Indiana Office of Technology Geographic Information Office

2021 - 2024 Indiana Orthoimagery Program – Overview and Buy-ups

January 7, 2022  11:00 pm EST

Shaun Scholer - Point of Contact, (POC)  
GIS Program Director

Megan Compton, MPA  
Indiana Geographic Information Officer

Shawn Benham, PMP  
Project Manager

Brad Arshat, CP, EIT  
Director, Strategic Accounts
Indiana Statewide Programs

- **2021-2024 Ortho – 6”**
- 2016-2019 Ortho – 1’
- 2011-2014 Ortho – 1’
- 2005-2006 Ortho - 1’
Indiana Statewide Program Management

- Administered through Indiana Geographic Information Office (GIO)

ALL Inquires

Shaun Scholer
Indiana Geographic Information Office

Sanborn
Indiana Statewide Program - Funding

• Indiana Office of Technology (IOT)
• Indiana Department of Transportation (INDOT)
• Additional Partnerships
Indiana Statewide Program - Specification

- **Base Products**
  - 6-inch (15-cm) Pixel Resolution
  - Tile 4 -Band (R,G,B, NIR) Imagery
    - GeoTIFF Uncompressed
    - ECW & MrSID compressed
  - County Mosaic MrSID 3-Band
Project Planning

• Sanborn - Flight Analyst
  • Project Layout
  • Track Daily Progress
Tier I Flight Capture
February 25th – April 13th
Boots on the Ground

- DNR Employees
- GIS Vendor Employee
- County GIS Managers
- County 911 Director
- County IT Director
Orthophotography QC
INDOT Aerial Surveys Team

• Eric Banschbach
• Jennifer Waymon
• Jonathan Schiemann
• Mark Shambaugh
Imagery QC
Additional Review
Surveyed Orthophoto Photo Identifiable Points

- Edge of pavement
- Well defined sidewalk corners
- Well defined pavement markings
Indiana Statewide Program – Distribution

- Sanborn FTP Service
- Survey followed with instructions on how to login and download imagery.
Indiana Statewide Program – Products

File Structure

- Orange_County
- Checklist
- Indexes
- Metadata
- Mosaic_MrSID_SPW_IN
- Tiled_ECW_SPW_IN
- Tiled_MrSID_SPW_IN
- Tiled_TIFF_SPW_IN

Checklist

<table>
<thead>
<tr>
<th>General Quality Checks</th>
<th>Yes</th>
<th>No</th>
<th>Comments</th>
</tr>
</thead>
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<tr>
<td>Do the deliverable files match the specifications in Table 1?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the projection information correct?</td>
<td></td>
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<tr>
<td>NAD_1983_H appropriated Indiana West_FIPS_1302_Feet</td>
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<td>Do the files display correctly and in the correct projection?</td>
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<td>Does the delivery contain the correct number of files?</td>
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<tr>
<td>Tiled GeoTIFF: 2019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiled ECW: 2019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiled MrSID: 2018</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Does the image name attribute match the Tile Index?</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Are the geotiff files the correct size?</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Is the ISO 9001 2015 Quality Review Form complete?</td>
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</table>

All Compressed products are compressed at 20:1 (nearly lossless)

Image tile grid & Photo centers with date stamp
Sanborn Company Overview

• Founded in 1866
• Full service, dedicated geospatial solution provider
• 125 employees in 4 locations nationwide
• Quality-oriented company and culture
  – Corporate Quality Management System derived from ISO principles
### Chronology of Service Offerings

<table>
<thead>
<tr>
<th>Service</th>
<th>Offered Since</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Surveys</td>
<td>1866</td>
</tr>
<tr>
<td>Aerial Photography</td>
<td>1966</td>
</tr>
<tr>
<td>Photogrammetric Mapping</td>
<td>1966</td>
</tr>
<tr>
<td>Digital Photogrammetric Mapping</td>
<td>1979</td>
</tr>
<tr>
<td>Digital Terrain Modeling</td>
<td>1984</td>
</tr>
<tr>
<td>Digital Orthophotography</td>
<td>1988</td>
</tr>
<tr>
<td>Lidar</td>
<td>1998</td>
</tr>
<tr>
<td>Digital Vertical Aerial Imagery</td>
<td>2004</td>
</tr>
<tr>
<td>Digital Oblique Aerial Imagery</td>
<td>2011</td>
</tr>
<tr>
<td>UAS Operations</td>
<td>2013</td>
</tr>
<tr>
<td>HD Mapping</td>
<td>2014</td>
</tr>
<tr>
<td>24 Hour Emergency Response</td>
<td>2016</td>
</tr>
<tr>
<td>Large Area UAS Processing</td>
<td>2017</td>
</tr>
<tr>
<td>Proprietary Oblique Camera</td>
<td>2018</td>
</tr>
</tbody>
</table>

### Recent State-Level Mapping Programs
- New York
- Virginia
- Maryland
- Connecticut
- Michigan
- Arkansas
- North Carolina
- Louisiana
- Vermont
Sanborn Overview – Comprehensive Geospatial Solutions

- **Data Map Production**
  - LiDAR, Digital Oblique & Orthoimagery, Photogrammetric, Topographical Maps

- **Value-Added Services**
  - Land use and land cover analyses
  - Change detection
  - Other imagery analysis services/viewers

- **Decision Support Systems**
  - Wildfire Management
  - Forestry and Ecosystem Management
  - Emergency Response

- **Visualization Systems**
  - 2D
  - 3D
  - Prism 4D
  - Common Operating Picture

- **Software Applications**
  - GIS Software Development
  - Cloud Services
  - Portals and Distribution Tools
2021 Program Overview

- Central portion of Indiana
- Total Project Area ~ 11,783 mi²
- 6-inch spatial resolution
- 4-band RGBN, 8-bits per channel
- Accuracy of 2-pixels (12-inches) RMSE, 29-inches at 95% confidence
- Geo-referencing - Indiana State Plane East or West zone: NAD83/HARN, US Survey Feet (EPSG Codes 2967 [east] or 2968 [west])
- Tiled and County-area delivery
- Spring, snow-free, flood-free, leaf-off conditions
Imagery Acquisition

**Draft Imagery Acquisition Specifications**

<table>
<thead>
<tr>
<th></th>
<th>6-inch (15 cm)</th>
</tr>
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<tbody>
<tr>
<td><strong>GSD</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Proposed Sensor</strong></td>
<td>Vexcel Imaging UltraCam Eagle</td>
</tr>
<tr>
<td><strong>Focal Length</strong></td>
<td>100 mm</td>
</tr>
<tr>
<td><strong>Acquisition Altitude</strong></td>
<td>9,464’ AGL</td>
</tr>
<tr>
<td><strong>Aircraft Speed</strong></td>
<td>175 kts</td>
</tr>
<tr>
<td><strong>Std. Side lap</strong></td>
<td>30%*</td>
</tr>
<tr>
<td><strong>Std. End lap</strong></td>
<td>80%*</td>
</tr>
<tr>
<td><strong>Sensor Platform</strong></td>
<td>Multi-Engine Fixed-Wing Aircraft</td>
</tr>
<tr>
<td><strong>Radiometry</strong></td>
<td>4-band, 14-bit per channel RGB/NIR</td>
</tr>
<tr>
<td><strong>Acquisition Date</strong></td>
<td>Spring of each Acquisition Year</td>
</tr>
<tr>
<td><strong>Acquisition Time</strong></td>
<td>~10am – 3pm</td>
</tr>
<tr>
<td><strong>Sun Angle</strong></td>
<td>30 degrees or greater</td>
</tr>
<tr>
<td><strong>Conditions</strong></td>
<td>Snow free, leaf off, no clouds, cloud shadows, or other ground obscuring conditions covering more than 5% of any image. Water bodies within natural banks.</td>
</tr>
</tbody>
</table>

*Areas of dense urban development, or where true or near true orthophotography is required, will be flown at higher overlap (80% forward overlap and 60% side overlap) to minimize radial displacement of buildings and warping of elevated highway structures such as interchanges, bridges, and overpasses. Areas flown at 6-inch spatial resolution or higher will be acquired with minimum 80% forward overlap.*
• Acquisition for the program is based on the Vexcel Imaging UltraCam Eagle digital aerial camera with a 100mm lens system.
• 260 megapixels (20,010 x 13,080 pixel CCD)
• 4-band RGB/NIR collected at 16 bits per channel
• Interfaced to airborne GPS and IMU subsystems for sensor position & orientation
• Gyro-stabilized camera mounts
• 56 aircraft and 7 UltraCam Eagle cameras available through the Sanborn team. Three (3) cameras needed for annual acquisition tiers.
Early Review of Raw Imagery

- Sanborn’s browser-based Image QC™ application provides the ability to review and comment on imagery within 10 days of acquisition.
- Log-in access, as granted by the State

- Imagery is geo-referenced only. No color-balancing or other corrections performed at this point.
- WMTS access also possible
Technical Approach Summary for Orthoimagery

**Source Data Review**
- Flight Planning
- Control Planning
- Existing State control
- Existing State Lidar DEM

**Data Acquisition**
- Ground Control
- UltraCam Eagle Large Format Camera
- RGB/NIR Imagery Acquisition
- AGPS/IMU Support
- "Quick View" client access to raw imagery

**Aerial Triangulation**
- Photo matching
- Rigorous least squares adjustment
- Accuracy Verification
- PILOT PROJECT!

**DEM Preparation**
- Editing/updating of State’s existing LiDAR DEM

**Ortho Rectification**
- Cubic convolution rectification
- Create seam lines
- Correct bridge distortion
- Color balance
- Deliverables and Metadata
- Rigorous QC with review Indiana DOT. Process any needed corrections

**Technical Approach Summary for Orthoimagery**

6-inch 3-inch
Lessons Learned

- Timely availability of quickview imagery aids in decision making for reflights
  - Flooding
  - Snow
- East/West flight line design proved valuable
  - When snow fell in northern areas, collected reflights/other lines in south
- Refinements to QC process will be implemented for Tier 2
  - Continue with delivery by blocks
  - Review common QC calls with staff prior to production
    - Seams through rooflines
    - Pixelation at bridge/road edges
## Annual Projected Milestones

<table>
<thead>
<tr>
<th>Activity</th>
<th>Completion Date</th>
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<tbody>
<tr>
<td>Project Kickoff, Flight/Control Planning Complete</td>
<td>January</td>
</tr>
<tr>
<td>Paneling and/or survey of ground control</td>
<td>February - March</td>
</tr>
<tr>
<td>Imagery Acquisition</td>
<td>Early February - Early March, weather and ground conditions pending</td>
</tr>
<tr>
<td>Imagery Quickview via Image Analyst</td>
<td>Online 10 days from completion of acquisition</td>
</tr>
<tr>
<td>Pilot Product Delivery to State for Review</td>
<td>~May 7</td>
</tr>
<tr>
<td>Imagery Production</td>
<td>May – September</td>
</tr>
<tr>
<td>Orthoimagery Delivery via WMTS, and Online QC Analyst</td>
<td>Complete by September 30</td>
</tr>
<tr>
<td>QC/Review Period per County</td>
<td>30-days from Delivery</td>
</tr>
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</table>
Buy-up Overview

• Options Impacting Spring Airborne Data Acquisition
  – Higher-resolution orthophotography
  – True orthophotography
  – Airborne LiDAR
  – Oblique Imagery

• Options with No Impact to Airborne Data Acquisition
  – Planimetric mapping – New or updating
  – Land cover/land use/impervious surfaces mapping
  – Contours
  – 3D buildings and infrastructure modeling
  – Other derivative data sets
High Resolution Orthophotography

- 3-inch spatial resolution
- 4-band RGB/NIR, 8-bit per channel
- Requires additional flying, control, and enhanced DEM accuracy
- Benefits include:
  - Higher accuracy
  - Ability to see and extract smaller features
  - Ability to support additional applications such as engineering design, traffic & transportation (pavement condition, lane striping, parking studies), utility mapping, vegetation identification, code enforcement, assessment, and logistical planning.
True Orthophotography

- A consideration in urban cores with tall buildings, generally >5 stories
- Orthorectifies buildings, not just the terrain surface – eliminates “building lean”
- In addition to putting each building in true map position, it helps expose otherwise hidden “urban canyons”.
- Requires supplemental high-overlap imagery, and high sun-angle acquisition time
- Requires 3D modeling of buildings
Full-color imagery provides complete 5-view coverage your chosen project area
  - 4 oblique views (45 degrees) + 1 vertical
  - Vertical image is 4-band RGB/NIR

Available resolutions from 2 inches to 12 inches+

2- to 3-pixel accuracy

Licensed product, but:
  - No usage, sharing or deployment restrictions
  - No “per seat” costs
  - Right to use never expires
Sanborn Oblique Analyst®

Capabilities include:
- Search by address
- Search by Parcel ID Number
- Pan, zoom
- Set a location
- Show coordinates
- Measure Height
- Measure Length
- Measure Area
- Measure Slope
- Draw (add) Point
- Draw (add) Line
- Draw (add) Polygon
- Draw (add) Text
- Erase Drawings
- Clear Location
- Create PDF
- Ingest shapefiles
- Help Documentation

Sanborn Oblique Analyst® Demo Link:
https://oblique.sanborn.com/Hennepin/
Airborne LiDAR

- Fully compliant with USGS-National Geospatial Program (NGP) per current LiDAR Base Specification v2.1
- Quality Level 2 (2 pts/m²) or Quality Level 1 (8 pts/m²)
- Note that spatial accuracy of QL-2 and QL-1 lidar is the same.
- Delivery of raw point cloud, classified point cloud, hydro-flattened DEM.
- Supports creation of 1-foot contours
- Other enhancements and derivative data sets can be produced – enhanced classification, hydro-enforcement, DSM’s, contours, etc.
Planimetric Mapping

- Vector mapping of visible features
- Fully customizable data sets – can be complete mapping or selected features only, e.g. buildings
- Formatted to your geodatabase design specifications
- All feature data extraction performed using stereo-photogrammetric techniques – no “heads up digitizing” from orthos
- Additional classification such as pervious/impervious can be performed
- GIS or CAD data formats, 2D or 3D
- Old data sets are often cheaper to replace than to update
  - Searching for changes takes a lot of time
  - Specs of legacy data are often unknown
- Pricing is highly scope and feature density dependent – custom quotes will be provided
Contour Development

- Can be derived from lidar or imagery-derived DEM’s
- Breakline enhancement performed as required
- Created at the desired interval (1-foot, 2-foot)
- ASPRS accuracy
- Fully attributed or layered to discriminate index contour, index depression contour, obscured index contour, obscured index depression contour, intermediate contour, intermediate depression contour, obscured intermediate contour, obscured intermediate depression contour, and hidden contour.

- GIS and CAD data formats
Pricing – Orthoimagery Buy-ups

<table>
<thead>
<tr>
<th>Area</th>
<th>Price/mi²</th>
<th>State Contribution</th>
<th>Actual Buy-up Price/mi²</th>
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<tbody>
<tr>
<td>3-inch Spatial Resolution</td>
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<tr>
<td>Orthoimagery</td>
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<tr>
<td>Out of cycle, at least 400 mi²</td>
<td>$265.00</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>Out of cycle, at least 36 mi²</td>
<td>$434.00</td>
<td>NA</td>
<td>NA</td>
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<tr>
<td>At least 10,000 mi²</td>
<td>$175.00</td>
<td>$51.39</td>
<td>$123.61</td>
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<td>At least 2,000 mi²</td>
<td>$205.00</td>
<td>$51.39</td>
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<td>At least 400 mi²</td>
<td>$250.00</td>
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<td>At least 36 mi²</td>
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<td>$51.39</td>
<td>$372.61</td>
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<tr>
<td>At least 5 mi²</td>
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<tr>
<td>6-inch Spatial Resolution</td>
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<tr>
<td>Orthoimagery</td>
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<tr>
<td>Out of cycle, at least 400 mi²</td>
<td>$85.00</td>
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<tr>
<td>True Orthophotography – 6-inch Resolution</td>
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</tbody>
</table>
Sample Calculations

Case #1: Assume 500 mi² county, 3-inch resolution orthoimagery upgrade

From pricing table, cost for areas from 400 to 1,999 mi² is $250/mi²
State covers cost of baseline imagery ($51.39/mi²)

Cost = ($250/mi² - $51.39/mile²) x 500 mi² = $99,305
Pricing – Lidar Buy-ups

### Lidar – Quality Level 2 (QL-2)
**2 points per square meter**

<table>
<thead>
<tr>
<th>Area</th>
<th>Price/mi²</th>
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<tbody>
<tr>
<td>At least 40,000 mi²</td>
<td>$ 152.00</td>
</tr>
<tr>
<td>At least 5,000 mi²</td>
<td>$ 140.00</td>
</tr>
<tr>
<td>At least 400 mi²</td>
<td>$ 205.00</td>
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</table>

### Lidar – Quality Level 1 (QL-1)
**8 points per square meter**

<table>
<thead>
<tr>
<th>Area</th>
<th>Price/mi²</th>
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<td>At least 40,000 mi²</td>
<td>$ 165.00</td>
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<tr>
<td>At least 5,000 mi²</td>
<td>$ 170.00</td>
</tr>
<tr>
<td>At least 400 mi²</td>
<td>$ 275.00</td>
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</table>
## Pricing – Contour Buy-ups

<table>
<thead>
<tr>
<th>Area</th>
<th>1-Foot Price/mi²</th>
<th>2-Foot Price/mi²</th>
</tr>
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<tbody>
<tr>
<td>At least 40,000 mi²</td>
<td>$85.24</td>
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<td>At least 5,000 mi²</td>
<td>$85.42</td>
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<tr>
<td>At least 400 mi²</td>
<td>$87.80</td>
<td>$45.19</td>
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## Pricing – Oblique Imagery Buy-ups

<table>
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<th>Area</th>
<th>Price/mi²</th>
</tr>
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<td>At least 40,000 mi²</td>
<td>$85.00</td>
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<tr>
<td>At least 10,000 mi²</td>
<td>$95.00</td>
</tr>
<tr>
<td>At least 2,000 mi²</td>
<td>$105.00</td>
</tr>
<tr>
<td>At least 400 mi²</td>
<td>$150.00</td>
</tr>
<tr>
<td>At least 36 mi²</td>
<td>$400.00</td>
</tr>
<tr>
<td>At least 5 mi²</td>
<td>$5,747.01</td>
</tr>
</tbody>
</table>

*Other spatial resolutions, 2-inch to 12-inch, by custom quote*
By Custom Quotation

- Planimetric Mapping – New or Updating
- Land cover/land use/impervious surfaces Mapping
- Change detection
- Lidar enhancements and derivative products
- 3D Building and infrastructure modeling
- Cloud hosting
- Other relevant requested products and services
Price Quotations, Ordering, Contracting

1 - Contact Shaun Scholer
   Email: sscholer@iot.in.gov
   Phone: 317-414-0889

2 - Define Area of Interest and Scope of Work
   - Shapefile for boundary or tile grids are preferred. Include any required buffer areas
   - Sanborn will provide any needed technical information, price quotation

3 – Contract for buy-ups and ancillary products
   - Direct contract with Sanborn contract, from state pre-agreed contract
   - Acquisition-dependent buy-ups must be confirmed no later than 2-15-2022
   - Other buy-ups can be ordered any time
Project Team

Shaun Scholer (GIO)
GIS Program Director
Cell: 317-414-0889
Email: sscholer@iot.in.gov

Megan Compton (GIO)
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Email: sbenham@sanborn.com

Brad Arshat (Sanborn)
Price Quotations, Technical Information, Contracts Liaison
Cell: 443-603-7725
Email: barshat@sanborn.com
Thank you for your Time

- Acquisition and Production Experience
- Successful Project History
- ISO Certified Production Processes
- Robust Software and IT Infrastructure
- State of the Art Sensor Technology
- Highly Qualified Human Resources
- Proven Project Management

www.sanborn.com
1.866.726.2676
Stay Informed

Indiana Geographic Information Council (IGIC)
Orthophotography/LIDAR Committee

4th Tuesday of every month
Tuesday, February 23 at 11 a.m