

# IMAGERY USE IN ENVIRONMENTAL ENFORCEMENT

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## ABSTRACT

The US EPA National Enforcement Investigations Center in Denver, Colorado uses imagery products in different phases of environmental investigations. In the targeting and prioritization phase, imagery can provide information about an area's population, natural systems, and obvious environmental impact. In the planning phase, change detection provides insight into process or operational changes as well as possible illegal activity. The field inspection phase makes use of imagery by providing the opportunity for "virtual field reconnaissance" to help familiarize field personnel with a site they may have never visited. Once the field team arrives on site, imagery provides a base map for geophysical, sampling, ground verification, and analytical activities, thus supporting the field inspection phase of an environmental investigation. Regular updates to image archives provide a method to monitor a specific area without requiring a field visit. This conserves resources and minimizes risks to field personnel, thus supporting a compliance monitoring phase. Finally, imagery also supports the evaluation and communication phases by providing a crucial visual element in reports, court-room exhibits, and technical presentations. Each phase in an environmental investigation has specific imagery requirements which vary depending upon the case objectives.

## INTRODUCTION

There are many sources of imagery that can be used for practical environmental enforcement applications. Once the investigator has defined the case objectives and enforcement function, imagery specialists can assist with determining the analytical and quality assurance requirements. Acquisition, management, documentation, certification, and affirmation of imagery products are typically done on a case by case basis. For example, if an image product reveals possible criminal activity, the chain-of-custody as well as certification of authenticity requirements is much tighter than an image product simply being used as a base map for field activities. Table 1 lists some image product requirements for various enforcement functions.

Table 1: Imagery Product Requirements for Enforcement Functions

Enforcement Function	Delivery Time	Legal Certifications	Historical Coverage	Resolution
Targeting	< 8 weeks	Metadata, specialist interpretation	Yes	Low to high
Project prioritization	< 4 weeks	Metadata, specialist interpretation	No	Medium to high
Planning	< 4 weeks	Metadata, specialist interpretation	Yes, if for geophysical focus or process evaluation	Medium to high
Field support	< 1 week	Source information	No	High
Site monitoring	< 8 weeks	Metadata, specialist interpretation	Yes	Medium to high
Illustrations	< 4 weeks	Source information	Yes, if for geophysical focus or process evaluation	Low to high

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## FURTHER DEVELOPMENT OF IMAGERY USE

The demand for imagery is increasing within the scope of environmental applications. Imagery provides intelligence to aid the investigator in performing the various enforcement functions. The continued development of readily available digital imagery product has expanded its use in the enforcement community. There are areas that can be improved and marketed by imagery suppliers to increase the use of imagery products in an environmental context.

### Required Features for Imagery Products

Aerial and remote-sensing imagery products have and will continue to support environmental investigations. Future development of nonvisible spectral bands, LIDAR, and RADAR remote-sensing will require quality imagery products for georeferencing remote sensing data that may be used in enforcement actions. Table 2 summarizes the current procedures followed in supporting environmental enforcement actions (Brilis, 2000) and the desired product or service to support those procedures.

Table 2: Products and Services of Interest to the Support the Environmental Investigator

Function	Product/Service Needed
Acquisition	<ol style="list-style-type: none"> <li>1. Streamlined procurement method for aerial or satellite image collection</li> <li>2. Ability for rapid image collection to support criminal or emergency cases</li> <li>3. Rural coverage availability</li> </ol>
Indexing and Archiving	<ol style="list-style-type: none"> <li>1. Easily accessible archive for determining historical coverage availability</li> <li>2. Indexing of archived aerial image prints and negatives</li> <li>3. Maintaining security of sensitive images</li> <li>4. Georeferencing for GIS</li> </ol>
Chain-of-custody	<ol style="list-style-type: none"> <li>1. Record of acquisition and analysis</li> <li>2. Record of handling from supplier to shipper to customer</li> <li>3. Block the release of information that could compromise the investigation (i.e. releasing customer information about specific image purchases)</li> </ol>
Certification of authenticity	<ol style="list-style-type: none"> <li>1. Metadata in FGDC or required format</li> <li>2. Availability of sensor/camera specifications if needed</li> </ol>
Interpretation	<ol style="list-style-type: none"> <li>1. Specialists for visibility analysis, spectral evaluations, vegetation index</li> <li>2. Produce digital imagery in useable GIS format</li> </ol>

Other desirable features for imagery products also include interpretation of ground based photography with overhead imagery to support investigations involving buried materials. Low-cost seasonal coverage of specific sites, access to images via secure internet connection that meet enforcement sensitivity requirements, and availability of smaller file size images for use with a Pocket PC or GPS data logger are also services that are growing in demand.

### Increased Acceptance of Imagery Use

The important *Dow Chemical Co. v. United States* case involving the use of aerial photography by a federal authority conducting an investigation paved the way for environmental professionals to be able to make use of aerial and satellite imagery (Brilis, 2000). The outcome of the *Dow* case settled questions about image acquisition and privacy. Some questions abound about the acceptance of imagery use in enforcement actions. Ground verification provides a means to gauge the benefits derived from using imagery and to evaluate environmental protection efforts. Imagery has supported cases under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Clean Water Act, and the National Environmental Policy Act (Brilis, 2000). Imagery is growing in acceptance along with geographic information systems (GIS) within government, industry, and other organizations. Together imagery and GIS data are valuable to the investigator in terms of time, resources, and safety during an investigation.

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