

Map and Chart Information Storage and Retrieval

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ABSTRACT

The U.S. Geological Survey Map and Chart Information System (MCIS) was developed to store, retrieve and display information about domestic maps and charts. Information is gathered both from known digital data banks and from physically handling and encoding selected source material. Data elements include title, scale, area, producer, publication and survey dates, rectangular and irregular geographic area, inset information, grids, contour interval, projection, and microfilm storage location. Search criteria are interactively edited in a dialog between the user and the computer. The user may direct that his retrieved information be sequenced and printed in one of seven report formats or be graphically displayed on a plotted index, tailored by the user as to size and projection.



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INTRODUCTION

The National Cartographic and Geographic Information Service (NC&GIS) distributes information on domestic aerial and space photographs, space imagery, maps, charts, geodetic control, and digital cartographic data. The Service was established within the U.S. Geological Survey as the information arm of the National Mapping Program. Main offices are in Reston; regional and State-affiliated offices have been established in 28 States.

Historically, NC&GIS has provided map and chart information from a variety of sources, including:

- Published references including graphic sales indexes, catalogs, books and periodicals.
- Black-and-white 35mm roll microfilm of historical Geological Survey maps.
- Library of Congress listings which include descriptive text concerning over 31,000 maps depicting domestic coverage.

Early in the formation of NC&GIS, plans were made for the design, development, and implementation of a formal information storage, retrieval, and display system, officially designated as the Map and Chart Information System (MCIS).

DATA-BASE SIZE

While it is not the function of NC&GIS to serve as a library and maintain a map repository, the range of map and chart products about which information must be gathered, stored, and made ready for dissemination is diverse.

From a physical standpoint, maps are printed on one or both sides of individual sheets, are mosaicked over several sheets, are included in atlases and various thematic reports, and may have multiple insets. The geographic coverage of each map can be identified by a variety of political and feature names, latitude/longitude, UTM coordinates, State plane or local coordinate systems, and the public land survey system.

Any use of trade names and trademarks is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

Although there is considerable mapmaking at the Federal, State, and local government, and the private level, few in-depth machine-readable indexes to these maps and charts are available. The NC&GIS data base is soon expected to contain information on 200,000 maps from the following Federal agencies:

Library of Congress	31,000
U.S. Geological Survey	134,000
National Ocean Survey	1,000
Defense Mapping Agency	19,000
Federal Highway Administration	11,000
Corps of Engineers	4,000

SYSTEM DESIGN

To hold the coded data elements describing administrative and descriptive features of maps and charts, a structured system was designed. Some of the features of the system are:

- Every map is described by a basic information record that contains the map name, dates (publication, survey, revision, and photography), horizontal and vertical datum, contour intervals, projection, grids, coordinates, relief, and microfilm location if NC&GIS holds a microfilm copy.
- Maps which are not in the quadrangle system may be described by the latitude and longitude at each vertex. From 3 to 27 coordinates may be entered.
- Maps or charts having sheets, insets, or a combination thereof may be described. The depth of indexing for each unit is approximately to the same level as that of the basic map or chart; that is title, scale, coordinates, etc. Up to 999 sheets with insets intermixed may be entered and related to a basic map entity, map index, or atlas.
- In situations where it is sufficient to record only those differences that occur in historical editions of the same basic map, a logical record may be constructed to give dates, map names (if different from current name), and microfilm locations. Up to 99 historical editions may be related to the current edition. This record type is particularly suitable for describing historical versions of USGS quadrangle maps. The NC&GIS distributes 35mm roll microfilm copies of these maps organized by State.
- To allow the data transcriber to add administrative or descriptive commentary about the product, a logical record in which free text can be stored is included. Up to nine lines of information, each containing up to 106 characters can be entered.

To describe the logical records defined for the MCIS data base, data elements were delineated (table 1) and coding schemes were developed. National coding standards and other standards in the mapping, charting, and geodesy community were adopted whenever possible.

Table 1. DATA ELEMENTS IN THE MAP AND CHART INFORMATION SYSTEM

Map/Chart Title	Trim Size	Horizontal Datum
Map/Chart Series	Area Coverage	Vertical Datum
Record Identification	Rectangular/Irregular	Contour Intervals
Type of Edition	Scale	Relief
Edition Status	Publication Date	Navig. Overprint
Edition Number	Revision Date	Microfilm Location
Producer	Survey Date	External Reference
Distributor	Photography Date	Latitude/Longitude
Type of Copy Available	Projection	State/County
Price	Grids	Township/Range

Table 2 is a representative sample of data codes used in the system, and identifies authorities such as the National Bureau of Standards (NBS) and the Office of Management and Budget (OMB), and organizations such as the Geological Survey and Defense Mapping Agency (DMA) that support formal automated map information systems. In the absence of standards, it was necessary to develop a list of codes; an example of this is the data code list specifying the public land survey system (table 3).

Table 2. STANDARD DATA CODES IN THE MAP AND CHART INFORMATION SYSTEM
(Partial List)

<u>Data Elements</u>	<u>Code Source</u>	<u>Maximum Size in Char.</u>	<u>Sample Codes</u>	<u>Meaning</u>
Producer, Distributor	OMB, USGS NAWDEX	6	1028	U.S. Geological Survey
			064801	National Ocean Survey
			3315	Tennessee Valley Authority
			0701	Defense Mapping Agency
			TX011	Texas Highway Dept.

<u>Data Elements</u>	<u>Code Source</u>	<u>Maximum Size in Char.</u>	<u>Sample Codes</u>	<u>Meaning</u>
Projection	DMA	2	MC	Mercator
			AC	Albers Equal Area
Dates	NBS	6	196801	Year, Month (e.g.,
			188403	Survey, Publication)
State	NBS	2	AK	Alaska
			VA	Virginia
County	NBS	3	059	Fairfax County
Edition Status	USGS	1	R	Revised
	DMA		O	Original
Relief	DMA	1	E	Hachures
			F	Spot Elevations
Horizontal Datum	DMA	3	NAS	North American, 1927

Table 3. DATA CODES FOR THE PUBLIC LAND SURVEY SYSTEM IN THE MAP AND CHART INFORMATION SYSTEM

<u>Meridians</u>	<u>Governing Surveys in</u>	<u>Data Code Chain</u>		
		<u>State</u>	<u>Base Line Latitude</u>	<u>Principal Meridian Longitude</u>
Black Hills	S.D.	SD	44	104
Boise	Idaho	ID	43	116
Chickasaw	Miss.	MS	34	089
Choctaw	Miss.	MS	31	090
Cimarron	Okla.	OK	36	103
Copper River	Alaska	AK	61	145
Fairbanks	Alaska	AK	64	147
Fifth Principal	Ark., Iowa Minn., Mo., N.D., S.D.	AR	34	091
First Principal	Ohio, Ind.	OH	41	084
Fourth Principal	Ill.	IL	40	090
Fourth Principal	Minn., Wisc.	WI	42	090
Gila and Salt R.	Ariz.	AZ	33	112
Humboldt	Calif.	CA	40	124
Huntsville	Ala., Miss.	AL	35	086
Indian	Okla.	OK	34	097

<u>Meridians</u>	<u>Governing Surveys in</u>	<u>State</u>	<u>Data Code Chain</u>	
			<u>Base Line Latitude</u>	<u>Principal Meridian Longitude</u>
Louisiana	La.	LA	31	092
Michigan	Mich., Ohio	MI	42	084
Mt. Diablo	Calif., Nev.	CA	37	121
Navajo	Ariz., N.M.	NM	35	108
New Mex. Princ.	N. M., Colo.	NM	34	106
Principal	Mont.	MT	45	111
Salt Lake	Utah	UT	40	111
San Bernardino	Calif.	CA	34	116
Second Princ.	Ill., Ind.	IN	38	086
Seward	Alaska	AK	60	149
Sixth Principal	Colo., Kan., Neb., S.D., Wyo.	KS	40	097
St. Helena	La.	LA	31	091
St. Stephens	Ala., Miss.	AL	31	088
Tallahassee	Fla.	FL	30	084
Third Principal	Ill.	IL	38	089
Uinta	Utah	UT	40	109
Ute	Colo.	CO	39	108
Washington	Miss.	MS	31	091
Willamette	Ore., Wash.	OR	45	122
Wind River	Wyo.	WY	43	108

The linking of formats, data elements, data chains and codes is currently recorded in the MCIS Data Dictionary.

HARDWARE AND SOFTWARE

Initial planning of the MCIS took place during 1977. The system now uses batch processing and operates on the AMDAHL 470V/7 system at USGS in Reston, Virginia. Additional hardware with graphic capability is also available, particularly, Tektronix terminals and Calcomp and Versatec plotters.

Of the available compilers, PL/1 was selected for all subsystems except graphic display. The FORTRAN programming language and a proprietary software package were selected to develop the graphic display capability. Standard IBM Time Sharing Option software is used to drive an interactive query editing function of the MCIS. Fourteen application programs were identified and ultimately were developed to direct:

- Data translation from available machine-readable files
- Data Editing
- File building and maintenance
- Retrieval
- Display (textual and graphic)

CONTENTS OF THE MCIS DATA BASE

The MCIS data base is now operational and is updated weekly. Table 4 is a recent inventory of maps and charts indexed by the system. Future accessions are expected to include index information about aeronautical charts as well as other specific and multipurpose maps from the Federal, State, and local governments, as well as the private sector.

Table 4. MCIS FILE CONTENT AS OF AUGUST 1981

<u>Type</u>	<u>Number of Maps</u>
Metropolitan Area Series	81
1:1,000,000--International Map of World	68
1:250,000 (2° x 1°)	3,251
United States Series	6
State Series	269
15-minute (1:62,500 and 1:50,000)	25,630
15-minute (1:48,000)	787
Alaska (1:63,360)	4,521
7 1/2-minute	79,512
Puerto Rico (7 1/2-minute)	429
7 1/2-minute X 15-minute	18
6-minute (1:24,000)	386
30-minute (1:125,000)	4,683
30-minute (various scales)	128
1 degree	480
Alaska Reconnaissance	2
Antarctica	125
County Series	245
County Highway Series	3,394
Intermediate (1:100,000)	213
National Park Series	137
Miscellaneous quadrangle maps	820
Nautical Charts	1,008
Total	126,193

INFORMATION RETRIEVAL

The retrieval capability of the current system is sequential and batch oriented. A user may initiate from 1 to 25 searches of the file by either of two options. If access to the time-sharing query editing module is not available, the user may card punch the query logic and use a card reader on a remote job entry terminal. To illustrate the more popular interactive access method, a job setup which includes the sign-on procedure, establishing a job priority and designating tape reel numbers for input and output follows

1. In response to a prompt from the computer, the user enters a numeric code to request either a particular report format in its unique sequence, or a graphic plot with its own abridged report.
2. Up to three title lines may be entered to identify the retrieval.
3. Selection of data is specified in a free format "SELECT" statement.
4. Areas may be delineated by the operands "POLYGON," "CIRCLE," or "CORRIDOR."
5. After the user has specified up to twenty-five unique queries during the session at the terminal, the interactive system provides, upon request, a playback of the retrieval logic as currently constituted. The user may selectively cancel one or more queries, and, if desired, may again review the list of surviving queries. This "final review" feature can be particularly helpful to a user at a video terminal that does not have an auxiliary hard copy device.

The display formats designed for the MCIS include printed reports and graphics. The following reports are available:

- The Tally Report provides a count of records that satisfy the query logic. This report may be requested as a solitary report, but always appears as the first page on each report and serves as a title page and permanent record of the query specification.
- The Unit Record Report is a catalog of all data elements in every record retrieved by the query logic. It is the most comprehensive of all reports, and is the working tool of the MCIS data base manager. This report is sequenced by the type of product.
- The Latitude/Longitude Report is an abridged report sequenced by the coordinates of the southeast corner of each map or chart.
- The States Covered Report is an abridged report sequenced by State. Where a map covers more than one State, a copy of the map record appears in each State group on the report.

- The Map Microfilm Contents Report is an abridged report which describes the location of each map image on 35 mm. roll microfilm. This report is sequenced first by State of major area coverage, then by roll and frame number.
- The IMW (International Map of the World) Report is an abridged report which groups maps and charts with reference to a 4 degrees (of latitude) by 6 degrees (of longitude) cell. It is sequenced first by IMW code, then by product series and map record identifier.
- The Producing Agency Report is an abridged report which groups maps and charts by their publisher. It is sequenced first by agency code, then by product series and map record identifier.

One of the most important and innovative aspects of MCIS is its ability to plot the location of different maps and charts that meet a user's requirements. The map outlines are numerically indexed from south to north. The index numbers refer to the associated textual report.

STANDARD REPORTS

Standard reports in the system are provided in both computer output microfiche and paper copy. Microfiche with appropriate eye-readable headings and micro-indexes are provided for the Unit Record, Latitude/Longitude, States Covered, Map Microfilm Contents, IMW, and Producing Agency Reports. A monthly Accessions Report is produced in paper form.

CONCLUSION

The MCIS became operational in early 1979. New map sources are continuing to be identified and sought. Memorandums of understanding have been signed by cooperators and NC&GIS to allow encoding of map and chart index data from a variety of holdings. Selective microfilming of maps is being performed at the USGS. Distribution of the latest edition of microfiche index reports was scheduled for early fall of 1981.