

Regional Aerial Photo Consortium 5-Year Strategic Plan 2021-2025

INTRODUCTION

The Regional Aerial Photo Consortium (the Consortium) is an informally organized group of local governments and special districts in the Portland metropolitan area. The Consortium, administered by Metro, has pooled resources to share the costs and leverage public dollars for the purpose of acquiring aerial photography and fixed-wing aircraft lidar collection since the mid-1990s. This Strategic Plan represents an overview and goals for the Consortium that will keep the imagery program on track and responsive to current and future needs through 2024.

PURPOSE

The Consortium's purpose is to coordinate the acquisition of high-quality imagery products in a cost-effective manner, a goal that is achieved through collaboration, pooling resources, and leveraging regional staff expertise. The collection of aerial photography, oblique imagery and lidar are costly but essential projects for the member agencies. Each collection project has significant startup costs and there are significant benefits and value to the public and all consortium members in working together to acquire the data.

OBJECTIVES

- Collectively acquire aerial photos and related imagery.
- Pool resources and leverage economies of scale for shared benefits.
- Identify a consistent annual budget target that will ensure funding and inform members for their budget planning.
- Provide transparency in the budgeting process.
- Establish rules and procedures for member participation.

HISTORY AND BACKGROUND

The Regional Aerial Photo Consortium (the Consortium) as we know it today has operated since the mid-1990s. The first digital product was produced by scanning traditional aerial photos from 1994. In 1996 the second digital aerial photo product was created as part of

the initial imagery collection. The second digital product, which was easier to view and analyze, kicked off the modern era of annual digital imagery. On behalf of the Consortium, Metro has contracted for an annual aerial photo flight and data collection since 1996. The coordination and cost sharing among Consortium members is estimated to save the region between \$700,000.00 and \$800,000.00 per year as a result of not duplicating data acquisition efforts and project costs.

Digital photos collected by fixed wing aircraft, processed to remove distortion, are very important to the Consortium members and the public. These **orthophotographs** or **orthophotos** are used in multiple business processes and programs to support operational needs and increase efficiency.

As Consortium members report that orthophotos play a significant role in their activities and operations, data quality is one of the primary considerations in each flight. Orthophotos and other remotely sensed data are perishable relative to the time taken as the state of things visible on the ground are always changing. Therefore, timely flights with a consistent schedule and data quality are vitally important to many of the Consortium members to address this issue of change over time.

To increase the frequency of collection and reduce costs, the Metro Data Resource Center (DRC) in partnership with regional local governments developed the **Regional Air Photo Consortium (Consortium)**. The Consortium allows government entities and non-profit organizations to:

- Buy **larger coverage areas** thereby getting **better pricing** per square mile.
- **Share the costs** of areas of common interest among multiple partners.
- **Reduce duplication** - the final costs are reduced by as much as 1/5 of a contract they might undertake on their own.
- **Increased administrative efficiency** by having Metro handle administration, procurement and contracting.

Consortium member needs for remote sensing products evolves over time – so too does the technology utilized to capture and process these products. It is important to stay on top of emerging trends as well as stakeholder needs. The DRC has tracked these issues over time and adjusted the program accordingly. This document will help guide the next phases of the Consortium’s evolution.

As Lidar – Light Detection and Ranging – has become more readily available and affordable, the Consortium also collected Lidar data as part of the 2014 and 2019 projects. This is now considered a regular product to be acquired through the Consortium.

GOVERNANCE

Metro is the coordinator and administrator of the Consortium and will make decisions related to completing the business of the Consortium. Metro will strive for consensus of the Consortium members for all major decisions and seek input from Consortium members for matters pertaining to the Consortium. If consensus or significant majority agreements cannot be reached Metro will reserve the privilege to make final decisions.

TIMELINE AND ACQUISITION SCHEDULE

YEAR	Orthophoto Leaf-on	Orthophoto Leaf-off	Lidar
2021	YES		
2022	YES*		
2023	YES	YES	
2024	YES*		YES
2025	YES		

**Extended area and biennial participation*

Leaf-on acquisition schedule

The current summer orthophoto (leaf-on) contract with GeoTerra, Inc. expires in 2024. The annual acquisition will proceed using the following general timeline.

Month (year of acquisition)	Milestone
February	Member meeting: flight proposal
March	Deadline for additional AOI and member feedback
April	
May	Vendor contract finalized and flight plan confirmed
June	Acquisition window
July	
August	Pilot project due 6 weeks from flight completion date
September	Preliminary web service available

October	Full resolution TIFF images due 12 weeks from flight completion date
November	All images and corrections due 4 months from completion date
December	Hard drive delivery deadline
January	Final invoices out

Leaf-off acquisition schedule

The most recent regional leaf-off flight occurred in late March/early April of 2012. Members are interested in a new leaf-off flight and the Consortium will coordinate one regional flight in 2023 and plan for a five-year cycle thereafter. The actual interval may vary to avoid overlapping a lidar project year and/or to maximize participation with non-annual participants.

Metro will either go out for bid or leverage existing contracts through the State of Oregon or the GIG to obtain the 2023 imagery. (See section: Collaboration). Leaf off flights have historically been conducted in November or March timeframes. The acquisition would proceed using the following general timeline, assuming a March acquisition window.

Month (year of acquisition)	Milestone
January	Vendor contract finalized and flight plan confirmed
February	
March	Acquisition window
April	
May	Pilot project due 6 weeks from flight completion date, preliminary web service
June	Full resolution TIFF images due 12 weeks from flight completion date
July	All images and corrections due 4 months from completion date
August	Hard drive delivery deadline + Final invoices out

Lidar

The 2021 member survey shows that the current five-year collection cycle is preferred. Therefore, the Consortium will continue a 5-year cycle for collecting lidar data. The project planning process will begin in February 2023 for a 2024 project.

Oblique Imagery

According to our 2021 member survey there is a general lack of budgetary support and/or business need for a regional oblique flight, therefore, it will not be included in this five-year plan. However, some members place a high value on obliques. Metro will continue to explore opportunities and assess member needs over time. More information about potential solutions and opportunities are described below in the collaboration section.

ACQUISITION GEOGRAPHY

Orthophotography (Vertical)

A core area, “Area 1” (see below), is the minimum geography covered for orthophotography for each annual flight. An additional area, “Area 2” (see below), will be included every other year to coincide with participation of the Consortium members who participate biennially.

Area 1

All sections that fall all or partially within the Urban Growth Boundary buffered 1 mile define Area 1. Area 1 may be changed per consortium member requests that complete a logical contiguous area or by special need (see Governance).

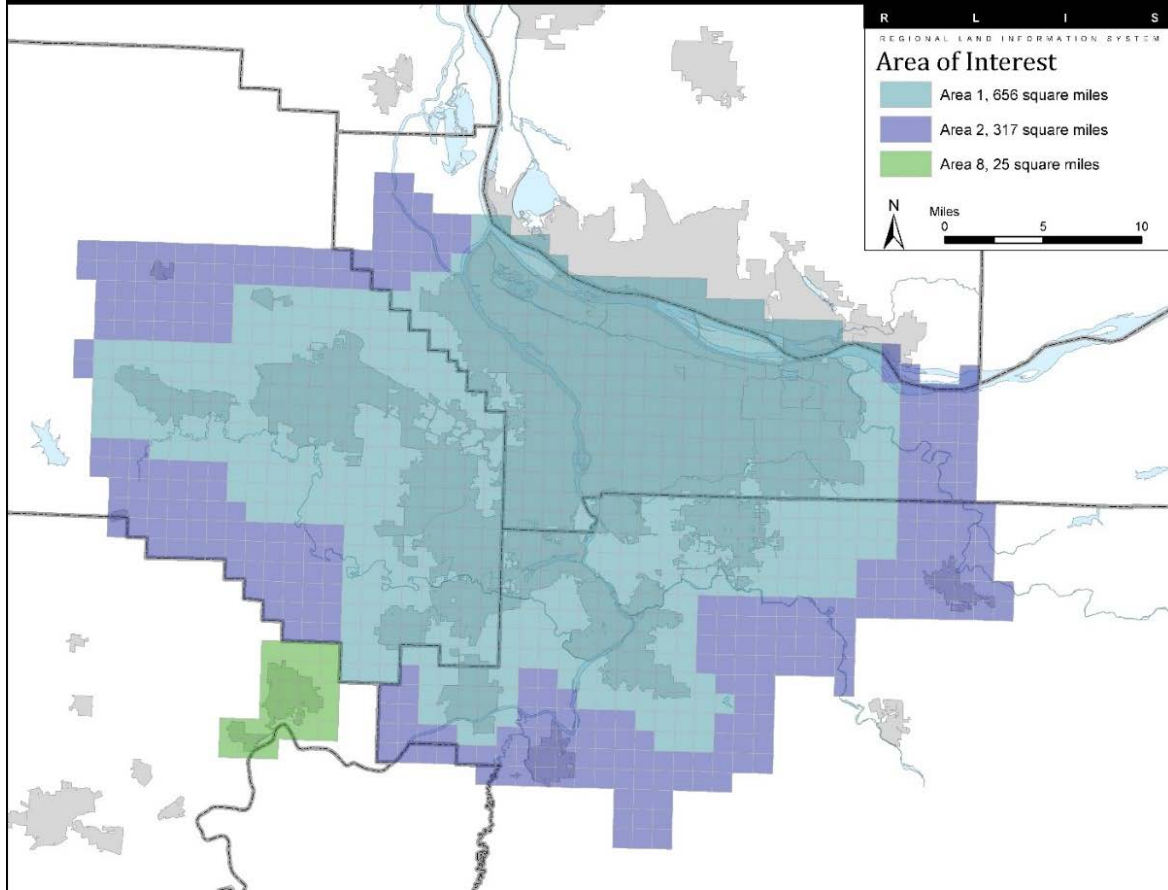
Area 2

All of Area 1 plus contiguous area agreed on by the Consortium. Area 2 is primarily 2-5 additional miles around Area 1, areas of particular interest to a Consortium member in Area 1 or contiguous area regularly requested by a Consortium member less than 5 sections (the latter is to reduce the administrative overhead of tracking additional area).

Additional Area(s) - adjacent jurisdictions

Additional areas may be added to the flight by request from Consortium members or other agencies. (Example: Area requested by Newberg in green on the Area of Interest map.) Other adjacent organizations that have participated have included Sandy, East Multnomah Soil and Water district, and ODOT. See Budgeting and Cost Sharing for information on paying for the additional area(s).

Area of interest map



Oblique Imagery

The project area of interest (AOI) will be defined by the Consortium members participating in the individual projects.

Lidar

The project area of interest (AOI) will be defined by the Consortium members participating in the 2024 Lidar project. The Lidar AOI is anticipated to be a minimum of Area 1 and Area 2 but likely to include a much larger area of interest.

BUDGETING AND COST SHARING

Part of the success of the Consortium is that the funding model has benefited all parties and is straightforward and simple. The overhead and core Areas 1&2 expenses are allocated to the Consortium members based on their area of interest (AOI).

Current Cost Sharing Model

The Consortium currently shares costs year-to-year based on the yearly project cost on a per section basis. The total cost of the project is determined by adding the cost of the contract with the acquisition and processing vendor, Data Acceptance Testing (DAT) vendor, and an administrative cost for Metro.

The cost of the project is divided among Consortium members on a per section purchased basis and is calculated after the total number of sections purchased is identified. The more members who participate the lower the cost for each section purchased. For example, if two members each purchase the entire project area, the sections would each be purchased twice so the cost per section would be halved.

In the current model, members choose each year whether they wish to participate in the project and to what extent (I.e., the area they wish to purchase). Although there is no obligation for a member to participate in the program any given year, members are strongly encouraged to provide a general commitment schedule for participation. It is beneficial for the members and Metro to know members' plans for budgeting, planning and administration of the program.

2025 Cost Sharing Model

To allow for more consistent and predictable annual budgets and to reduce financial risk for Consortium members, the Consortium will explore options for changing the cost allocation model after the next lidar cycle in FY 2024. It is recommended by the Strategic Plan Working Group that an equal pay or "big" player model (see appendix) be reviewed and that the GIG's annual imagery budgeting and imagery cost sharing formula (GIG Five Year Imagery Plan Final) be used as a model for the Consortium starting in FY 2025.

Additional Area Budgeting

The members requesting Additional Area(s) pay the full per section cost without any cost sharing. Unless other members request the same area in which case those organizations would share the cost.

See appendix for budgeting examples.

MINIMUM SPECIFICATIONS

Orthophotography

The Contractor will capture the area of interest, as delineated on the Area of Interest map, with a digital aerial mapping camera controlled with AGPS/IMU. The Contractor will meet the resolutions and accuracies as defined in ASPRS Accuracy Standards for Digital Geospatial Data (see Table 4, class III)

<https://www.asprs.org/news-resources/asprs-positional-accuracy-standards-for-digital-geospatial-data>

The Contractor must use industry-standard digital sensor technology and all the accompanying technologies and methods associated with this technology. The camera system must be capable of producing natural color 3- band and color infrared band imagery products at high resolution, from a single flight mission. The raw images must result in orthophotos which are in 4-band TIFF format at 8-bits per band. The Contractor must achieve a nominal forward overlap of 60% (assuming frame-based camera) and lateral overlap of 30%. However, additional exposures must be captured over the urban core area to ensure that not more than 25% of roadway/transportation features are obscured. The Contractor must indicate their proposed ground sample distance (GSD), flying elevations, camera model and camera specifications. The Contractor is responsible for all geodetic surveying data acquisition and processing necessary to meet horizontal and vertical accuracy requirements of the deliverables. The Contractor will use a suitable Digital Terrain Model (DTM) to meet the ASPRS horizontal accuracy specification referenced above.

Leaf-off conditions

Leaf-off imagery will be captured, between November and March as determined by the weather, leaf cover and other conditional requirements stated in the existing orthophoto contract. The specific timing for the flight will be coordinated with Metro's project manager. Photography shall not be undertaken when the sun angle is less than 30 degrees above the horizon.

Oblique

- Acquired either during the summer flight window or winter/early spring leaf-off window
- Cover the area of interest referenced in section B within the Metro Region including 100-meter buffer outside the Region's Area of Interest, as well as any additional areas contracted
- Processed using the best available DEM
- Conform to Metro's geodetic control specifications, and spatial projection as already described

- Support creation and delivery of an orthoimagery product with oblique images
- Provide an Esri extension for viewing the oblique imagery within the Esri GIS environment of Arc 10.x or ArcGIS Pro

Lidar

The LIDAR flight should be flown in accordance with the USGS Lidar Base Specification

<https://www.usgs.gov/core-science-systems/ngp/ss/lidar-base-specification-online>

Delivery Item	Description
LAS 1.4 PDRF 1	<i>Classified Lidar attributed with RGB values, if available</i>
GeoTIFF, tiled by PLSS section	<i>Hydro-Flattened DEM at 3' interval</i>
GeoTIFF, tiled by PLSS section	<i>DSM or First Return at 3' Interval</i>
GeoTIFF, 16-bit, tiled by PLSS section	<i>Intensity Returns at 1' interval</i>
Project Index, Arc geodatabase format	<i>Includes Lidar flight lines, LAS tiles, raster tiles, boundary, and control.</i>
Hydro flattened areas, Arc geodatabase format	<i>Water body and stream feature classes of features used for hydro-flattening DEM</i>
Lidar Project Index LiDAR Technical Report	<i>PDF</i>
SBET data	<i>Lidar swath trajectories</i>
Metadata	<i>FGDC compliant metadata files for each delivery item</i>

Lidar Derivatives:

- Bare Earth or DEM Raster
- Classified ground returns, hydro-flattened features (water bodies >2 ac. and streams >100 ft. wide), and Lidar-derived break lines used to create a final terrain dataset in ArcGIS geodatabase format. The terrain is used to then create the Bare Earth or Digital Elevation Model (DEM) at 3-foot intervals. Linear interpolation was used for filling in voids as needed. The DEM grid of points is cut into seamless section-sized raster tiles conforming to Metro's tiling scheme and exported to GeoTIFF format.
- Highest Hit or DSM Raster
- A highest hit or Digital Surface Model (DSM) created as an Arc terrain dataset using all first return points, excluding those points previously identified as sensor noise. The

resulting surface model is used to create a 3-foot resolution grid by using the maximum LAS point elevation value found within each 3-foot cell. The DSM grid of points is cut into seamless section-sized raster tiles conforming to Metro’s tiling scheme and exported to GeoTIFF format.

- Intensity Raster
- Create a grid of points by saving the intensity value of the highest elevation point within each 1 ft² cell. Data are exported to raster format and re-cut into overlapping, section- centered tiles to match the layout used for orthophotography, DEM and DSM.
- Automated .las point classification scheme consistent with classifications created for the 2019 acquisition

COLLABORATION

Metro Contracts

The contracts that Metro procures on behalf of the Consortium will be available to the members to use for projects that are not specified in this strategic plan or done on behalf of the whole Consortium. Examples are:

- Smaller groups for one-off flights
- Coordinating flights/contracts with the state

Other contracts

Metro will, when available and prudent, use contracts obtained by other jurisdictions to reduce costs and improve efficiency in completing Consortium projects.

State of Oregon

The State of Oregon continues to work on a statewide aerial photo collection program and coordinates data collection flights for their needs. The Consortium will support and coordinate with the State to leverage public resources and dollars to maximize the benefits to all agencies involved.

Commercial Products (Off the Shelf)

Commercial off the shelf products continue to advance and are intriguing products for many Consortium members. The Consortium will continue to monitor available products and evaluate the feasibility of coordinating a purchase through the Consortium.

APPENDIX

Budget and cost sharing

Estimates based on 2020 and 2021 photos and 2019 lidar

Large Organization (Metro – the region)

	2022	2023	2024	2025	2026
Summer Photo	\$24,000	\$16,000	\$45,000	\$16,000	\$24,000
Leaf-off Photo		\$24,000			
Lidar			\$200,000		
Oblique					
Total	\$24,000	\$40,000	\$245,000	\$16,000	\$48,000

Medium Organization (Hillsboro – 137 sections)

	2022	2023	2024	2025	2026
Summer Photo	\$3,200	\$3,200	\$3,200	\$3,200	\$3,200
Leaf-off Photo		\$3,200			
Lidar			\$20,000		
Oblique					
Total	\$3,200	\$6,400	\$23,200	\$3,200	\$6,400

Small Organization (Oregon City – 63 sections)

	2022	2023	2024	2025	2026
Summer Photo	\$1,600	\$1,600	\$1,600	\$1,600	\$1,600
Leaf-off Photo		\$1,600			

Lidar			\$10,000		
Oblique					
Total	\$1,600	\$3,200	\$11,600	\$1,600	\$1,600

Outside Core Area (Newberg – 25 sections)

	2022	2023	2024	2025	2026
Summer Photo	\$1,800	\$1,800	\$2,500	\$1,800	\$1,800
Leaf-off Photo		\$1,800			
Lidar			\$15,000		
Oblique					
Total	\$1,800	\$3,600	\$17,500	\$1,800	\$1,800

2025 Cost Sharing Model

There are several funding models that have been explored in the past. The ones that the strategic plan work group suggests the Consortium consider in the future (2024 for 2025 implementation) are listed below.

Equal pay – average cost over a set period of years. Like the GIG’s cost allocation for acquiring imagery products, the Consortium could implement a similar model for budgeting consistency and other benefits. Primarily this would change the model for Consortium members outside the GIG. This provides advantages to average the cost over a period of years for easier budgeting and reduces budgeting risk for the Consortium. Benefits are that the cost would be the same every year or vary at a known amount based on planned project, reconciled at some interval and all Consortium members would have access to all products. The disadvantage is that it increases administrative overhead of additional accounting and would require formal agreements with Metro (assuming Metro is the fiscal agent).

Large organization model - have the larger organizations fund the photo and lidar projects. Likely funding members would be Metro, TriMet, Portland, Multnomah and Clackamas Counties and the Washington County Geographic Information Group (GIG). Potential funding members are other Federal and State agencies. Benefits are reduced administrative work and cities not part of the GIG, special districts and the public would receive all products at no cost.