1013105

Energy, Mines and Resources Canada
Canada Centre for Remote Sensing

Énergie, Mines et Ressources Canada
Centre Canadien de Télédétection

An Economical Approach to ERTS Data Reception and Dissemination

E. Shaw

This document was produced by scanning the original publication.

Ce document est le produit d'une numérisation par balayage de la publication originale.

Technical Note 74-2
February 1974

An Economical Approach to ERTS Data Reception and Dissemination

Originally presented at U.N.
Task Force Meeting on Remote
Sensing, New York, February 1974

Technical Note 74-2
February 1974

E. Shaw
Chief, Data Processing Division

Canada Centre for Remote Sensing
Department of Energy, Mines and Resources, Ottawa

ABSTRACT

Canada has participated in the ERTS programme by building a tracking and recording facility at Prince Albert, Saskatchewan, and a data processing facility at Ottawa. The cost of purchasing and integrating this equipment represented an investment of approximately $6 million. The further development of a quick-look image recording facility at Prince Albert illustrates an alternate rapid and economical method of producing and distributing imagery, which could be used on a regional or global scale for the dissemination of ERTS data.

RESUME

Le Canada a contribué au programme ERTS en construisant la station de poursuite et d'enregistrement de Prince Albert, en Saskatchewan, et an établissant un Centre de traitement des données à Ottawa. L'achat et la mise en service de ces installations a nécessité un investissement d'environ 6 millions de dollars. En mettant au point, par la suite, un dispositif d'enregistrement d'images par visionnement rapide (quick-look), à Prince Albert, le Canada a montré qu'il était possible de trouver une nouvelle méthode pour produire et distribuer des images de manière rapide et économique, méthode qui pourrait être utilisée pour la diffusion, à l'échelle régionale ou nationale, des données de l'ERTS.

1. INTRODUCTION

Canada has participated in the ERTS programme by building a tracking and record-facility at Prince Albert, and a data processing facility at Ottawa. These facilities have benefited from the development work which has been performed by NASA but have cost somewhat less than their American counterparts. The cost of purchasing and integrating this equipment represented an investment of approximately $6. million.

Unfortunately, the data processing facility at Ottawa proved unreliable and was unable to keep abreast of the new data. Consequently the quick-look image recording facility at Prince Albert was further developed in order to provide an alternate rapid method of producing and distributing imagery.

2. THE INITIAL CAPABILITIES OF THE PRINCE ALBERT STATION

In the beginning the prime function of this station was to receive and record the ERTS data on tape. A film recorder was used to perform a system quality check on the performance of the station and was also to be used for rapid dissemination of selected scenes such as forest fires and ice conditions. In Figure 1, one can distinguish a fire which is burning near the town of Stony Rapids, Saskatchewan and Figure 2 shows the ice conditions near the Ringnes Islands in the Canadian Arctic.

2.1 Distribution

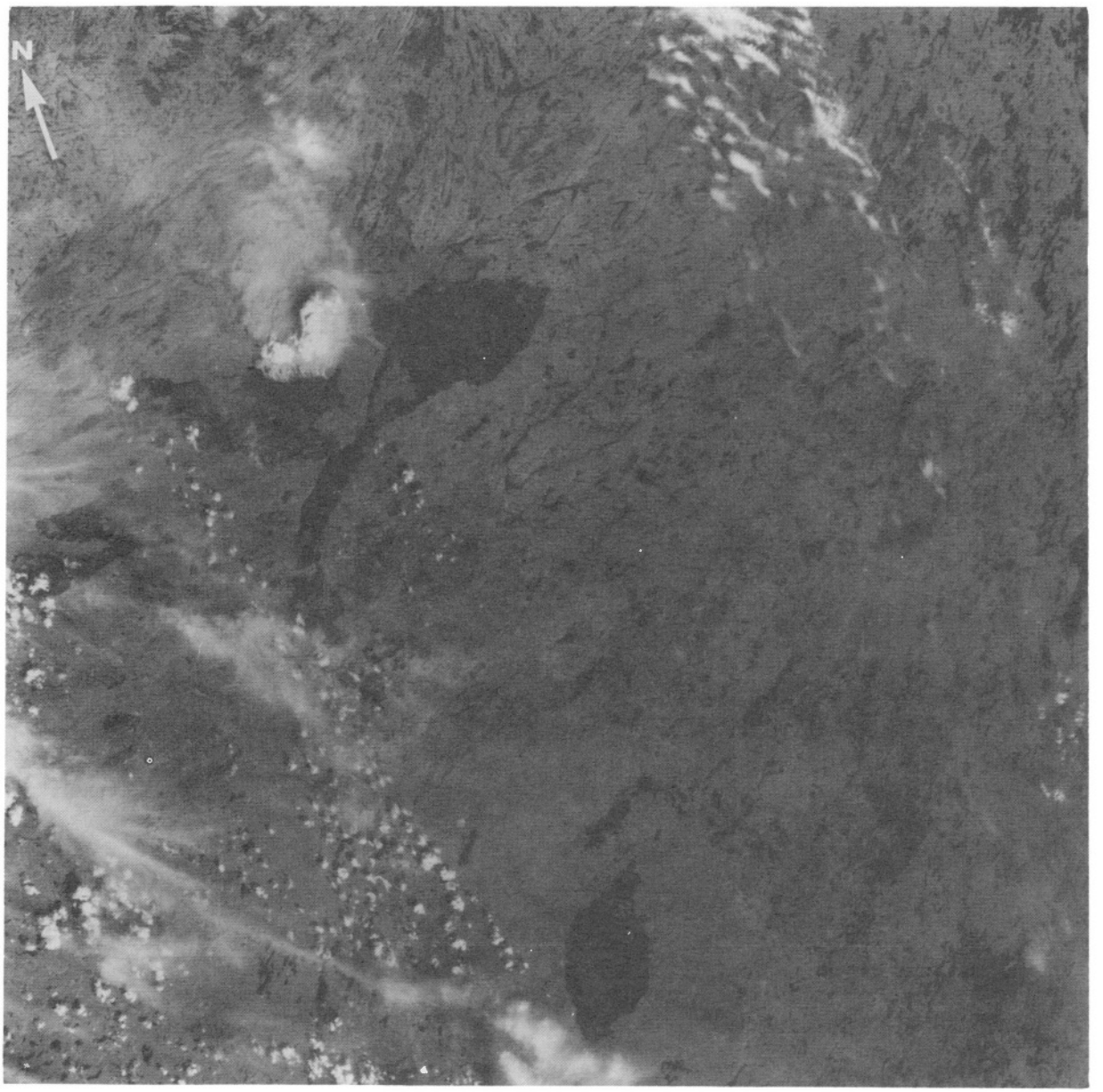
In order to provide rapid distribution services, a private firm was hired to photographically process the images. They provide a three day turn-around on B&W prints via mail or they use facsimile transmission equipment to send urgent data within a few hours of its reception at the station. The majority of the radiometric striping has been eliminated from these images by the use of analogue corrections, and the picture framing has been synchronised to give repetitive coverage and provide the potential for colour composite production. Each day, all images received are microfilmed and distributed within twelve hours as microfiche duplicates. The scenes are annotated with an index map number and date, to facilitate determining the geographic location of the image and the subsequent re-ordering.

2.2 Planned Capabilities

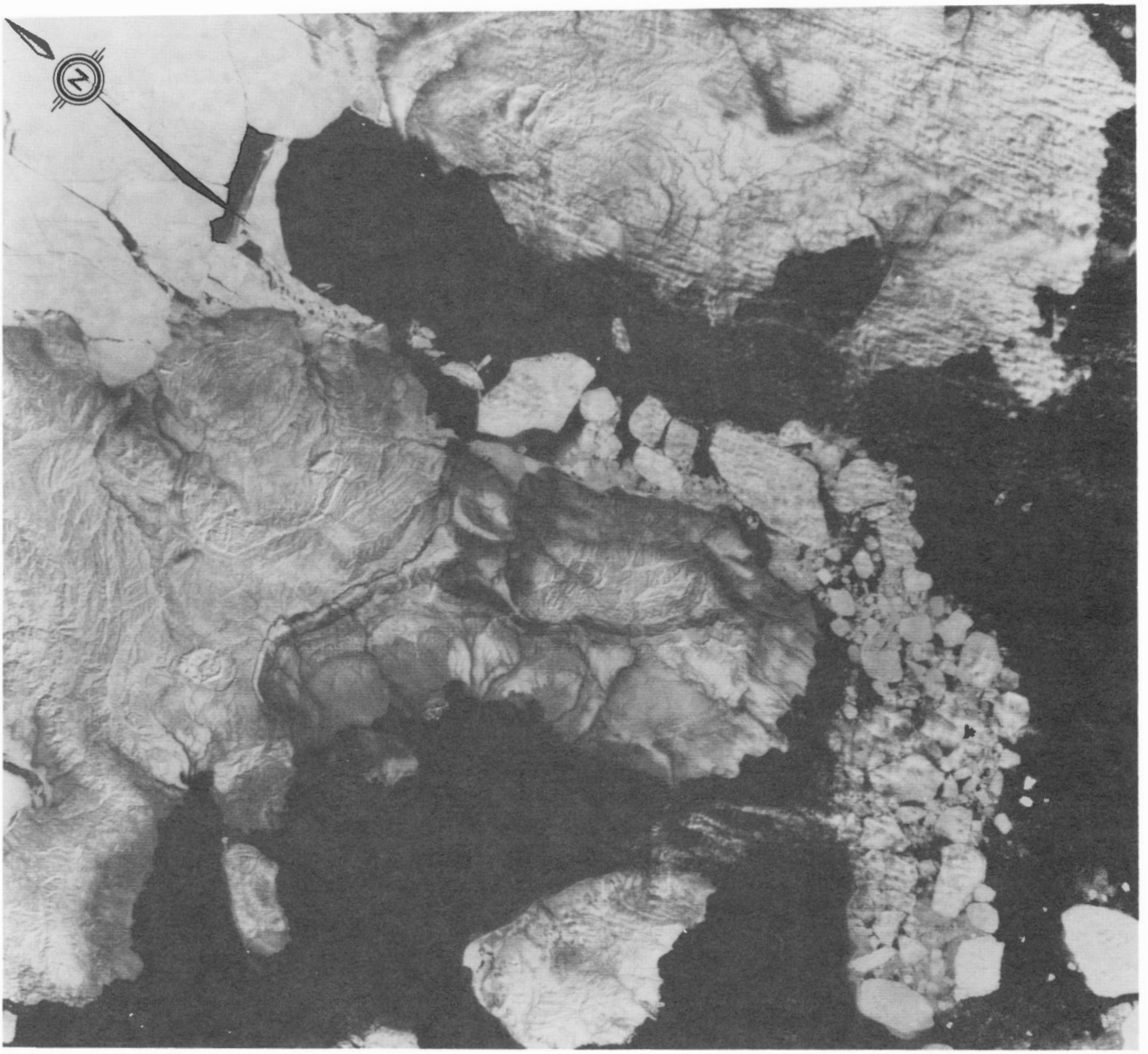
In 1976 earth rotation corrections will be introduced into these images and at a later date full digital radiometric corrections will be added. The camera/CRT recorder which is presently in use gives good print quality but it does not have the desired spatial resolution. The purchase of a B&W laser beam recorder, which would not only meet ERTS resolution needs, but would also be suitable for the projected resolution requirements of the EOS sensors, will be procured in 1976.

At present, photographic processing is performed manually on primitive equipment but the purchase of superior automated equipment is planned. A mini-computer facility for the production of computer compatible tapes will be added, and long-range plans include the replacement of the aging 85' antenna with a modern 30' one.

The Very High Resolution Data from NOAA - 2 and 3 satellites have been tracked and recorded. These data have a spatial resolution of 1 km and are sensed in both visible and near infrared bands; the swath width is sufficient to provide daily coverage of Canada.



F-1 ERTS Quicklook MSS Band 6 (28 June 1973) Stoney Rapids, Saskatchewan.



F-2 ERTS Quicklook MSS Band 6 (11 Sept. 1973) Showing ice conditions near The Ringnes Islands, Northwest Territories.

Based on present experience, it is now believed that an economical system which gives a rapid turn-around of high-quality imagery should be comprised of the following elements:

a) Tracking and recording system,

b) B&W photographic processing, including microfilming,

c) Information retrieval based on microfiche and index map annotation.

3. TRACKING AND RECORDING SYSTEM CAPABILITIES

This system has the capability of automatically tracking the ERTS satellites at S-band and it can be upgraded to acquire data from the NOAA satellite at L-band and the EOS satellites at X-band. It can simultaneously record the uncorrected RBV images directly on to film and the MSS data on to magnetic tape. The tape is replayed, one band at a time, to produce MSS bulk corrected images. The spatial correction compensates for the non-linearity of scan and the effects of earth rotation. A full complement of digital look-up tables perform the radiometric corrections and high resolution imagery could be obtained from a laser recorder.

3.1 Tracking and Recording System

The system, as illustrated in Figure 3, is basically the same as the one now in existence at our Prince Albert Station - apart from the use of modern components.

3.1.2 Tracking and Recording Equipment Costs

The costs of the receiving equipment are used for planning purposes, and were obtained from various manufacturers within the last year. The charges as shown in Table 1, are for capital equipment only - an integrated system would be more expensive.

3.2 B&W Photographic Processing Equipment

The master images and the microfilm master are processed by the low-cost processor which requires daily removal and refilling of its chemistry. The master images are retained on a daily roll of film and are spliced, if necessary, to retain their correct sequence. The microfilm camera is used to film all band 6 scenes which have been produced during the day. After processing, the film is inserted into the master fiche, which is then used for the duplicate microfiche production. Standing and back-log orders for prints and transparencies are produced on the projection enlarger which has an automatic repeat capability. These products are processed in a versamat which uses continuous chemistry replenishment in order to maintain its development activity and a complete exchange of chemistry is required on an infrequent basis. This equipment is intended to handle 100 microfiche and 500 prints of transparencies per day. (See Figure 4.)

3.2.1 Photographic Equipment Costs

The costs of this equipment, as listed in Table 2, were obtained from the manufacturers within the last six months. These include allowances for quality control equipment such as densitometers and sensitometers, and visual aids such as projectors and light tables.

Table 1 Tracking and Recording Equipment Costs

Antenna Including Mono-Converter, Paramp, Downconverter and Servo Sub-System	225K	
3 Receivers and Multi-Coupler	35K	
Bit Sync and Demux	77K	
Formatter (For Laser Recorder)	42K	(60K)
Annotation Switches, Time Code Reader/Generator	10K	
Digital Tape Recorder	70K	
CRT/70 mm Camera (Laser Recorder)	68K	(150K)
VPASS	54K	
Test Generator	9K	
System Cabling	20K	
	610K	(710K)

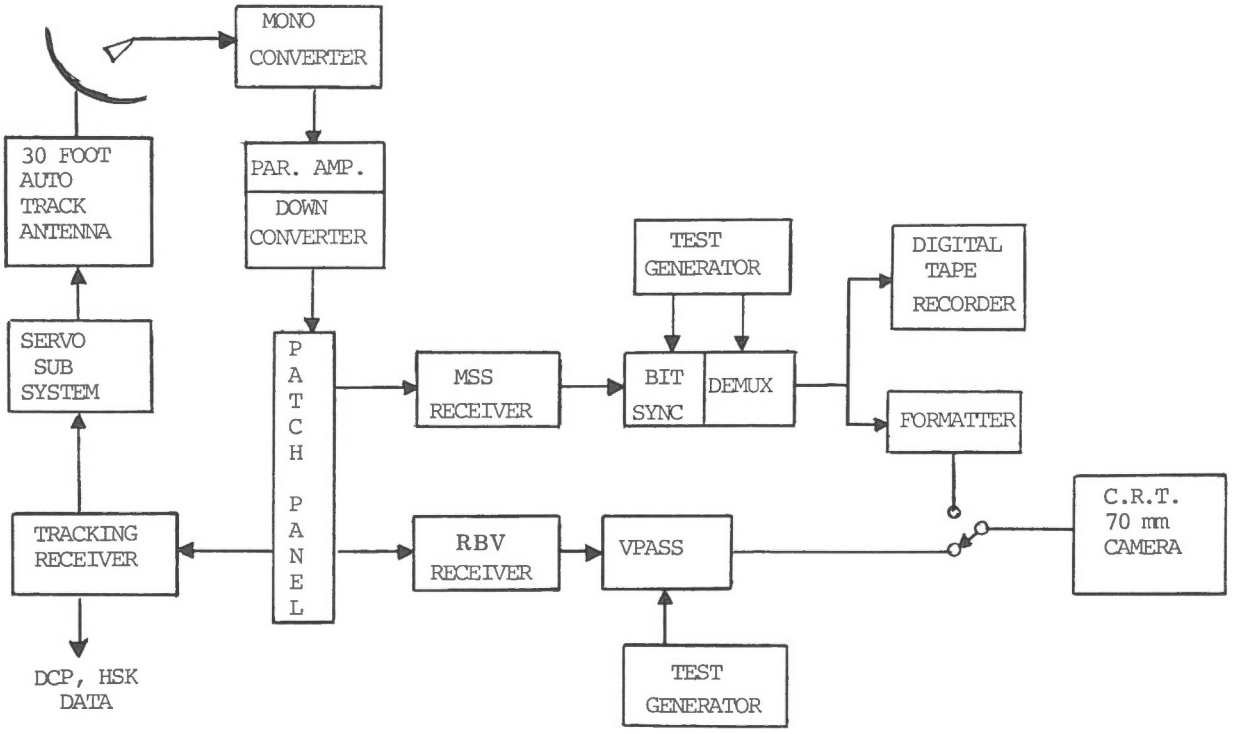


FIGURE 3 - TRACKING AND RECORDING SYSTEM

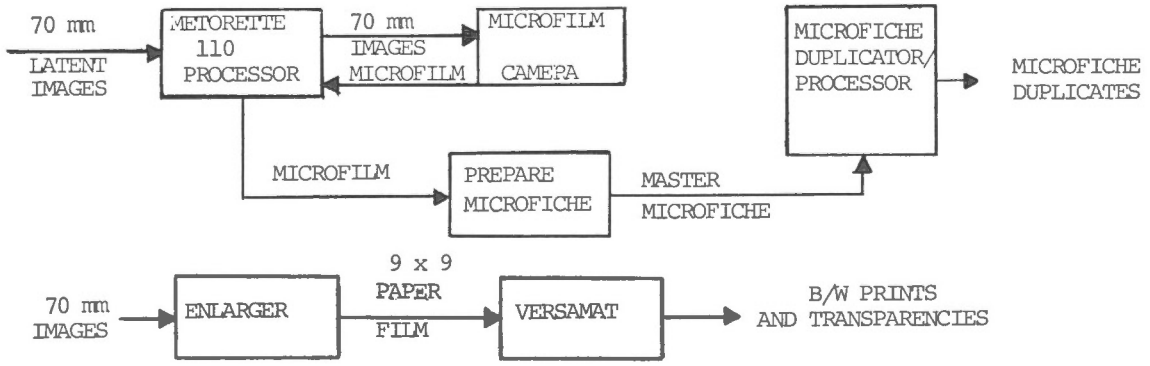


FIGURE 4 - B/W PHOTOGRAPHIC PROCESSING

Table 2 Photographic Equipment Costs

70 mm Film Processor	9.5K
Microfilm Camera	2 K
Microfiche Duplicator/ Processor	5 K
Printer/Enlarger	20 K
Versamat 11-C	28 K
Quality Control Accessories	4 K
Viewing Accessories	6.5K
Miscellaneous	6 K
	81 K

4. INFORMATION RETRIEVAL

The information retrieval system is based on an index map which shows the locations of the imagery by track number and the number of the image in the along-track direction.

Figure 5 shows the eastern portion of Canada with the orbit tracks numbering 1 - 16 from east to west. Using track number 1, the images along it are numbered 23 - 28. Thus the image showing St. John's is No. 01 F27. This indexing system could be used globally so that any ERTS image could be located by a unique track and frame number.

The images are annotated with this number, the band number, date and the NASA frame-id for cross-reference purposes.

4.1 Microfiche

Band 6 images are microfilmed and are inserted into microfiche jackets (see Figure 6) so that frames 1 - 11 appear in the first fiche, 12 - 22 appear in the second, etc. The rapid dissemination of microfiche is a low-cost method of ensuring that a visual catalogue of all imagery received at a site is quickly available to users for placing orders.

4.2 Maintenance of Data Bases

There are three data bases to be maintained:

a) the daily rolls of film containing indexed imagery,

b) the daily microfiche set,

c) a daily cloud cover assessment of the images, recorded along the picture centre numbers for that day.

All three data bases are stored by date in a matrix of 18 columns by 20 rows. The 18 columns in this matrix correspond to the eighteen-day cycle for the ERTS tracks, and the 20 rows refer to the number of cycles in a year. Thus the film and microfiche would be labelled by day-cycle number and date. This storage procedure ensures that repetitive film images are found in a vertical column in the storage container.

The daily cloud cover assessment is performed to support standing orders. The picture-centre numbers of all users, with orders for that day, are compared with the cloud cover threshold and a consolidated work order is then manually prepared.

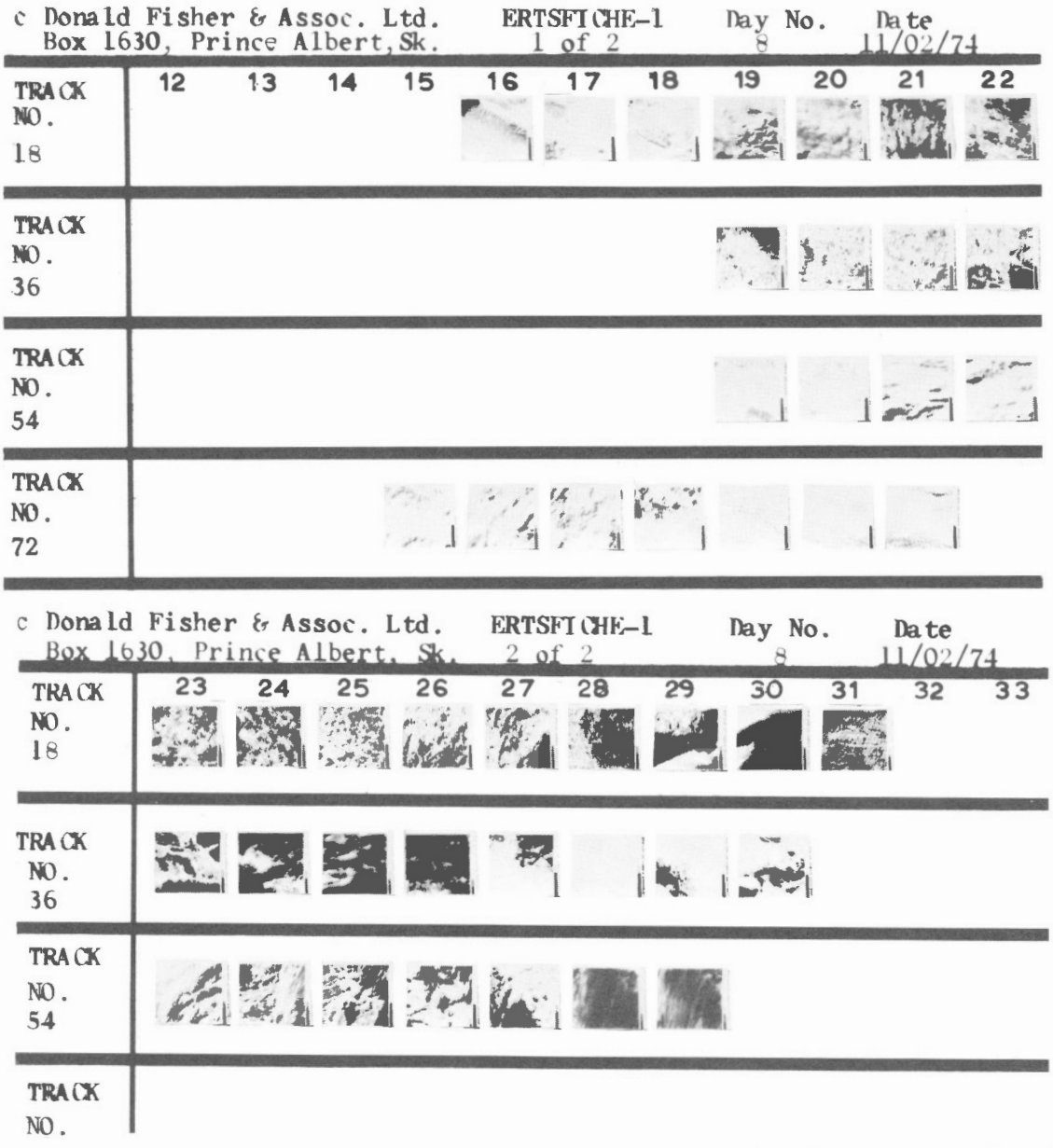
The frames for back-log orders are selected from the microfiche, so that the user knows the location of the cloud cover, if any, and can then order by picture centre number, date, band and product type. It is assumed that either local or individual libraries of microfiche are available to users and every few days these individual orders can be manually consolidated as work orders for production.

F-5 ERTS-1 Index Map Circles indicate the approximate location of image centres on the orbital paths. An image position is described by path number and image row number.

4.3 Expenditures

The acquisition costs of capital equipment have been listed in Table 1. Table 3 shows the estimates for additional costs which would have to be borne in order to have an operating system in a new location. The actual cost will vary depending upon the location of the system.

The annual operating costs, as shown in Table 4, are based on actual experience at Prince Albert, except for the photographic costs which are based on estimates only. The income is based on the throughput capacity of the system rather than on demand. In fact, the demand in Canada has been slightly less than the throughput



F-6 ERTSFICHE provides complete daily coverage of ERTS-1 over Canada. Filing by day and track number collocates successive images of a geographic area.

Table 3 Total System Cost Estimate

Building (14,000 sq. ft. conditioned area)	350K
Tracking and Recording Equipment	610K
Integration of Equipment (40% of above)	240K
Photographic Equipment	81K
Shipping	50K
On-site Training (4 Man-years)	150K
	11,481K

Table 4 Annual Operating Costs

EXPENSES	
Administrative and Security Services	45K
Operations and Maintenance, Tracking and Recording	110K
Building Supplies and Maintenance	50K
Magnetic Tape	120K
Spares and Test Equipment	60K
Operation and Maintenance, Photographic Processing, Etc.	180K
Photographic Supplies	80K
Total Expense	645K
POTENTIAL INCOME	
Print Sales (500 x 365 x $2)	365
Microfilm Sales (100 x 365 x $3.33)	121
Total Income	645K
Net Operating Cost	159K

capacity, and as the microfiche service has only recently started, it is difficult to estimate its demand.

Also, the total demand for Canadian computer tapes has amounted to only 170 tapes,* unlike the United States where the more sophisticated users are turning to tape analysis. For this reason, tape production was not included in this system, however, it could be added at a cost of approximately $100K. The tape analysis and interpretation equipment would be more expensive and would currently cost approximately $300K.

5. TRAINING APPROACH

A suggested approach to the training of personnel to operate and maintain the station, and to use the data, would consist of the following phases:

a) Key personnel to visit existing receiving sites and to take courses in image interpretation.

b) Station to be operated by contractor personnel who would be on the site during the first year.

c) Initial interpretation to be performed by using photographic products and visual aids, including colour additive viewers.

d) Computer tape production and automated analysis should be introduced at a later stage.

6. REGIONAL AND INTERNATIONAL EXTENSION

In summary, the approach described in this paper has illustrated that a map indexing system and a microfiche data base could be used on a regional or global scale for the dissemination of ERTS data.

* CCT usage has since increased substantially - to over 1000 as of October 1975.

In the regional centre, copies of the m microfiche and film rolls representing the daily reception could be dispersed to all nations, who would then have all the imagery received by the centre. Further processing and distribution would be done by these national centres. It would be possible to restrict the distribution of this data by national boundaries but this would present operating difficulties and, of course, the host nation would have access to all data received.

A low cost approach to the United Nation's international library would be for the library to receive only microfiche copies from all the receiving stations. This would ensure that there was an international browse facility of up-to-date imagery available for placing imagery orders. The orders would then be placed with the regional centres who obtained the master imagery. It is felt that an international centre would have production difficulties in endeavouring to rapidly satisfy world user demands for imagery.