



United States Department of the Interior

GEOLOGICAL SURVEY
EROS Data Center
Sioux Falls, South Dakota 57198

IN REPLY REFER TO: OC 8-2

August 5, 1985

Mr. Edward F. Conlan
Chief, Landsat Operations Division
NOAA/Goddard Space Flight Center
(Code 435.7) Building 28
Greenbelt, Maryland 20771

Dear Ed:

Enclosed is the planned baseline of Landsat data handling and processing activities to be performed at the EROS Data Center (EDC) during FY 86. This baseline is generally a continuation of FY 85 functions currently in operation at EDC. Projected FY 86 costs are \$6,700,000, an increase of approximately \$450,000 over FY 85 baseline costs. This increase is due to inflation, plus we have included \$200,000 in the baseline for minor changes (unidentified at this time) that may be required as part of commercial transition. Any major changes required by commercial transition will have to be handled outside the \$6,700,000 funding level.

I would be happy to discuss at your convenience, any questions or comments you may have.

Sincerely,

Allen H. Watkins
Chief, EROS Data Center

Enclosure

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FY 1986 EROS Data Center Baseline

Landsat Data Handling and Processing Activities

The EROS Data Center (EDC) began operating the final data processing, data archives, and data product generation and distribution portions of the Landsat ground segment October 1, 1982, on a cost-reimbursable basis for NOAA. It is understood that after the commercialization contract is signed between NOAA and EOSAT, and EOSAT is the commercial operator of the Landsat program, funding for EDC Landsat related functions will continue to be transferred from NOAA.

Following is the baseline of Landsat data handling and processing activities to be performed at EDC during FY 86. This baseline is generally a continuation of FY 85 functions currently in operation at EDC and has been structured into logical categories including a discussion of the functions performed, performance levels planned, and corresponding costs. The projected \$6.700 million required in FY 86 is to cover EDC operating costs and does not include capital expenditures for new systems or major modifications to existing systems. Included in the \$6,700,000 is however, \$200,000 to cover minor changes (unidentified at this time) that may be required by NOAA. EDC performance of the baseline data handling and processing activities is contingent on interface data (MSS and TM) and required related information and activities conforming to the Interface Control Documents (ICD's) and agreements that have been established between NOAA and the USGS for Landsat.

I. Data Receipt and Cataloging

A. Landsat MSS Data

MSS partially processed High Density Tape-A (HDT-A) data will be received at EDC nominally 5 days/week via Domsat communications link and recorded on HDT's. Approximately three hours/day of Domsat communications link time will be scheduled to receive 100 to 140 scenes/day. Two to three HDT's (assuming 50 to 60 scenes/tape) will be generated daily for final processing and archiving. Data received that are not processable will be retransmitted if retransmission has a reasonable chance of correcting data problems. A retransmission rate of approximately 2 percent can be anticipated.

B. MSS Inventory Information

Corresponding Goddard HDT Inventory Tape (GHIT) information that describes each of the incoming MSS scenes will be received via the Decnet established between GSFC and EDC and recorded on CCT's. The GHIT information will be processed by the INquiry, ORder,

and ACcounting (INORAC) processing system to update the Main Image File (MIF) and schedule subsequent MSS image processing operations. The MIF is a computerized inventory of the data archived at EDC.

C. Landsat TM Data

Fully corrected, full-scene black-and-white 241mm TM positive film (30 to 50 scenes/day, 5 days/week) and fully and partially corrected quadrant scene TM CCT's (10 to 14 scenes/day, 5 days/week) will be received by mail at EDC. The incoming data will be inspected, verified and cataloged.

D. TM Inventory Information

Corresponding Goddard Film Inventory Tape (GFIT) information that describes each of the TM scenes received will accompany the TM film data. The GFIT information will be processed by the INORAC processing system to update the MIF and schedule subsequent TM image processing operations. During TM CCT verification, MIF update information will be extracted from the CCT's and processed into INORAC.

E. Historical and Retrospective Landsat MSS Data

Selected historical Landsat MSS data acquired during the years 1972 through 1978 are being converted from wideband video tape (WBVT) to CCT-X format at GSFC and sent to EDC for archiving and reproduction. Approximately 45,000 scenes are required from this seven-year period of interest, of which about 20,000 have been produced. Retrospective customer orders for Landsat digital data that does not reside at EDC (1972-1978) are also produced at GSFC from the WBVT's and sent to EDC for reproduction and dissemination to users. GSFC current CCT production rate is about 125 scenes/week and is expected to remain at this level. Upon receipt at EDC, both historical and retrospective CCT's are inspected, verified and cataloged. These data are stacked (3 scenes/tape) on 6250 BPI tapes to minimize archive storage requirements.

II. Data Processing and Archive Creation

A. Landsat MSS Data

Each scene of incoming MSS data will be processed in a pipeline mode beginning with the EROS Digital Image Processing System (EDIPS) ingesting the partially processed HDT-A data, verifying readability,

correcting geometry, and generating high-resolution black-and-white 24lmm latent negative film. Data that cannot be processed thru EDIPS will be evaluated to determine the problem. If retransmission of the data will solve the problem, retransmission will be requested. If, however, reprocessing by GSFC is required, several parameters will be examined before the data are reordered. EDIPS will be operated nominally 5 days/week - 2 shifts/day and pipeline process 100-140 scenes/day. Maintenance will be performed as needed during the remaining shift.

EDIPS latent film will be processed in the photographic laboratory by a special product line dedicated to Landsat archival film. The photographic laboratory which will be operated nominally 5 days/week - 2 shifts/day will support EDIPS film processing requirements. The processed film will be inspected for quality and cloud cover, and chipped into working masters. The quality and cloud-cover information will be used to update the MIF. The data are considered to be in the public domain at this time (3 to 5 working days after data receipt at EDC) and available for ordering by users. The HDT's will be archived and the film chips used to generate user products and accession aids. These working masters will be replaced as needed by reprocessing the HDT-A data through EDIPS.

Both EDIPS and photographic laboratory processing will be controlled by work order cards generated by the INORAC system.

B. Landsat TM Data

GSFC produced TM roll film will be assessed for quality and cloud cover and then reproduced to generate working master chips. The quality and cloud-cover information will be used to update the archive records. TM film that does not meet agreed to GSFC-EDC specifications will be reordered from GSFC. The GSFC produced roll film will be archived and the reproduced working master chips will be used to generate user photographic products and accession aids. The data are considered to be in the public domain at this time (3 to 5 working days after data receipt at EDC) and available for ordering by users. Replacement working masters will be reproduced from the archive roll as needed.

TM digital data (CCT's) will be inspected for physical defects such as tape damage, improper labelling,

uneven tape wind, and for tape content errors such as improper indicators for record/scene I.D., record types, record length, numeric range of video data, and occurrence of parity errors. CCT's failing inspection or verification will be reordered from GSFC. CCT's passing inspection and verification will be archived until needed to produce user products.

III. Archive and Data Base Maintenance

A. Landsat Data Physical Archives

In addition to current and future Landsat MSS and TM data, substantial quantities of historical Landsat MSS, RBV, and TM data reside at EDC in the form of black-and-white 70mm film rolls, black-and-white and color 241mm film chips, CCT's and HDT's, which are stored in the digital tape library and roll/chip film archive. Table 1 gives a breakdown of the EDC Landsat archive as of May 1985.

The tape library consists of about 4,400 square feet of environmentally (temperature and humidity) controlled floor space in the EDC basement. Approximately 11,700 HDT's (264,609 scenes) and 19,500 CCT's (34,175 scenes) are stored in this area in compact movable shelving built specifically to archive digital tapes. The current archive is sufficient for an estimated 3 to 4 years at projected growth rates of TM CCT's and historical MSS CCT's. The current archive space is sufficient for Landsat HDT's for an estimated 4 to 5 years.

The film archives are environmentally (temperature and humidity) controlled and cover some 2,000 square feet of on-site floor space. Approximately 42,000 rolls of 70mm film and 850,000 241mm chips are stored in movable compact shelving built specifically for film archiving. Landsat MSS and TM film chips are stored in the Photographic Laboratory and TM film rolls are stored in Data Management. In addition, some 23,400 rolls of duplicate 70mm Landsat 1, 2, and 3 film are stored in an off-site facility. Daily maintenance of the on-site archives is required nominally 1 shift/day - 5 days/week for physical upkeep, tape and film handling, cleaning, etc.

B. Landsat Data Base

In addition to the physical archive, reference information (including scene ID, date acquired, cloud cover, quality, etc.) about each scene archived will

be maintained in the INORAC MIF. The MIF will receive a preliminary update as each scene of new data arrives at EDC and then a final update when the scene has completed inspection and archival processing and is available to users. The MIF included 652,000 Landsat accessions as of May 1985. Daily maintenance is required nominally 1 shift/day - 5 days/week to make error corrections, changes, and updates to assure MIF integrity and efficient data management operations. Also included in the data base is reference information about holdings of certain other foreign countries (currently Argentina, Australia, Brazil, Canada, Italy, South Africa and Sweden).

IV. Customer Interface

A. User Services

Interface with Landsat data customers will be accomplished by the EDC User Services Section and the network of National Cartographic Information Center (NCIC) sites and State affiliate offices spread across the country. Major interface functions that will be performed include: processing all requirements for TM and MSS data acquisition which includes user special acquisitions and basic data set requirements; responding to inquiries about data availability; processing orders for data products; accounting and billing procedures associated with data acquisition and user products; handling customer complaints; and maintaining up-to-date inquiry forms, order forms, price lists, CCT user documentation, etc. User Services will operate nominally 5 days/week - 1 shift/day. NCIC and affiliate offices Landsat-related support costs are not included in the FY 86 cost estimate as they are negotiated directly between NCIC and NOAA.

B. INORAC Support

In addition to supporting the user interface functions mentioned above, the INORAC system supports remote terminals located in User Services (21), the NCIC Offices (17), NCIC State Affiliate Offices (16), other Federal and State Offices (25) and private industry and universities (22). The INORAC system will be online for nationwide access nominally 11 hours/day - 5 days/week. Hook-up of new terminals to the network will continue to be controlled per established EDC procedures and criteria regarding remote terminal access.

C. Landsat Accession Aids

In addition to the INORAC system, manual accession aids will be produced and updated that will enable users to determine availability of Landsat data. These include copies of 26 Worldwide Reference System (WRS) indexes that reflect the Landsat path and row intersections (nominal scene centers); microfiche catalogs of MSS, RBV, and TM scenes acquired that will be updated monthly for North America and quarterly for other regions of the world; and 16mm microfiche (1 black-and-white band) of Landsat data available.

D. Landsat Information

Users are currently kept informed about Landsat status, acquisition/ordering statistics, new product developments, data applications, training courses, symposia, and general information of interest about the Landsat program via the Landsat Data Users Notes and other bulletins and announcements. The Notes are published quarterly, bulletins and announcements as needed, and distributed to approximately 8,000 addressees.

V. Product Generation and Distribution

A. Landsat Photographic Products

A Photographic Laboratory for high throughput production of standard photographic products and custom products requiring special photographic processing will be maintained. Fully corrected photographic products will be available in film and paper, in positive and negative format, in black-and-white and color, and in sizes ranging from 35mm to 40 inches. User products will be inspected for cosmetic and photographic defects.

Standard products will be generated from the archival working masters. Orders requesting special EDIPS processing, such as a different map projection or resampling algorithm or enhancement (edge enhancement or contrast stretch) will be generated from special-order EDIPS film (requires a separate run on EDIPS). Orders requiring special photographic processing--such as nonstandard image scale (enlargement), color balance, density, or base material--will be produced by the Photographic Laboratory. MSS false-color products will normally be made from color working masters that have been generated by sequentially exposing blue,

green, and red filtered light through bands 1, 2, and 4 respectively of the black-and-white 2nd generation positives. Color working masters will be archived but not routinely replaced when damaged or worn out. Color working masters are generated on demand to produce user products. Development activities will continue to determine the optimum bands to use for false and natural color TM products. Bands 1, 2, 3, and 2, 3, 4 are currently used for TM natural and false color, respectively.

The photographic laboratory will be operated nominally 5 days/week - 2 shifts/day. Photographic laboratory production, scheduling, and statusing will be controlled by INORAC. Projected volumes and target turnaround times are reflected in Table 2.

B. Landsat Digital Products

Both fully corrected and partially corrected digital products will be produced for users. CCT's of MSS data (post January 1979) will be produced by EDIPS during a special run after the pipeline process is finished. Floppy disk products are also available from this MSS data set. Floppies are cut from EDIPS produced CCT's and sent to users. Floppy disks are not archived. TM CCT's will be produced at GSFC, based on user demand, sent to EDC for reproduction and dissemination to the customer. EDC has the capability to convert from 6250 BPI to 1600 BPI but cannot convert from BSQ to BIL and vice versa. A copy of all TM CCT's will go into the EDC archive for subsequent reproduction as needed. User documentation for the new quadrant scene TIPS CCT's will be disseminated to CCT users as required. Customer CCT's of historical (pre-January 1979) MSS and RBV data will be reproduced from the CCT's in the EDC archive or produced retrospectively at GSFC and forwarded to EDC for reproduction and dissemination. Digital data production will be carried on nominally 5 days/week - 2 shifts/day. Projected volumes and target turnaround times are reflected in Table 2.

C. Special Product Handling

A special product line has been established to meet the unique MSS product and timeline requirements of the agency. This consists of a special pre-pipeline EDIPS run to generate CCT data, then direct color film generation on the color Fire recorder, and nonstandard processing in the photographic laboratory. The same non-standard photo processing will be used for agency

TM photographic products. Provisions are also included to support the LEAP system that has been established by NOAA. Provisions for handling other large volume special production requirements are not included in this baseline.

D. Product Shipment

Product shipment to customers will be done primarily by 1st class mail and UPS. Special requests for urgent or disaster situations will be handled by registered mail, Emery Air Freight, Federal Express, etc., or whatever necessary to meet those requirements.

VI. Equipment Maintenance and Logistics Support

Performance of the Landsat data handling and processing functions will require extensive equipment maintenance and logistics support. Consistent and reliable preventative and remedial maintenance of both electronic computer and photographic processing equipment will be provided to assure a system effectiveness level of 85 percent. Systems will be maintained normally by an in-house staff of electronic and mechanical maintenance technicians who are devoted to maintenance activities for high- and low-density tape recorders, EDIPS system components, laser beam film recorders, the color Fire recorder, photographic printers and processors, and related support equipment. Logistics support will be provided for the large quantities of high- and low-density tapes, film and chemistry rawstock, accession aid materials, forms, etc., needed.

VII. Software Maintenance

Computer software systems supporting Landsat data handling and processing activities require periodic maintenance and modification to improve data and information flow, resolve minor interface problems between EDC and GSFC, and provide unique management reporting information and statistics.

VIII. NOAA Administrative Support

Office space, secretarial support, and related administrative support will be provided for one or two NOAA on-site representatives. EDC will advise and assist NOAA in anticipating the volume of data products and services likely to be required by users each year; making changes to data products and services available to users; and pricing of available data products and services.

IX. EOSAT Support

Office space will be provided for one or two EOSAT on-site representatives. Limited funding (\$200,000) is included in FY 86 for minor changes required by NOAA to support plans for increased Landsat marketing and sales activities, etc.

X. FY 86 Operating Costs

The following EDC operating costs are projected for FY 86. Costs for equipment maintenance and logistics support which are spread across each of the major functions cannot be readily broken out of the cost accounting system.

<u>Function</u>	<u>Cost</u> (in thousands)
Data Receipt and Cataloging	\$ 732.2
Data Processing and Archive Creation	1,771.3
Archive and Data Base Maintenance	278.6
Customer Interface (User Services)	681.8
Product Generation and Distribution	2,820.2
Software Maintenance	161.3
NOAA Administrative Support	38.0
EOSAT Support	<u>216.6</u>
Total	\$6,700.0

TABLE 1LANDSAT ARCHIVE
as of May 1985

	<u>Total # of Unique Scenes</u>	<u>Archive Media (Scenes)</u>				
		<u>70 mm Film (Roll)</u>	<u>241 mm Film (Chip)</u>	<u>Computer Compatible Tape (CCT)</u>	<u>High Density Tape (HDT)</u>	<u>Color Composites</u>
Landsat 1	145,857	150,516	————	22,977	————	5,394
Landsat 2	185,119	143,698	41,032	8,067	46,613	7,115
Landsat 3	236,642	112,730	117,527	1,154	140,979	2,634
Landsat 4	39,022	————	38,862	277	40,143	474
Landsat 5	<u>40,179</u>	<u>————</u>	<u>40,333</u>	<u>1,700</u>	<u>36,874</u>	<u>448</u>
TOTAL	646,819	406,944	237,754	34,175	264,609	16,065

TABLE 2

Projected FY86 Landsat Production Volumes
and Target Timelines

<u>Item</u>	<u>User Products</u>	<u>Archive/Working Master Intermediates</u>	<u>Target Delivery Times</u>
<u>Photographic</u>			
TM	-	91,000 Frs.	3-5 days from receipt of data at EDC
EDIPS	-	145,600 Frs.	3-5 days from receipt of data at EDC
B/W Film	22,000 Frs.	20,000 Frs.	7-10 days from receipt of order at EDC*
B/W Paper Contact	9,000 Frs.	-	5-7 days from receipt of order at EDC*
B/W Paper Enlargement	5,000 Frs.	-	7-10 days from receipt of order at EDC*
Subtotal	36,000 Frs.	256,600 Frs.	
<u>FCC & Color Film</u>			
Color Paper Contact	4,500 Frs.	5,000 Frs.	10-12 days from receipt of order at EDC*
Color Paper Enlargement	1,000 Frs.	-	5-7 days from receipt of order at EDC*
	2,000 Frs.	-	7-10 days from receipt of order at EDC*
Subtotal	7,500 Frs.	5,000 Frs.	(add 10-12 days if FCC master does not exist)
Total Photographic	43,500 Frs.	261,600 Frs.	
<u>Accession Aids</u>			
Microfiche	750 Sets	40 Sets	Master 5 days, dupe time 2-3 days
MicroCatalog	110,000 Fiche	3,300 Fiche	Master 2 weeks, dupes 1-2 weeks
Total Acc. Aids	110,750 Items	3,340 Items	
<u>Digital Products</u>			
HDDT's	-	36,400 Scenes	2-3 days from receipt of data at EDC
CCR's	7,000 Scenes/Quads	14,500 Scenes/Quads	2-3 days from receipt of order at EDC*
Floppy Disks	750 Items	-	2-3 days from receipt of order at EDC*
Total Dig. Products	7,750 Items	50,900 Items	
Grand Total Items	162,000 Items	315,840 Items	

* assumes data resides at EDC