilton County include several advanced datasets critical for diverse applications such as emergency management, urban planning, environmental monitoring, and infrastructure development. Here's a summary of the primary datasets available:

- Orthophotography:** High-resolution, 4-band (RGB and Near-Infrared) digital orthoimagery at a 3-inch pixel resolution. This dataset supports urban planning, emergency response, environmental monitoring, and tax assessment.
- Lidar Data:** Hamilton County utilizes Quality-Level 1 (QL1) 3DEP lidar with 8 points per square meter, essential for flood risk management, topographic mapping, and 3D modeling. It includes 1-foot contour lines and detailed terrain models.
- Planimetric and AI/ML-Derived Land Cover Features:** Using AI-driven methods, Hamilton County provides detailed 2D and 3D land cover layers. These include height-attributed buildings, roads, vegetation, and impervious surfaces, valuable for urban design, environmental conservation, and infrastructure management.
- Elevation-Derived Hydrography (EDH):** This 3D hydrography dataset, derived from lidar data, maps water bodies, stream networks, and watershed boundaries. It aids in water resource management, stormwater planning, and flood control.
- Dynamic Elevation Data Services:** Through the USGS 3DEP and other REST services, Hamilton County supports on-demand elevation data access for flexible, up-to-date terrain analysis, enhancing projects in urban planning, hazard assessment, and environmental studies.

These datasets form the backbone of Hamilton County's geospatial resources, enhancing decision-making in government operations and community services by offering precise, multi-purpose geospatial insights across the county.

What are the key uses of Lidar? How is AI used in mapping here?

Message Hamilton County GeoNavigator

ChatGPT can make mistakes. Check important info.

Open AI Chat GPT – Custom GPT

Expert Advisor that provides authoritative data information, geospatial support and guidance for using the Hamilton County GeoHUB.

Hamilton County GeoNavigator



This will display the park boundaries for Hamilton County, allowing you to analyze and interact with the spatial data for parks

display it



Here is the map of Hamilton County, Indiana, highlighting the park boundaries. The parks are outlined and shaded against a base map showing roads and geographical features, providing a clear view of the designated recreational areas across the county.

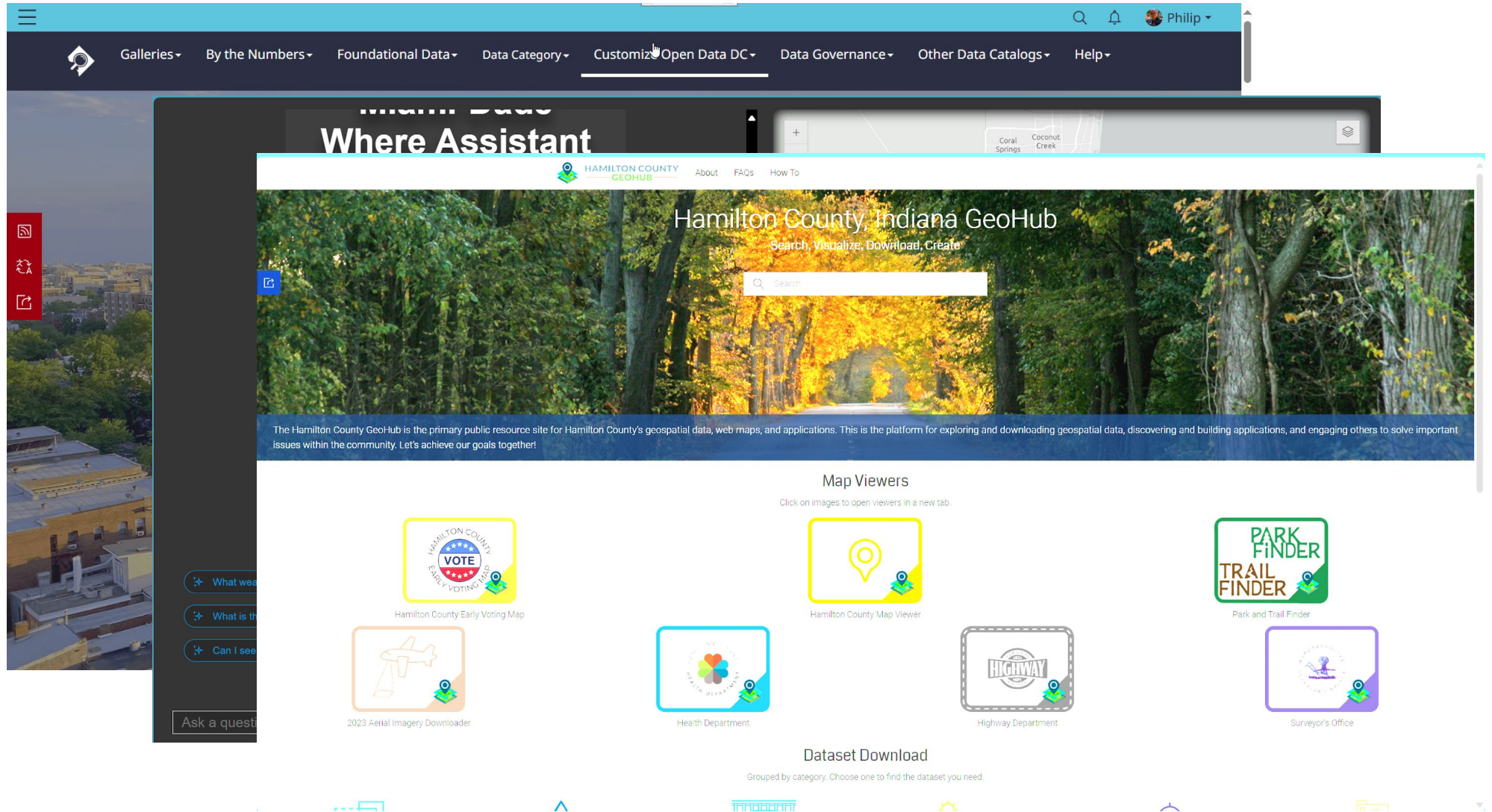


Message Hamilton County GeoNavigator



Esri HUB Assistant Early Adopter Program

AI Assistant to answer questions to Open Data on Esri HUB Site



Esri HUB Assistant Early Adopter Program

AI Assistant to answer questions to Open Data on Esri HUB Site

The screenshot shows the Esri HUB Assistant interface. At the top, there is a navigation bar with a search icon, a notification bell, and a user profile for Philip. Below the navigation bar, there are several menu items: Galleries, By the Numbers, Foundational Data, Data Category, Customize Open Data DC, Data Governance, Other Data Catalogs, and Help. A banner below the navigation bar states: "DC Compass is currently a pilot in public beta and provides answers related to publicly available information on Open Data DC. Visit [Understanding DC Compass](#) for what to expect." Below the banner is a red button that says "What can I request?".

The main content area is titled "DC Compass AI Assistant (beta)". It features a blue button that says "Display parks within a half mile of the White House". Below the button, there is a text box that reads: "Here are the parks within a half mile of the White House: 1. Triangle - Pennsylvania Ave., Between 19th & H sts., NW 2. Triangle - Pennsylvania Ave., Between 18th & H Sts., NW 3. Farragut Square - 17th St., Between I & K Sts., NW 4. Lafayette Square - Pennsylvania Ave. to H St. and Jackson to Madison Pl. 5. Mcpherson Square - 15th St., Between I & K Sts., NW You can explore the National Parks dataset [here](#)." Below the text box is a map showing the area around the White House in Washington, D.C., with several parks highlighted in green.

To the right of the text box is a map of the District of Columbia area, showing the White House and surrounding streets. Below the map is a table titled "National Parks (Total: 457 | Selection: 0)". The table has the following columns: Name, Address, Alpha Code, and Park Co. The table contains the following data:

Name	Address	Alpha Code	Park Co
Beach Parkway	DC Line, Between East & ...	ROCR	821
North Portal	16th St., between North Po...	ROCR	821
Rock Creek Park & Piney B...	Klinge Rd. To DC Line, We...	ROCR	821
Piney Branch Portal	Piney Branch Rd. & Easter...	ROCR	892
Pinehurst Parkway	Pinehurst Circle To Rock C...	ROCR	859

Questions?



Thank You!

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