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HOUSE PERMANENT SELECT
COMMITTEE ON INTELLIGENCE
AND HOUSE SCIENCE, SPACE
AND TECHNOLOGY COMMITTEE

STATEMENT OF

THE DIRECTOR OF THE
DEFENSE MAPPING AGENCY

MAJOR GENERAL WILLIAM K. JAMES, USAF

JOINT HEARING OF THE
HOUSE PERMANENT SELECT
COMMITTEE ON INTELLIGENCE
AND HOUSE SCIENCE, SPACE
AND TECHNOLOGY COMMITTEE

ON THE DEFENSE MAPPING AGENCY
USES OF LANDSAT

JUNE 26, 1991

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Mr. Chairman and committee members:

I welcome this opportunity to appear before you to present the current use of LANDSAT imagery within the Defense Mapping Agency (DMA) and to discuss modifications to the system that would make it more suitable for mapping, charting and geodetic (MC&G) production.

I. DMA's Use of Source Imagery.

DMA must have imagery to produce a wide range of MC&G products to meet the critical needs of the military forces in the Unified and Specified Commands. These products are all characterized by cartographic representations of natural and cultural features found on the earth's surface or beneath the ocean's surface. Such representations are presented on media ranging from traditional paper maps to Compact Disks and are produced at various scales, levels of detail, information content and positional accuracies.

In order to locate, identify and categorize features portrayed on our products we require current imagery to determine size, shape and other attributes. By imaging the same ground area from two locations (stereoscopic coverage), it is possible to determine the height of the earth's surface for representation as elevation contours or digital elevation data. To maintain currency of our products, it is necessary to collect imagery at different times to identify cultural or natural changes. To do so requires broad area image coverage. DMA uses high resolution imagery to provide precise coordinates of tactical and strategic targets in support of our military weapon systems. High resolution scenes of targets can also be produced. DMA also produces digital elevation data, including TERCOM (Terrain Contour Matching) data for cruise missile navigation, using high

resolution imagery. (The TOMAHAWK missile cannot fly without this product.) High resolution imagery is essential for, and the only source of, identification and attribution of certain small features required by map and chart product specifications.

To provide these products from imagery, several constraints are placed upon the collection system. The sensor must be capable of global stereo image collection and must be metric in order to determine position and attitude at the moment of collection. From this information, accurate ground positions can be measured with the required precision. Required resolutions range from approximately 1/2 meter to 10 meters to allow the identification and attribution of features to support military mapping. Finally, the sensor must allow access to all areas of the world for which military requirements exist.

It is most important to note that DMA's current film-based, analog production system and the new Digital Production System, now nearing completion, are both specifically designed to accept and efficiently exploit optical imaging sensors.

II. DMA's Use of LANDSAT.

DMA's exploitation of LANDSAT imagery is limited due to:

- low resolution;
- lack of stereoscopic coverage;
- lack of precise metric (positioning) data.

We do, however, use it to produce several interim special purpose and crisis support products, and to support hydrographic, bathymetric, and terrain categorization products. These applications exploit the unique value-adding characteristics of LANDSAT multispectral imagery. LANDSAT

image maps are produced by using three selected bands to make a natural color photograph which is printed at a 1:100,000 scale, with map grid data and margin data. To provide interim support for mapping requirements of the counternarcotics program, 192 LANDSAT image maps were produced of Peru, Columbia, Bolivia and Panama. In similar support to Operation DESERT SHIELD/STORM, DMA produced 122 LANDSAT image maps over Saudi Arabia, Iraq and Kuwait, in order to provide an interim product until standard topographic line maps could be produced.

Hydrographic products also benefit from the multi-spectral capabilities of LANDSAT. It can be used as an ancillary source to provide information about water depth and subsurface hazards in shallow water. DMA currently uses LANDSAT for the detection of subsurface hazards to navigation in shallow coastal waters and, if detected, Notice to Mariners warnings are posted and survey assets deployed to chart the hazard. LANDSAT is also used in the pre-survey planning operations to support collection of bathymetric and acoustic data.

Additionally, LANDSAT is used by DMA as a supplemental source of information to produce terrain analysis products. Information such as soil composition, soil moisture content and vegetation classification can be obtained through the use of the multispectral data.

III. DMA's Need for Broad Area Imaging.

DMA does not currently receive sufficient imagery coverage to support our mapping and charting mission. Thus, a broad area collector, such as an improved LANDSAT, would mitigate our imagery shortfall. The combination of such a broad area collector (with the characteristics described below) and continued availability of current assets would be optimum for our mapping mission.

IV. DMA's Future Use of Multispectral Data.

As I have indicated, our current use of LANDSAT is limited by system design. To provide truly effective support of the military mapping mission, a collection system would need the following:

- 3-5 meter ground resolution;
- 5-band spectral resolution;
- precise metric data;
- stereoscopic coverage;
- broad area collection.

However, it should be noted that if DMA were to produce products using an imagery source like that described above, it would require significant changes to our production process. The estimated cost to rewrite Digital Production System software in order to use enhanced multispectral data is between \$20M and \$30M. It is also estimated that production costs for some products could increase as much as 35 percent. However, DMA's ability to meet user requirements would definitely improve as a result of the availability of this additional broad area source imagery.

In summary, DMA currently makes some use of LANDSAT imagery to augment our imagery source materials and to produce interim products in uncharted areas pending the completion of standard topographic products. An improved collector would allow DMA to make significant use of its products and reduce our current backlog. It would complement the current assets on which DMA production processes depend and help reduce or eliminate the broad area collection shortfall.



DMA's Use of LANDSAT

DMA Uses of Current LANDSAT:

Limited To: Interim Special Purpose and Crisis Support Products

Limited By: Low Resolution
Lack of Stereoscopic Coverage
Lack of Precise Metric (Positioning) Data



DMA Requirements

Comparison of DMA Requirements and Current LANDSAT Capabilities for Selected Characteristics:

<u>CHARACTERISTIC</u>	<u>DMA REQUIRED</u>	<u>CURRENT LANDSAT</u>
Resolution	3-5 Meters	30 Meters
Stereoscopic Coverage	Yes	None
Metric Data:		
Positioning Data	GPS	None
Orientation Data	Star Sensors	None



High Resolution Imagery

The Following Are Examples of Features That Require High Resolution Imagery for Identification and Attribution to Satisfy Military Requirements:

- Lineal - Fences, Power Lines, Hedge Rows
- Areal - Drydock, Buildings, Bridges, Mobile Home Parks
- Point Features - Towers, Flare Pipes, Tunnel Tubes, Wells
- Others - Ferry Crossings, Bouys, Achorage, Reef, Spring, Cave, Culverts



Resolution

The Following Chart Compares Image
Quality at Resolutions of:

5 Meters

10 Meters

30 Meters



Stereoscopic

Two images taken from two exposure stations with sufficient overlap to allow measurements of an object common to both

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Metric (Positioning) Data

The precise latitude, longitude and height of a calibrated imaging system and its orientation with respect to the earth allows image measurements to be translated into accurate ground coordinates



DMA's Use Of Source Imagery

Primary Source Material For Production --

Imagery