# Purpose & Project Objectives

The State will award a contract for collecting, processing, and delivering orthoimagery and lidar data. IOT intends for the base products to be statewide 3-inch or 6-inch pixel resolution orthoimagery and Quality Level 1 (QL1) lidar data pulse density of 8 points per meter. The lidar collection shall adhere to the current USGS 3DEP Lidar Base Specification (<https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online>). The lidar DEM shall be used to support the orthoimagery process.

The contract goal is to acquire these products for the entire State within four years. The schedule requires approximately one-third of the State to be flown annually within the first three years (see Figure 1). The fourth year will be used for optional purchases and project finalization. Any additional acquisition areas will be determined by negotiations between the State and Counties to address buy-ups and out-of-cycle participation. The schedule is anticipated as follows:

* Year one (2025): tier one, central tier
* Year two (2026): tier two, eastern tier
* Year three (2027): tier three, western tier
* Year four (2028): optional purchases and project wrap-up

The VENDOR will deliver all final orthoimagery products no later than December 31st of the year that the imagery and lidar were captured, or as negotiated by IOT and the selected VENDOR. The State will apply to the USGS Data Collaboration Announcement (DCA, formerly the Broad Agency Announcement or BAA) in the fall of 2023. The VENDOR should assume that the USGS will perform the quality assurance of the data to the Lidar Base Specification (LBS). The State will perform quality control of the additional products and specifications beyond the base LBS.

All orthoimagery, lidar, and ancillary data products delivered through this contract shall be public domain data without restrictions on distribution or use. Ownership of the final data products and any ancillary products will reside with the State of Indiana.

IOT reserves the right to issue any subsequent request(s) for proposals for specific mapping work as it deems necessary to fulfill its requirements and is under no obligation to conform to VENDOR’s expectations regarding possible contracted work outside the scope of this RFP.

Figure 1. Anticipated 4-year Flight Coverage

Map

Description automatically generated

# Project Administration

The Indiana Geographic Information Office (IGIO), which is part of the Indiana Office of Technology (IOT) will administer the contract. IOT will designate a point of contact for this project. Unless otherwise specified, all references in this RFP for contact with IOT shall be through this designated point of contact.

The VENDOR shall furnish all labor, resources, and materials required to develop and deliver digital orthoimagery, lidar data, and related products per the specified requirements.

# Project Area

The project encompasses the entire land area of the State of Indiana, approximately 37,000 square miles. The entire perimeter of the State shall be buffered by at least 1,250 feet. The border with the State of Illinois along the Wabash River and the State of Kentucky along the Ohio River shall be buffered a minimum distance of 1,250 feet or to the opposite riverbank, whichever distance is greater. Border areas of the State proximate to Lake Michigan (Lake, Porter, and LaPorte counties) shall be buffered beyond the shoreline a minimum distance of 1,250 feet. In addition to these dimensions, data coverage shall extend to the geographic extent of the delivery tile grid, so that no “No-Data” areas exist in any source or final data product. The tile grid is available from attached “**2021-2023\_control.zip**” file.

# Ground Control

The State will provide the VENDOR with the ground control used in the previous statewide ortho projects. The State has well-established ground control for previous imagery projects. The VENDOR may consider using existing control provided below. VENDORS should not assume that sufficient control exists for a specific project area.

* Orthoimagery Control 2021-2023 – See attached “**Indiana\_all\_Tiles.zip”** file.
* Lidar Control 2016-2020 – [Link to Lidar Control Points](https://rockyweb.usgs.gov/vdelivery/Datasets/Staged/Elevation/metadata/IN_Indiana_Statewide_LiDAR_2017_B17/vertical_accuracy/contractor_provided/)

VENDORS shall propose their approach for controlling the orthoimagery and lidar, including how, if applicable, existing control used by local governments will be included.

The VENDOR shall be responsible for establishing ground control of sufficient density and accuracy to meet the accuracy requirements of the deliverable orthoimagery and elevation data at the resolutions indicated, including the additional ground control check points necessary to perform the National Standard for Spatial Data Accuracy (NSSDA) horizontal and vertical accuracy assessments. An internal horizontal accuracy assessment shall be performed for the orthoimagery, and a vertical accuracy assessment shall also be performed for the lidar dataset.

The VENDOR will determine the availability and/or quality of any other existing ground control. The Indiana Department of Transportation (INDOT) operates a Continuous Operation Reference Stations (CORS) network in Indiana. Any ground control established for the project must be established by a surveyor licensed in the State of Indiana. The VENDOR shall describe the method used to ensure consistency and compliance with standards. All ground control points collected shall be documented and marked so that other surveyors can easily relocate them and survive throughout the project's timeframe.

Any control established for use in the project shall become a deliverable of the project.

# Mosaicking and Radiometry

While we are not requiring “true orthophotos” we want the radial distortion to be minimized. For example, overpasses/bridges along roadways shall retain the correct horizontal location and geometry and buildings shall not obscure visibility of roadway from curb to curb in urban areas. The VENDOR shall describe the process to constrain building lean within the orthoimagery and to account for excessive building lean, particularly in metropolitan areas with concentrations of structures over five stories.

The digital orthoimagery shall be seamless and have uniform, balanced color. The imagery will be geometrically and radiometrically correct and match without noticeable differences, free from double image 'ghosting' effect at the mosaicking edges.

Mosaic lines shall NOT cross through buildings or bridges. Other man-made structures not at ground level, fences, above ground pipelines, etc. should be avoided where possible including tall antennas, transmission towers, windmills, etc.

The imagery in each tile shall be clipped to the tile grid without overlap, and the pixels in adjacent tiles aligned precisely.

Tiles shall be mosaicked so the images appear to be completely seamless, except at mosaic lines on bodies of water and unavoidable above ground features. Radiometric adjustment shall include color balancing, overall tone adjustment, and brightness and contrast enhancements of the imagery over the entire project. Dark and light areas shall be evened out.

# Quality Assurance / Quality Control Process (QA/QC)

The VENDOR will conduct independent horizontal and vertical accuracy checks in compliance with current ASPRS standards (<https://www.asprs.org/news-resources/asprs-positional-accuracy-standards-for-digital-geospatial-data>) and provide an accuracy report for all orthoimagery (horizontal) and lidar (vertical) datasets using ASPRS accuracy standards.

The VENDOR shall provide the raw imagery within 10 days of acquisition to an OGC (Open Geospatial Consortium) Web Map Service (WMS) to allow internet viewing at full-scale of the imagery ahead of web-based quality control viewer delivery detailed below. The intent is to let the State and its partners review the imagery early and request possible reflights. Collected imagery that is not up to the expected standard is grounds for a no-cost re-flight at IOT’s discretion. The VENDOR should anticipate simultaneous users. The service need not be permanent but should be available during the term of the contract.

The VENDOR shall post orthoimagery to a web-based service for quality control by the State and its partners. The State will use this system for review and acceptance of imagery before physical delivery of the imagery. The system shall provide a means for the State to create and track quality control callouts.

The VENDOR shall post the lidar-derived hydro-flattened DEM rendered as a shaded relief to a VENDOR-hosted web-based service for quality control by the State and its partners. If the State chooses to acquire advanced classification of vegetation and buildings, the Vendor shall also produce a DSM for quality control of the point classification. The State will use this system to review and accept the lidar data and its derived products before physically delivering the data. The system shall provide a means for the State to create and track quality control callouts.

IOT, in conjunction with the INDOT aerial surveys team, will manage the QA/QC process for the project. INDOT and USGS and potentially an independent third-party reviewer will verify the lidar deliverables. Final products shall be incrementally delivered according to the VENDOR-supplied project plan as approved by IOT. IOT expects to receive county-by-county deliverables as soon as each delivery area is completed.

IOT will review and provide comments on each delivery within two months. USGS review and acceptance will be based a future DCA between IOT and USGS.

# Scope of Work Tasks

Work performed under any contracts issued as a result of this RFP will support mandatory core deliverables and any optional buy-up deliverables requested by IOT and its partners.

## Core Deliverables

### Aerial 4-band Digital Orthoimagery

The VENDOR will capture and produce 3” or 6” pixel resolution, 4-band (red, green, blue, near-infrared, 32-bit with 8-bit unsigned pixel depth per band) digital orthoimagery. The imagery will meet the Class 1 standard as defined by ASPRS for the chosen resolution. The imagery will be free of snow, cloud shadows, atmospheric haze, and sun glare reflections. The same family of sensors shall be used for each product set.

All imagery shall be collected during the late winter / early spring flying season (approximately mid-February to late April) during leaf-off conditions for deciduous vegetation in Indiana. The sun angle shall be 30 degrees or greater, streams should be within their normal banks, unless otherwise negotiated, and the ground is free of snow and excessive moisture.

Imagery where leaf-on conditions of deciduous vegetation obscure road edge or stream banks are grounds for a no-cost re-flight at IOT’s discretion.

The VENDOR will minimize building lean and shadows. At a minimum, all vehicular roads adjacent to tall buildings should be visible curb-to-curb without being obscured by buildings and bridges. The VENDOR’s proposal should clearly explain the methodology to achieve these results.

The VENDOR will develop a flight plan that ensures full coverage of the study area. The VENDOR will provide the flight plan to IOT for approval before undertaking the flight.

The VENDOR will, immediately after the aerial photography capture, inspect it for cloud shadow, color, exposure, and clarity, as well as sidelap, endlap, and crab. The VENDOR will provide a quality control summary report to IOT in digital format within a reasonable time after the photography date. The report will describe conditions during the flight, including, but not limited to, flight date, aircraft used, weather conditions, altitude, subcontractors, scales, resolutions, camera type, number of flight lines, number of tiles created, and datum utilized.

Before orthoimagery production starts, a representative sample of urban, rural, agricultural, forest, and wetland areas shall be submitted by the VENDOR to the State for review and approval of radiometric settings, including color balancing, overall tone, dodging, brightness, and contrast. Image radiometry shall be agreed upon before deliveries commence. Each year, the first county delivered shall be used as a pilot to verify processing, radiometry, quality control, naming, and delivery. The VENDOR shall be accountable for matching the approved image settings across all subsequent imagery deliverables.

If an entire county or buy-up area cannot be acquired in the same season, the entire county or buy-up area shall be acquired in the next season.

The VENDOR shall present a plan for re-visitation of areas in the event of image rejection during the QC process or where original imagery could not be collected because of weather or ground cover conditions or other factors outside the control of the VENDOR’s precluded collection at the scheduled time of the flyover. Mechanical or technical problems shall not be considered a legitimate reason for non-collection.

The imagery will be delivered in the following formats:

* 2,500 x 2,500-foot grid tiles (provided by the State) with no “No-Data” areas in uncompressed cloud-optimized GeoTIFF (COG) format, ECW format, and MrSID v4 format.
* Complete county coverages in RGB MrSID v4 format.

All datasets will be delivered in the latest Indiana State Plane coordinate system. The specific coordinate system and linear units will be determined in coordination with the selected VENDOR.

When adjacent counties captured in the same year have different pixel resolutions, the highest resolution tile shall be delivered, and the VENDOR shall not resample from a larger source pixel (lower resolution) size to a smaller pixel size (higher resolution). IOT recognizes that this will require the VENDOR to process the higher-resolution counties first. Image tiles with the same file name must be identical if delivered to two or more counties.

The VENDOR shall work with IOT to upload the imagery grid tiles directly to the State’s cloud data store.

### Lidar

The VENDOR will capture and produce lidar meeting the latest USGS’s Lidar Base Specification (<https://www.usgs.gov/ngp-standards-and-specifications/lidar-base-specification-online>) - Quality Level 1, including the following:

* Hydro-flattened Break lines, Esri Shapefile format
* 2-foot hydro-flattened, Bare Earth Digital Elevation Model (DEM), in in uncompressed cloud-optimized GeoTIFF (COG) format
* 2-foot resolution Intensity Image: intensity recorded from reflective surface (first return) pulse
* Point cloud in .laz 1.4 or higher format; all returns
* Ground returns, overlap points, and low/high points should be classified in the full point cloud and all returns .laz files
* The VENDOR shall be responsible for all vertical and horizontal project control in support of lidar data acquisition and processing
* Perform and report independent QA/QC of the horizontal accuracy of the orthoimagery
* Perform and report independent QA/QC of the vertical accuracy of the lidar

All datasets will be delivered in the latest Indiana State Plane coordinate system. The specific coordinate system and linear units will be determined in coordination with the selected VENDOR.

#### Elevation Data Captured Using Lidar

The VENDOR will use the following classifications:

* 1 – Processed, but unclassified
* 2 – Bare earth
* 7 – Low noise
* 9 – Water
* 17 – Bridge deck
* 18 – High noise
* 20 – Ignored ground (typically breakline proximity)
* 21 – Snow (if present and identifiable)
* 22 – Temporal exclusion (typically nonfavored data in intertidal zones)

The USGS will perform the QC for the base lidar classifications.

Point density should be as consistent as possible across the project area, and the same sensor should be used for the entire program.

The lidar will be delivered in the following formats:

* 2,500 x 2,500-foot grid tiles (provided by the State) in LAZ format.
* 2,500 x 2,500-foot grid tiles (provided by the State) intensity images in Cloud-Optimized GeoTIFF (COG) file format.

#### Bare Earth Digital Elevation Model (DEM)

A 2-foot resolution DEM will be produced and delivered in Cloud-optimized GeoTIFF format for the project area. The DEM should be delivered as one GeoTIFF file per tile and as countywide GeoTIFFs. DEM tiles will show no edge artifacts or mismatches. The DEM will be devoid of a quilted appearance in the overall project surface, whether caused by differences in processing quality or character between tiles, swaths, lifts, or other non-natural divisions.

For the bare earth DEM, water bodies (ponds and lakes), wide streams and rivers, and other water bodies are to be hydro-flattened. Hydro-flattening shall be applied to all water impoundments, natural or man-made, that are larger than 2 acres in area, to all waterways that are nominally wider than 100 feet bank to bank, and to all boundary waters bordering the project area regardless of size. The VENDOR should describe in its proposal the methodology used for hydro-flattening.

Independent accuracy checks shall be performed per ASPRS NSSDA standards for orthoimagery and lidar deliverables including a minimum of 2 checkpoints per county. In buy-up areas, additional checkpoints shall be used to test horizontal and vertical accuracy.

The DEM will be delivered in the following formats:

* 2,500 x 2,500-foot grid tiles (provided by the State) with no “No-Data” areas in uncompressed cloud-optimized GeoTIFF (COG) format.
* Complete county coverages in lossless Cloud-Optimized GeoTIFF (COG) file format.

### Lake Michigan Coastal Program for Lidar 2025-2028

In addition to the lidar collection detailed in Section 7.1.2, the VENDOR shall acquire QL1 lidar and 3” orthoimagery for approximately 120 square miles along Lake Michigan in years one, two, and four. In year three, the lidar and 3” orthoimagery shall be considered a standard product for the program. The VENDOR shall also produce a bare earth DEM. The same specifications as indicated in Sections 7.1.1 and 7.1.2 shall be applied.

## Optional Buy-Up Deliverables

The VENDOR’s proposal should describe its capacity to offer buy-up products for IOT and/or its partners. The quality levels and coverage areas for such products may vary. Products may include but are not limited to:

* Higher resolution orthoimagery
* Contours at various intervals (such as 1-foot or 2-foot contours)
* Additional lidar classifications and products (INDOT and potentially an independent third-party will QC the vegetation and building classifications)
* 2-foot Digital Surface Model (DSM), in uncompressed cloud-optimized GeoTIFF (COG) format. The classified Digital Surface Model (DSM) will be generated from classified lidar point cloud data to represent the Earth's surface, including all above-ground features, such as buildings, trees, vegetation, and terrain. These points represent the uppermost surfaces of objects and terrain features. The DSM shall be colorized by the lidar point classification.
* Building footprints for buildings greater than 100 square feet
* Planimetric data such as the edge of pavement, road markings, vegetation, etc.
* Impervious cover
* Land use
* Land cover
* Custom geographic boundaries of the base products
* Hydro-flattened DEM for waterways wider than 25 ft
* Lidar point density of 25 points per square meter
* 2-foot Normalized Digital Surface Model (nDSM)
* Raw swath data
* Vendor-proposed additional optional buy-up deliverables
* Meta Raster Format (MRF) overviews as a final deliverable along with the COG TIFF files

# Media and File Format Requirements

The IOT requires one set of deliverables on hard drives. Hard drives will be provided by IOT. Additionally, the VENDOR must make the imagery deliverables available for unlimited public download using web or cloud-based technology, preferably without the need for additional software (with the exception of FTP client). In the case of FTP, Secure FTP must be used. Dropbox, Box, and Google Drive cannot be used. All imagery products shall be available for a duration 3 years following capture.

The VENDOR will provide options and pricing for electronic delivery and hosting of the lidar data.

Tile index vector files shall be polygons, with attribute fields coded with the X,Y georeferenced coordinates of the lower left corner of the tile in the State’s established file naming convention (all in lower case, no spaces). The IOT will supply the initial tile grid for the project, but the VENDOR will be responsible for updating and delivering to IOT the final tile delivery grid for each deliverable area based on the buy-up options exercised.

All image ancillary files shall have identical lower-case naming as the image file name. GIS vectors shall be in ESRI shapefile format.

The VENDOR shall provide ESRI shapefiles depicting the imagery and lidar acquisition dates so that the end user can easily determine the source date for each image and lidar lift.

The VENDOR shall provide ESRI shapefiles depicting survey control point locations, flight lines, the final imagery exposure stations (if applicable), and all quality control callouts with their resolution. GIS data shall be labeled and contain the appropriate attribution.

All surveys, intermediate photogrammetry products, and reports shall be delivered as electronic documents. The State does not want hard-copy reports.

# Metadata

For each of the product set deliverables, the VENDOR shall provide metadata compiled to Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM), Version 2 (FGDC-STD-001-1998 - https://www.fgdc.gov/standards/projects/metadata/base-metadata/v2\_0698.pdf). IOT will review and approve a metadata template file to be used for all product sets and deliverables.

Metadata shall be compiled for each product by acquisition year and provided with product set deliveries. Metadata shall contain information according to the current ASPRS Positional Accuracy Standards for Digital Geospatial Data (https://www.asprs.org/revisions-to-the-asprs-positional-accuracy-standards-for-geospatial-data-2023).

# Permanent Storage

The VENDOR will, at no expense to IOT, store all raw source, intermediate, and final digital files for a period of five years after all products have been delivered. After this time period the VENDOR may continue to store these data or provide it to IOT as mutually agreed upon.

# Project Management and Project Descriptions

## Project Plan

The VENDOR shall propose a management plan for the project, which clearly establishes lines of communication, authority, and responsibility with regard to the management of the project. The plan must demonstrate efficient and effective communication on all aspects of the project and minimize the administrative overhead of IOT. The plan must also state how the VENDOR will ensure that IOT will receive the deliverables specified above, and in a timely manner that will fit into the project’s overall purpose. The full project plan shall be delivered prior to year one acquisition and updated prior to each year’s acquisition.

The Project Plan of the VENDOR shall provide a statement of the priority of this project in relation to their other projects. It should include the number of aircraft and sensors available by the VENDOR that will be assigned to the project and an estimate of the total number of aircraft that will be assigned to collect the orthoimagery and lidar.

The plan shall include a Procedures Guide with a flow chart detailing production processes and Quality Assurance and Quality Control (QA/QC) procedures employed to ensure that all products meet the required accuracy and performance standards of these specifications.

## Point of Contact

Contact information for an individual or team of individuals shall be provided that will allow IOT to contact the VENDOR’s “Point of Contact” anytime during regular business hours (i.e., 8:00 AM to 4:30 PM) EDT and minimally as necessary outside of business hours. This “Point of Contact” will be utilized for general information and shall be considered separate from the “Key Persons” clause located in the sample contract (Attachment B).

## Meetings and Reporting Requirements

### Project Initiation Meeting

The VENDOR shall meet with IOT within two (2) weeks after the Contract is signed to review the DRAFT project plan.

The VENDOR will present the project schedule and project plan, and if possible, the initial flight plan for review and approval by IOT at the project initiation meeting. The VENDOR shall provide a timeline for final flight plan presentation and approval, ground control plan, delivery, and a schedule for all products. As specifically as possible, the plan shall include a matrix of who will be performing each of the anticipated tasks, to include quality assurance and delivery of final products.

The VENDOR shall summarize in writing all pertinent issues, clarifications and proposed changes resulting from the meeting and shall distribute them to IOT for approval within five (5) working days after the project initiation meeting.

### Post-Flight Evaluation Meeting

The VENDOR shall meet with IOT immediately following the completion of the spring flying season, within two weeks of the season’s last flight. The purpose of this meeting is to evaluate the success of the orthoimagery acquisition, and to consider alternatives for gaps where weather conditions or other factors precluded successful acquisition of orthoimagery.

The VENDOR shall initially provide IOT several completed and processed sample frames of imagery representative of each set of flight conditions that may affect image quality, within a timeframe mutually agreed upon by IOT and the VENDOR. IOT shall select the preferred frame or frames to be used by the VENDOR as a template that guides subsequent deliverables and by IOT to QA the resultant orthoimagery deliverables.

The VENDOR shall summarize all pertinent issues, clarifications, and proposed changes resulting from the meeting and shall distribute them to IOT for approval within five (5) working days after the initial post-flight evaluation meeting.

### Status Meetings, Status Reports, and Conference Calls

The VENDOR shall, at a minimum, participate in four (4) additional Web meetings each year in July, September, November, and January of the following year, unless deemed unnecessary by IOT. Up to two (2) additional meetings may be scheduled as required upon mutual consent of the VENDOR and IOT at no additional cost to IOT.

IOT will create a team on the State’s Microsoft Teams environment for the purpose of this project. Access will be provided to the VENDOR, subcontractors, and other project stakeholders where appropriate. The team will be used to update and document the status of the project in relation to the project schedule and identifying any issues, concerns, decisions, outstanding items, and next steps.

The VENDOR shall arrange and initiate weekly conference calls with IOT to discuss the status reports. Calls may be suspended after all flying has been completed upon mutual agreement of IOT and the VENDOR. Calls shall continue until such time as IOT is satisfied that all outstanding technical, financial, and contractual issues are properly resolved.