

The National Map—Orthoimagery

Orthoimagery

Orthorectified digital aerial photographs and satellite images of 1-meter (m) pixel resolution or finer make up the orthoimagery component of *The National Map*. The process of orthorectification removes feature displacements and scale variations caused by terrain relief and sensor geometry. The result is a combination of the image characteristics of an aerial photograph or satellite image and the geometric qualities of a map. These attributes allow users to:

- Measure distance
- Calculate areas
- Determine shapes of features
- Calculate directions
- Determine accurate coordinates
- Determine land cover and use
- Perform change detection
- Update maps

The standard digital orthoimage is a 1-m or finer resolution, natural color or color infra-red product. Most are now produced as GeoTIFFs and accompanied by a Federal Geographic Data Committee (FGDC)-compliant metadata file. The primary source for 1-m data is the National Agriculture Imagery Program (NAIP) leaf-on imagery. The U.S. Geological Survey (USGS) utilizes NAIP imagery as the image layer on its “Digital-Map”—a new generation of USGS topographic maps (http://nationalmap.gov/digital_map/). However, many Federal, State, and local governments and organizations require finer resolutions to meet a myriad of needs. Most of these images are leaf-off, natural-color products at resolutions of 1-foot (ft) or finer.

Applications of Orthoimagery

Digital orthoimagery is one of the base layers for most public and private Geographic Information Systems (GIS) and supports various geographic information analysis and mapping applications.

These data are used to develop and revise vector files of transportation, cadastral, and land-use/land-cover information. Federal, State, and local agencies use orthoimagery for base maps for wetlands, soil, land parcel, farm-field boundary, forest inventory, and other natural-resource mapping, analysis, and planning applications. Local governments rely on orthoimagery to map land-property boundaries and to manage their streets and other infrastructure assets. Orthoimagery serves as a seamless base map layer to which many other layers are registered, can be combined with digital elevation data for 3-D modeling and slope and terrain analyses, and is easily mosaicked to create seamless images of larger areas. Digital orthoimagery provides visual information for the following partial list of applications.

- Image layer for topographic maps
- Homeland Security
- Homeland Defense and Emergency Management
- Public Safety Planning, Response, and Mitigation



Duck Keys in the Florida Keys along Overseas Highway. Source imagery is Monroe County, Florida, March 2006.

- Tax Parcel Mapping
- Transportation Management
- Operations and Planning
- Economic Development
- Utilities Management, Operations, and Planning
- Land Planning and Zoning
- Drainage Planning and Management
- Code and Permit Enforcement
- Agriculture
- Insurance
- Surveying and Mapping
- Environmental Management
- Planning and Regulation
- Education
- Natural Resource Inventories and Assessments



Niagara Falls, along the border of New York and Ontario, Canada. Source imagery is New York State, April 2005.

Orthoimagery Plans and Data Availability

The orthoimagery maintenance plan consists of two parts: 1) 1-m resolution, leaf-on, NAIP digital orthoimagery are acquired through the Farm Service Agency (FSA) (<http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=maps&topic=landing>). Files of 1-m NAIP imagery will be collected on a 3-year cycle beginning in 2009, whereas files of leaf-off imagery are acquired as partnership requirements dictate. The USGS will partner with FSA for NAIP imagery for the 2009–2011 cycle. 2) 1-ft leaf-off orthoimagery over 133 urban



Hoover Dam in the Black Canyon on the Colorado River, September 2006.

areas are acquired by the USGS in partnership with the National Geospatial-Intelligence Agency (NGA) and State and local governments under the Homeland Security Infrastructure Program (HSIP). This program initially was created to collect imagery and other geospatial data layers over densely populated urban areas for homeland security and emergency operation purposes, but has expanded beyond its Federal scope to become one of the primary mechanisms available to Federal, State, and local governments and organizations for partnering to collect high-resolution imagery. This effort leverages the resources of multiple partners to achieve significant cost savings through economies of scale while meeting imagery requirements beyond the basic needs of the Federal government—larger collection areas, finer resolutions, and 4-band imagery are common “buy-ups” to the standard urban area product. The standard images are 1-ft, leaf-off orthoimages that cover a 1,500-m x 1,500-m footprint, georeferenced to the North American Datum of 1983 (NAD 83) datum and the Universal Transverse Mercator (UTM) coordinate system, and are true-RGB, GeoTIFF images with FGDC-compliant metadata. The largest 50 cities are acquired on a 2-year cycle with the remaining cities on a 3- to 4-year acquisition cycle. Both maintenance programs focus on partnerships with Federal, State, and local agencies to leverage resources and expand collection coverage.

Dissemination of 1-m or finer resolution digital orthoimagery acquired by USGS through contracts, agreements with other Federal, State, Tribal, or regional organizations, or direct purchases from private industry data vendors, are available through *The National Map Seamless Data Distribution Service* (<http://seamless.usgs.gov/>), a USGS Internet site for viewing and downloading no-cost, public-domain data.

Other Federal, State, and local agencies have their own programs for disseminating data independent of the USGS. The USGS will not duplicate orthoimagery data holdings unless

archiving or disseminating the data is part of a cooperative agreement; rather, the USGS will rely on those agencies to make their orthoimagery accessible on a National Spatial Data Infrastructure (NSDI) Clearinghouse node in the public domain. Whenever possible, USGS will link to other sites and services for orthoimagery data. Selected Internet sites to search for orthoimagery data distribution and web image services are:

- Geospatial One-Stop (<http://gos2.geodata.gov/wps/portal/gos/>)
- *The National Map* (<http://nationalmap.gov/>)
- The National Digital Orthophoto Program (NDOP) site (<http://www.ndop.gov/data.html>)

National Digital Orthophoto Program (NDOP)

The NDOP leads the effort to complete and maintain national orthoimagery coverage with a resolution that is 1-m or finer. The NDOP is a consortium of Federal and State agencies, principally the USGS, FSA, Natural Resources Conservation Service, U.S. Forest Service, Bureau of Land Management, Federal Emergency Management Agency, Bureau of the Census, National Oceanic and Atmospheric Administration, and National States Geographic Information Council (NSGIC), committed to providing national orthoimagery coverage by combining funding resources and creating partnerships to coordinate requirements and costs with Federal, State, other government agencies, and the private sector.



Falls Park on the Big Sioux River, Sioux Falls, South Dakota.
Source imagery is Minnehaha County, South Dakota, April 2008.

The Nation Needs *The National Map*

As one of the cornerstones of the U.S. Geological Survey's (USGS) National Geospatial Program, *The National Map* is a collaborative effort among the USGS and other Federal, State, local, and Tribal partners to improve and deliver topographic information for the Nation. *The National Map* has many uses ranging from recreation to scientific analysis to emergency response. *The National Map* is easily accessible for display on the Web, as products and services, and as downloadable data. The geographic information available from *The National Map* includes orthoimagery (aerial photographs), elevation, geographic names, hydrography, boundaries, transportation, structures, and land cover. Other types of geographic information can be added within the viewer or brought in with *The National Map* data into a Geographic Information System to create specific types of maps or map views.



The National Map is a significant contribution to the National Spatial Data Infrastructure (NSDI) and provides high quality, integrated geospatial data and improved products and services including new generation digital topographic maps. *The National Map* also is foundational to implementation of the Department of the Interior (DOI) Geospatial Modernization Blueprint and meeting the DOI mission. *The National Map* underpins the USGS Science Strategy, which is based on a systems approach to help address multifaceted issues, provide better understanding of earth processes, and evaluate broad causes and consequences of the use and management of natural resources. *The National Map* promotes interdisciplinary science by providing nationally consistent, trusted geospatial data, and establishing a consistent national geographic context.



Journey to Atlantis ride, Sea World, San Diego, California, March 2005.

Partnership Opportunities

Organizations interested in partnering with the USGS to develop orthoimagery data for *The National Map* can contact the USGS geospatial liaison in their State. The list of liaisons is available at http://www.usgs.gov/ngpo/ngp_liaisons.html

Further Information

Further information about *The National Map* and orthoimagery is available from the National Geospatial Program at <http://www.usgs.gov/ngpo/>.

For information on other USGS products and services, call 1-888-ASK-USGS, or visit the USGS Publications Warehouse at <http://www.usgs.gov/pubprod/>. For additional information, visit the USGS home page at <http://www.usgs.gov/>.

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