UNITED STATES GOVERNMENT

Memorandum

TO : Distribution

DATE: December 13, 1985

FROM : Chief, Technique Development and Applications Branch

RE: OAB12-40

SUBJECT: Fifth Draft of the "Basic Data Set" Report

In reference to the subject report (memo OAB12-23, dated 12-6-85), please use the attached report as a replacement for the one distributed on 12-6-85.

Donald T. Lauer

Attachment

Distribution:

Senior Staff
Members, Ad Hoc Committee

THE NATIONAL LAND REMOTE SENSING SATELLITE DATA ARCHIVE: SUGGESTED GUIDELINES FOR THE DEVELOPMENT AND MAINTENANCE OF A BASIC DATA SET

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PREFACE

The Landsat Commercialization Act of 1984 (Public Law 98-365) requires the Federal government to establish and maintain an archive of land remote sensing satellite data for long-term historical, scientific, and technical purposes.

The National Land Remote Sensing Satellite Data Archive will be a repository for satellite remote sensing data that will provide long-term scientific record of point-in-time status of the Earth and its resources. Criteria for defining the basic data set of the archive will be developed by NOAA and the National Land Remote Sensing Satellite Data Archive Advisory Committee.

This paper suggests preliminary guidelines for developing and maintaining a multi-tiered basic data set that includes global coverage, U.S. coverage, and scientifically relevant coverage from Landsat and other orbiting satellite systems. At a minimum, repetitive global coverage should be obtained every five to ten years, while more frequent coverage should be obtained for the U.S.A. and its territories. Other scientifically relevant data acquisitions may be required for either long- or short-term monitoring of specific areas which typify important natural or sociological phenomena.

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THE NATIONAL LAND REMOTE SENSING SATELLITE DATA ARCHIVE: SUGGESTED GUIDELINES FOR THE DEVELOPMENT AND MAINTENANCE OF A BASIC DATA SET

INTRODUCTION

Approximately two million Landsat scenes have been acquired since the 1972 launch of the first land remote sensing satellite system. These global data, presently archived by NOAA at the U.S. Geological Survey's EROS Data Center (EDC) and by receiving stations worldwide, are used by private, national, and international organizations for assessing natural resources, environmental conditions, and sociological processes. In the future, a United States commercially operated land remote sensing satellite program and several foreign satellite programs will provide a steady flow of new remote sensing data to land resource planners and managers. Scientists will continue to be interested in using the acquired data for decades after its initial purpose has been fulfilled.

The Land Remote Sensing Commercialization Act of 1984, under Title VI of Public Law 98-365, directs the Federal government to establish and maintain an archive of land remote sensing satellite data for historical preservation, scientific investigation, and other technical purposes. Public Law 98-365 provides general guidelines and requirements that must be met in determining the content of the basic data set for a National Land Remote Sensing Satellite Data Archive (hereafter referred to as the Archive), and it places important restrictions and limitations on access to the data.

A National Land Remote Sensing Satellite Data Archive Advisory Committee, consisting of data users representing all facets of private, institutional, and governmental interests will be established, as suggested by PL 98-365. The committee will be responsible for advising NOAA on archiving policy,

reviewing data acquisition strategies, and reviewing special data acquisitions. A possible task of the advisory committee will be to assure the operation of this archive in accordance with legislative stipulations and appropriations.

The purpose of this document is to suggest guidelines for developing and maintaining a basic data set within the National Land Remote Sensing Satellite Data Archive--which will be primarily a repository for satellite-acquired data that will provide long-term scientific evidence of point-in-time status of the Earth and its resources.

BACKGROUND

In determining the initial content of, or in upgrading, the basic data set, PL 98-365 directs the Secretary of Commerce "... to (1) use as a baseline the data archived on the date of enactment of the Act; (2) take into account future technical and scientific developments and needs; (3) consult with and seek the advice of users and producers of remote sensing data and data products; (4) consider the need for data which may be duplicative in terms of geographical coverage but which differ in terms of season, spectral bands, resolution, or other relevant factors; (5) include, as the Secretary considers appropriate, unenhanced data generated by the commercial Landsat system or other U.S. commercial land remote sensing systems; and (6) include, as the Secretary considers appropriate, data collected by foreign ground stations or by foreign remote sensing space systems."

PL 98-365 identifies certain mechanisms whereby data needed for the Archive may be obtained from satellite system operators. The Act requires U.S. commercial operators to promptly make requested data available in a form suitable for archiving, and to charge the government only reasonable costs for reproducing and transmitting the data. However, should the system operator be required to specially acquire data needed for inclusion in the basic data set,

the law implies that the government may pay additional, reasonable costs associated with such acquisition. Procedures and costs for obtaining data acquired by a foreign satellite system are not covered by PL 98-365 and must be negotiated with the foreign system operator.

A fundamental principal of PL 98-365 is that the policy of the United States shall be to avoid competition by the government with the commercial Landsat system operator or any other U.S. commercial system operators. In order to protect the competitive position of such operators, the Act places restrictions on the dissemination of data from the Archive. The U.S. System Operator has the exclusive right to sell all data for a period not to exceed ten years from the date of acquisition. This exclusive right to sell Landsat data is also extended retroactively for data already in the government inventory (i.e., 10 years from the date of contract signing). Thus, the right to sell includes <u>all</u> data generated by the Landsat system and inventoried by NOAA at EDC prior to implementation of the commercial marketing contract. The system operator may relinquish this exclusive right by terminating the offer to sell particular data. After expiration of such exclusive right to sell, or after relinquishment of such right, those data selected for the Archive shall be in the public domain and shall be made available to the general public at prices reflecting reasonable costs of reproduction and transmittal.

During the past 14 years, Landsat satellites have operated as a global land remote sensing data collection system utilizing ground reception stations located throughout the world. Initially, EDC was the sole U.S. repository and distributor of global Landsat data. In 1979, Presidential Directive 54, gave NOAA responsibility for the operation and maintenance of the Landsat program, and NOAA has continued to process and distribute Landsat data at EDC. At the end of CY 1985 the satellite data holdings of EDC include approximately

675,000 Landsat scenes. The current EDC holdings do not contain the data acquired by foreign receiving stations. Current EDC holdings constitute a valuable global remote sensing resource; however, these data will need to be inventoried, screened, and augmented to meet legislative requirements as the Archive of global satellite data.

In addition to Landsat, the United States has had numerous other Earth imaging systems in space. Selective copies of data acquired by these systems could be included in the Archive. These data sets include both Seasat synthetic aperture radar (SAR) data and Advanced Very High Resolution Radiometer (AVHRR) data available from the Satellite Data Services Division of NOAA/NESDIS, Space Shuttle (OSTA-1) imaging radar (SIR-A) data archived by NASA at the National Space Sciences Data Center, and Landsat 5 Thematic Mapper (TM) holdings at NASA's Goddard Space Flight Center. While it is anticipated that selections from these data sets could augment the basic Landsat data set in the Archive, selection criteria will need to be further defined.

BASIC DATA SET DEFINITION

The clear intent of Congress in Title VI of PL 98-365 is for the Federal Government to establish a National Land Remote Sensing Satellite Data Archive to preserve global land remote sensing data for long-term historical, scientific, and technical purposes. It is envisioned that this Archive will include data from many sources with varying resolution and spectral coverage, e.g., MSS, TM, AVHRR, SAR, SPOT, etc. It is important, however, to establish a Basic Data Set that will meet a broad spectrum of anticipated requirements.

The Basic Data Set can be thought of as a multi-tiered data set that includes data of 1) cyclic global coverage, 2) more frequently acquired U.S. coverage, and 3) specially acquired coverage that will document scientifically

relevant natural and sociological processes (figure 1). The global data set will initially be Landsat MSS and TM data where they are available. Higher resolution data from subsequent systems will be included as they become available. Landsat MSS and TM data will be acquired more frequently over the United States, but these data will be a special subset (U.S. data set) of the Basic Data Set.

Global Data Set

To meet potential worldwide scientific requirements, repetitive global coverage must be acquired. Fiscal, technological, and meteorological constraints will limit the frequency with which repetitive global coverage can be obtained. Obtaining repetitive coverage of the Earth, with available (multiple) satellite systems, every five to ten years is considered to be a minimum requirement to meet most longer-term monitoring needs. Acquiring a global data set should be the principal goal in developing an acquisition strategy for The Basic Data Set.

Scenes considered for the global data set should be as near cloud-free as possible and acquired in seasons when dominant cover types are most easily evaluated with respect to their signatures within the spectral range of the recording sensors. In the arctic and in tropic climatic zones, seasonal changes in the dominant cover may be minimal, requiring only one scene to represent a five to ten year acquisition period. In temperate zones, seasonal changes in growth stage and consequent changes in spectral response may require seasonal acquisitions. In either case, scenes entered into the global data set should be representative of the long-term attributes of the geographic region and should not be intentionally optimized for either short-term (catastrophic) or local, theme-specific interests.

Basic Data Set for the Archive

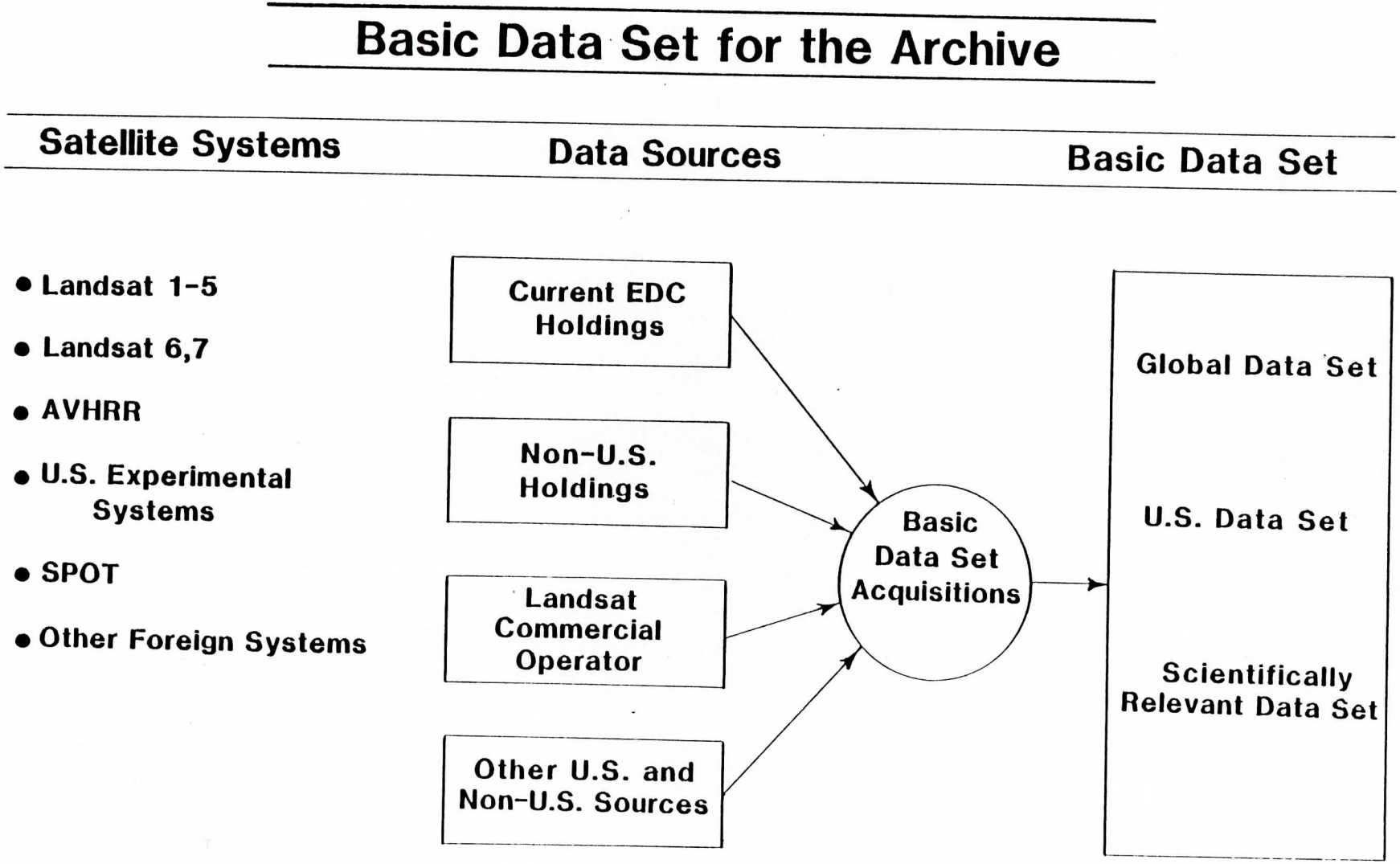

Figure 1.

As stated in PL 98-365, baseline Landsat MSS data currently in the EDC holdings will be reviewed and edited to identify voids and otherwise unacceptable scenes in the available global coverage. These areas should be filled in with either past acquisitions that are archived elsewhere or from new acquisitions on a first priority basis. Subsequent additions to the data set, in terms of both location and interval, should be generally prioritized on the basis of both difficulty of acquisition and available funding. Scenes should be acquired at uniform temporal intervals in order to develop and preserve the best historic continuity of the basic data set. Initially the Basic Data Set will consist primarily of Landsat 1-5 multispectral scanner (MSS) and TM data where available. After Landsat 6 and 7 are launched by the commercial operator, additional TM-like data will be added. Following the first five-year acquisition period, priority will be given to obtaining a first-time global data set of the higher resolution data.

U.S. Data Set

As a subset of the Basic Data Set, a more frequently acquired U.S. data set would provide a more detailed historical record of the United States and its possessions. The general guidelines defined for the global data base would also apply for this data set; however, the U.S. data set would provide a more detailed account of land cover and land use conversions through time.

Data representing cloud free coverage of leaf-off and leaf-on conditions should be acquired for the U.S. at a minimum of every two years. Evaluation of data currently in the EDC holdings would be helpful for determining specific acquisition problems and for developing strategies for optimizing data acquisition of the U.S. for the Archive.

Scientifically Relevant Data Set

Certain specific natural and sociological processes, such as desertification, deforestation, acid rain phenomena, urbanization, etc., will

almost certainly effect the quality of life of future generations. Some of these needs can be identified and study areas selected for special monitoring. To study and beneficially interact with these processes, repetitive satellite data acquired more frequently than every five to ten years will be required. Consequently, the acquisition strategy for developing the Basic Data Set should provide for coverage of scientifically relevant areas which typify important natural and sociological processes. Data covering these areas should be archived as frequently as necessary. The strategy should also recognize that catastrophic phenomena, such as volcanic eruptions, floods, storms, infestations, etc. will occur and that frequent, repetitive coverage may be required to optimally study the effects of such phenomena and the processes that operate in their aftermath.

These scientifically relevant data requirements should be carefully reviewed on a regular basis to establish immediate and far-reaching global or national needs. It is anticipated that these additional acquisitions will constitute only a minor portion of the Basic Data Set in the Archive.

IMPLEMENTATION OF THE BASIC DATA SET

An average of 35,000 new scenes have been added to EDC's holdings each year during the past several years. Many of these scenes will not meet the suggested minimum quality standards and will not be considered for the Archive. A high priority during the first five years will be given to screening and augmentation of the acceptable EDC holdings. It is estimated that in EDC's current holdings, 50 percent of the global coverage is less than adequate (due to cloud cover or poor image/data quality) for incorporation within the Basic Data Set. Augmentation of this initial global data set may require the purchase of up to 8,000 new scenes. If the initial EDC holdings

augmentation were to be completed at a uniform rate over five years, 1,600 scenes would be required each year (table 1).

Maintenance of the global data set would require an estimated 21,000 scenes for each repetitive archiving cycle[1/]. Thus, an average of 2,100 to 4,200 scenes would have to be acquired each year, on a five- or ten-year cycle. The U.S. data set would require 1,000 scenes every two years (an average of 500 per year). The scientifically relevant data acquisitions will probably be less than 500 scenes per year, because of funding limitations.

Because available funding will ultimately dictate the total number of purchases that can be made each year, approximately 70 percent of the funding during the first five years should be allocated evenly to augmenting existing holdings and to global data set acquisitions. Augmentation of the existing holdings could partially be from existing foreign archives, but new acquisitions would have to be acquired from the U.S. commercial operator. The remaining 30 percent of funding should be allocated to the U.S. data set to acquire a complete set for each two-year cycle. Priority assigned to special scientifically relevant acquisitions may vary with conditions of approval, higher priority global and U.S. data set requirements, and available funding.

Expected Data Costs

The costs identified in this document (table 1) are only for the purchase of Landsat MSS and TM digital data. They do not reflect the cost of screening, indexing, cataloging, and preservation of the data in the Archive.

1/ Estimate from a 1982 study at EDC. Approximately 14,000 scene centers cover the land area of the Earth. Approximately 50 percent of the land area would need more than one scene to be representative.

Table 1. Priorities and expected costs of Landsat data acquisitions for the Archive during the initial five years.

Acquisition Category	Data Type	Priority[1]	Acquisition Period	Scenes Per Year	Cost Per Scene[2]	Annual Cost[2]	
						1986-1987	1988-1990
Data Set Augmentation	MSS	1	5 years	1,600	$660	$1.05M	$1.05M
Global Data Set	MSS	2	10 years	2,100	$500	$1.05M	---
	TM	3	10 years	2,100	$2,000	---	$4.20M
U.S. Data Set	MSS	2	2 years	500	$500	$0.25M	---
	TM	3	2 years	500	$2,000	$1.00M	$1.00M
Scientifically Relevant Data Set	MSS	3	Variable	500	$1,120	$0.56M	---
	TM	4	Variable	500	$4,900	---	$2.45M
					TOTAL ANNUAL COST	$3.91M	$8.70M

[1] Suggested priority for initial five-year period.

[2] Full costs are assumed for new acquisitions requiring specified scenes. Reduced "reasonable" costs are assumed for U.S. and global data to be acquired by large blocks of contiguous data and for the reproduction and transmission of existing scenes.

The full acquisition costs are allocated for new acquisitions requiring specified scenes, based on the commercial operator's pricing schedule for Landsat products (revised November 1, 1985). Reduced "reasonable" costs have been assumed for the purchase of large blocks of contiguous data for the global and U.S. data sets and for the reproduction and transmission of existing scenes.

Costs were calculated for an initial 5-year period on the basis of the minimum number of scenes specified in the above implementation plan. Annual costs were calculated for the initial phase when Landsat 5 will be in operation (1986-87) and also for the phase to be serviced by Landsat 6 (1988-90). The expected annual costs by acquisition category are:

- Data Set Augmentation - Data set augmentation will require about 1,600 scenes per year for the initial 5-year period. Assuming that the bulk of these Landsat MSS scenes will be available from foreign archives at the commercial operator's price of $660 per MSS scene, an annual cost of $1.05 million will be required for the initial data set augmentation.
- Global Data Set - A minimum global data set will require the purchase of 2,100 scenes each year. During the initial phase, the Landsat MSS scenes will cost $1.05 million per year, at an average reduced price of $500 per MSS scene. After Landsat 6 is launched and a shift is made to TM-like data, these costs will increase to $4.20 million per year, at an average reduce price of $2,000 per scene.
- U.S. Data Set - The more frequently acquired U.S. data set will require 500 scenes of both MSS and TM data annually, during the initial phase (1986-87). The total cost of MSS and TM data will be $1.25 million each year, based on the average reduced prices. After Landsat 6 is launched, the costs of the TM-like data alone will decrease to $1.00 million.

- Scientifically Relevant Data Set - The cost for these specially acquired data will vary from about $0.56 million during the initial phase to $2.29 million through 1990, based on the U.S. commercial operator's full prices. These costs will probably be lowered as reasonable costs are negotiated with the commercial operator.

In summary, an average of about 5,000 Landsat scenes will be required each year for the initial 5-year period to support a minimum basic data set for the Archive. The annual acquisition cost during the initial phase (1986-87) would be $3.91 million, while the annual cost during the second phase (1988-90) would increase to $8.70 million. These estimated costs are based on minimum purchases for both the U.S. and global data sets. Until foreign ground stations are queried and the actual cost for foreign data is determined, the cost for augmenting EDC holdings is speculative.

The Basic Data Set is defined as being primarily Landsat MSS and TM data; however, it is anticipated that the Archive will also be the repository for other domestic and foreign satellite data. The cost and acquisition priorities for other satellite data have not been addressed. Thus, further consideration must be given to the support required for the acquisition of other satellite data for the Archive.

MANAGEMENT OF A NATIONAL REMOTE SENSING DATA ARCHIVE

A Memorandum of Understanding (MOU) between the USGS and NOAA will be established which will document the purpose and scope of the Archive and clarify the responsibilities of both parties. Arrangements for funding the archive and associated reimbursement policies will be defined in the MOU. It is assumed that NOAA initially will fund all activities associated with the Archive, but that funding responsibility will be transferred to the USGS in two or three years.

The NOAA, in cooperation with USGS, will establish a National Land Remote Sensing Satellite Data Archive Advisory Committee consisting of representatives from Federal, State, and local governments, academia, the private sector, and the international community. The NOAA and USGS will seek guidance from this Advisory Committee regarding strategies for data acquisition and other policy issues. Working in concert with the Advisory committee, the NOAA in cooperation with USGS will have the authority to establish and implement policies regarding the Archive.

The USGS will manage the day-to-day operations of the Archive, which will include data acquisition (via Interagency Agreement or direct purchase), screening and editing data, indexing and cataloging data, and insuring that the data are properly preserved and protected.

SUMMARY

The NOAA, in cooperation with USGS, will establish the National Land Remote Sensing Satellite Data Archive. An advisory committee which represents all areas of the user community will be established and will give guidance and approval for the proper management of a basic data set in the Archive.

Suggested guidelines for the development and maintenance of the Basic Data Set of land remote sensing satellite data have been presented for consideration. Global satellite data will be maintained in the Archive as a source of long-term scientific evidence of the status of the Earth and its resources. More frequently acquired satellite coverage from the U.S. and its territories will provide the sequential coverage necessary for a more detailed historical record.

Data procurement requirements suggested herein for developing and maintaining the Basic Data Set are considered to be reasonable for meeting the general requirements established in Public Law 98-365 for developing the Archive.

APPENDIX

Additional Issues Related to Basic Data Set Definition

- Disposition of Landsat 5 TM data currently held at Goddard Space Flight Center.
- Acquisition strategy for satellite data other than Landsat MSS and TM data.
- Additional data requirements defined by the implementation of a joint USGS-NOAA research program.
- Access to basic data set in support of data requirements in national emergency situations.