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**The Navy Standard Compressed Aeronautical  
Chart Database**

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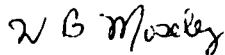
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# Foreword

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As the Navy's leading laboratory for research and development in mapping, charting, and geodesy topics, the Naval Oceanographic and Atmospheric Research Laboratory (NOARL) is actively involved in applying digital mapping, charting, and geodesy data to the support of naval weapons systems and in conducting research to improve these data.

This report describes the Navy's standard Compressed Aeronautical Chart database, a world-wide database of transformed and compressed scanned aeronautical chart images. The database was specifically designed by NOARL to support digital moving-map systems and mission planning systems of U.S. Navy and U.S. Marine Corps aircraft. Since the first quarter of fiscal year 1990, the AV-8B Harrier and F/A-18 Hornet have been flying with prototype data provided by NOARL. The first installment of NOARL's database was delivered to the Fleet in late April 1990. The database was produced by NOARL's Map Data Formatting Facility (MDFF) from standard aeronautical chart data distributed by the Defense Mapping Agency.



**W. B. Moseley**  
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Commanding Officer

# Executive Summary

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This report describes the interface control criteria for the exchange of chart image data from NOARL's Map Data Formatting Facility to the Fleet's aircraft mission planning systems and digital moving map systems. The Compressed Aeronautical Chart database consists of compressed and otherwise transformed aeronautical chart images stored on Compact Disk-Read Only Memory optical disks. The Compressed Aeronautical Chart is created from standard mapping, charting and geodesy products distributed by the Defense Mapping Agency.

The development and creation of this library is part of a NOARL effort to provide the Fleet with Navy standard digital mapping, charting, and geodesy products when the Defense Mapping Agency's products cannot be used in their original form. In a memorandum to the Commanding Officer of NOARL, the Chief of Naval Operations stated last summer that the NOARL Map Data Formatting Facility is "now in the critical path for operational deployment of most advanced Navy aircraft" (ser 961/9U549195, dated 17 August 1989). As this statement emphasizes, the Compressed Aeronautical Chart data is now a mission requirement for the successful flights of an increasing number of U.S. Navy and U.S. Marine Corps aircraft. This report is required by the Naval Air Systems Command in order to ensure that future aircraft mission planning systems and digital moving map systems are built to be compatible with this Navy standard database. It is also required as an engineering aid in developing future databases that will be used with the Compressed Aeronautical Chart.

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# Acknowledgments

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The mention of commercial products or the use of company names does not in any way imply endorsement by the U.S. Navy or NOARL.

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# The Navy Standard Compressed Aeronautical Chart Database

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## Introduction

The Naval Oceanographic and Atmospheric Research Laboratory\* (NOARL) Map Data Formatting Facility (MDFF) is developing a database of scanned chart images, the Compressed Aeronautical Chart (CAC), which is stored as a library of Compact Disk-Read Only Memory (CD-ROM) optical disks. The source scanned charts, which are distributed by the Defense Mapping Agency (DMA), are processed by the MDFF to permit a mission planning system to quickly select and load subsets of the database into the digital moving-map system (DMS) of an aircraft or for mission planning. This report describes the format and the content of the CAC database as it appears in NOARL's CD-ROM library. (A companion report [Shaw et al., 1989] details the MDFF's computer hardware and software configuration and the processing steps required to transform, compress, and reformat DMA's scanned chart data into the CAC.)

The following section provides background information about the MDFF project and NOARL's role in developing the CAC. A brief product overview is then presented. The Tessellated Spheroid (TS) projection system, used to store the geographic data, is explained and illustrated. The processes involved in decompressing CAC images and legend information for display are described. Detailed descriptions of the CD-ROMs' data content, data format and directory structure follow. The CD-ROM library is discussed, including specific indexing, labeling, and packaging schemata. A brief summary and description of future related work closes the report.

## Background

With the delivery in 1989 of the first production-model AV-8B Harrier and F/A-18 Hornet equipped with DMSs, the U.S. Navy entered a new realm in air navigation. It appears likely that aeronautical paper and filmstrip charts will gradually be replaced by the DMS (Goodwin and Shaw, 1987). Other naval aircraft

(notably the V-22 Osprey and the A-12 Avenger-II) already have plans to incorporate DMSs into their navigational systems.

The primary purpose of the CAC is to provide Navy DMSs with a standard, world-wide, seamless database of aeronautical chart image data in six different scales, specifically designed for use by such systems. The requirements of this database include that it use a minimum of storage, that it be rapidly and easily displayed, and that it be of optimal resolution. The CAC meets all of these sometimes conflicting requirements. In addition, the CAC could easily be more widely applied as a standard compressed ARC (Equal Arc-Second Raster Chart) Digitized Raster Graphics (ADRG) dataset for other than aeronautical uses.

The CAC is produced at NOARL's MDFF by processing DMA's ADRG data. Computer processing of ADRG into CAC consists of four major phases: transformation from the ARC projection system into TS, color compression, spatial compression, and formatting. The transformation from ARC to TS, which is accomplished using a neighborhood averaging function, reduces the image resolution by approximately one-half. Given the size (4.5 x 4.5 inches) and resolution (484 x 484 pixels) of map displays currently being used in the cockpit, the ARC-to-TS transformation allows the equivalent of about a 4 x 4 inch section of paper map to be displayed to a pilot at one time. Color compression is achieved by subjecting the image data to a color vector quantization process that selects the closest match of 240 entries in a color palette to represent each pixel. This process reduces storage requirements by a factor of 3:1 while preserving high image quality. Spatial compression is achieved by applying another vector quantization process that first classifies the image and then replaces each 4-pixel block in the image with a coded entry from a 256-entry lookup table, thus reducing storage requirements by a factor of 4:1. The compressed image data is so formatted that each file contains a compressed 2 x 2 inch section of chart. Decompression is quick and easy and is accomplished by using each byte in the compressed image as the index into a double table-lookup operation (using first the spatial

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\*Formerly the Naval Ocean Research and Development Activity.

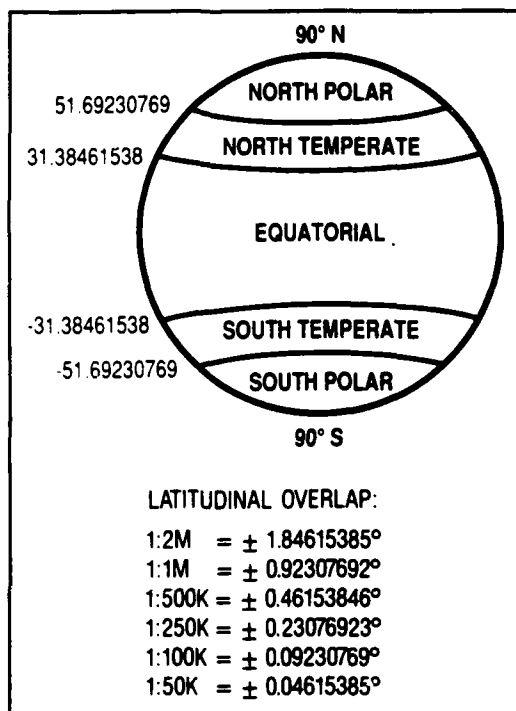


Figure 1. TS zones with latitudinal boundaries.

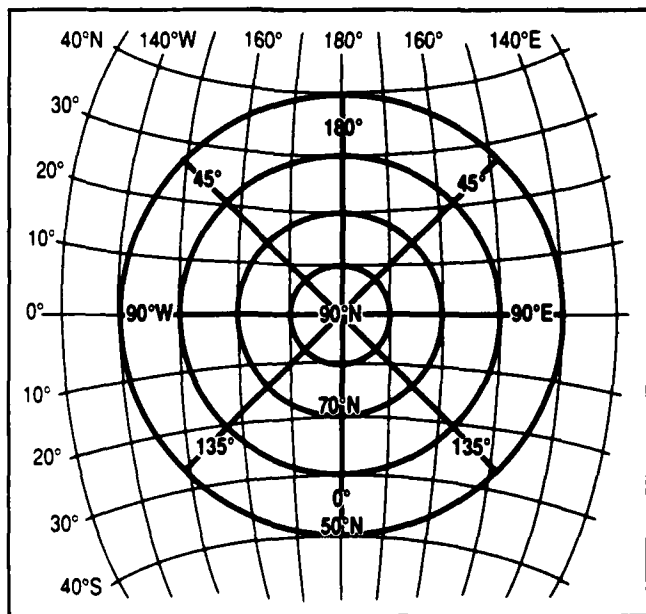


Figure 2. Rotation of equatorial grid into north polar zone.

Table 1. TS scale models and source charts.

Scale Model	DMA Source Chart
1:2,000,000	JNC (Jet Navigation Chart)
1:1,000,000	ONC (Operational Navigation Chart)
1:500,000	TPC (Tactical Pilotage Chart)
1:250,000	JOG (Joint Operational Graphic)
1:100,000	— (not yet available)
1:50,000	TLM (Topographic Line Map)

decompression table and then the color lookup table). Latitudinal and longitudinal boundaries of each compressed data file are encoded in each file name for easy identification and mosaicking.

### Product Overview

The CAC database conforms to the World Geodetic System (WGS) of 1984 (WGS-84). It is distributed by DMA as a library of CD-ROMs. Each CD-ROM contains compressed chart image data, in one of six scales, that cover a particular geographic region. Image data are contained in individual files, each corresponding to one TS "segment" (described in the next section). The geographic boundaries of each segment are predefined by the TS parameters. Segments are easily mosaicked to create a contiguous, seamless chart image. The name of each segment file contains the map scale and its geographic location.

Each CAC CD-ROM contains (a) compressed, transformed images from approximately 50 DMA ADRG CD-ROMs; (b) information identifying the source ADRG CD-ROMs; (c) information identifying the source paper charts (transferred from the source CD-ROMs); (d) compressed versions of the legend images contained on the source CD-ROMs; (e) spatial decompression code books; and (f) color palettes.

### Tessellated Spheroid Projection System

All chart image data in the CAC are presented in the TS projection system, which was developed at Honeywell, Inc. (Honeywell, 1986). The TS earth model is divided into five latitudinal zones. There is an overlap between edges of neighboring zones, the size of which depends on the scale of the chart data presented. Figure 1 illustrates these zones, their latitudinal boundaries, and the extent of overlap in each scale.

Each zone is divided into spherical rectangular segments. In the equatorial and temperate zones, these segments are arranged by rows and columns, the boundaries of which are lines of constant latitude and longitude. The polar zone segment boundaries are defined by a rotation of the equatorial segment grid into the polar regions. This rotated equatorial grid has been extended to cover the entire polar zone, which is larger than the equatorial zone by approximately 13.85 degrees of latitude. Figure 2 gives a representation of this rotation.

TS uses six scale models, one for each map scale for which TS has been designed. These scale models and their source paper charts are listed in Table 1. For a particular scale model, the width and height in degrees of a segment is constant. The number of segments per row or column of the equatorial and temperate zones of each scale model is proportional to the scale. Thus,

for example, the 1:1M (M = million) scale model has twice as many segments around the equator as the 1:2M scale model. Similarly, the number of segments per row or column of the equatorial zone rotated into the polar zone is proportional to the scale.

The definition of the 1:2M scale model is used as the basis for defining the other scale models. In the equatorial zone, the 1:2M scale model contains 380 columns; each has constant width in degrees of longitude. In the temperate zones, there are 304 columns. Thus, the width of a segment in the equatorial zone is  $360^\circ/380$ , or 0.94736842 degrees of longitude. Likewise, the width of a segment in the temperate zone is  $360^\circ/304$ , or 1.18421053 degrees of longitude. The first column in each of the equatorial and temperate zones is located with its western boundary on the  $0^\circ$  meridian. Subsequent columns extend from the eastern boundary of the first column around the earth in an easterly direction. The latitudinal height of segments in both the equatorial and temperate zones is constant in the 1:2M scale model and is equal to  $12^\circ/13$ , or 0.92307692 degrees of latitude. Rows begin at the equator and extend northward in the northern hemisphere and southward in the southern hemisphere.

In converting from the ARC projection system to TS, a grid of segments is draped over the polar region. In calculating the widths and heights of the polar zone segments, segment sizes from the equatorial zone are used. The number of rows of segments can be visualized as the number of segments lying along the  $0^\circ - 180^\circ$  meridian, while the number of columns equals the number of segments lying along the  $90^\circ\text{E} - 90^\circ\text{W}$  meridian. For the 1:2M scale model, these numbers can be calculated as follows:

$$\begin{aligned} &\# \text{ rows of polar segments} \\ &= (\text{upper polar boundary} - \text{lower polar boundary}) \\ &\quad * 2 / \text{segment height} \\ &= (90^\circ - 51.69230769^\circ) * 2 / (12^\circ/13) \\ &= 83 \end{aligned}$$

$$\begin{aligned} &\# \text{ columns of polar segments} \\ &= (\text{upper polar boundary} - \text{lower polar boundary}) \\ &\quad * 2 / \text{segment width} \\ &= (90^\circ - 51.69230769^\circ) * 2 / (360^\circ/380) \\ &= 80.87 \end{aligned}$$

Since a rectangular grid cannot be evenly draped over a sphere, the number of rows given here is the maximum number of segments to be found running parallel to the  $0^\circ - 180^\circ$  meridian. Near the "edges" of the grid, far fewer segments will run in this direction. Likewise, the number of columns shown here is the maximum number of segments parallel to the  $90^\circ\text{E} - 90^\circ\text{W}$  meridian. The amount of overlap between the polar and temperate zones roughly corresponds to

two temperate zone segments. The polar zone shown in Figure 3 illustrates these points.

All other scale models differ from the 1:2M scale model in that the segment heights and widths are proportional to the ratio between the 1:2M scale's measurements and the desired scale's measurements. For example, the segment height and widths for a 1:1M scale model are determined as follows:

$$\begin{aligned} &\text{height}(1:1\text{M}) \\ &= (1/2,000,000)/(1/1,000,000) \times \text{height}(1:2\text{M}) \\ &= 1/2 \times \text{height}(1:2\text{M}) \\ &= 1/2 \times 12^\circ/13 \\ &= 0.46153846 \text{ degrees latitude} \end{aligned}$$

$$\begin{aligned} &\text{equatorial width}(1:1\text{M}) \\ &= (1/2,000,000)/(1/1,000,000) \\ &\quad \times \text{equatorial width}(1:2\text{M}) \\ &= 1/2 \times \text{equatorial width}(1:2\text{M}) \\ &= 1/2 \times 360^\circ/380 \\ &= 0.47368421 \text{ degrees longitude} \end{aligned}$$

$$\begin{aligned} &\text{temperate width}(1:1\text{M}) \\ &= (1/2,000,000)/(1/1,000,000) \\ &\quad \times \text{temperate width}(1:2\text{M}) \\ &= 1/2 \times \text{temperate width}(1:2\text{M}) \\ &= 1/2 \times 360^\circ/304 \\ &= 0.59210526 \text{ degrees longitude} \end{aligned}$$

Thus, each segment in the 1:2M scale model contains an integral number of segments of any other scale model. Table 2 lists the TS scale models and gives for each the number of segment rows and columns in the equatorial and temperate zones, excluding overlap. (To include overlap, increase the number of rows by 4). Table 3 lists the TS scale models and gives their segment sizes for equatorial and temperate zones, as derived in the preceding equations. Appendices A and B list the segment boundaries for the equatorial and temperate zones for the 1:2M scale model.

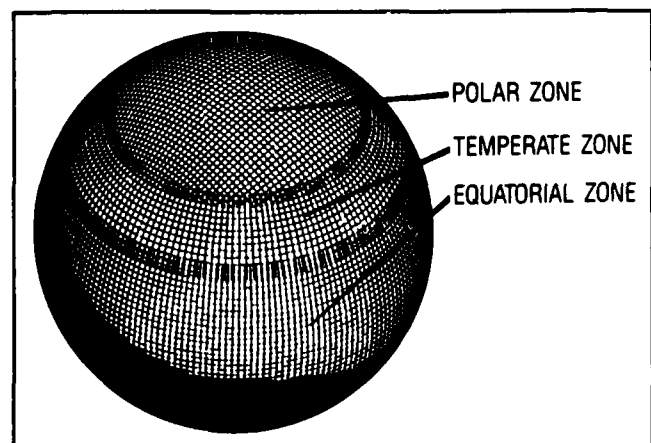


Figure 3.



Table 2. Numbers of segment rows and columns in each TS scale model.

SCALE	EQUATORIAL ZONE		TEMPERATE ZONES	
	# COLUMNS OF SEGMENTS	# ROWS OF SEGMENTS	# COLUMNS OF SEGMENTS	#ROWS OF SEGMENTS
1:2M	380	68	304	22
1:1M	760	136	608	44
1:500K	1520	272	1216	88
1:250K	3040	544	2432	176
1:100K	7600	1360	6080	440
1:50K	15200	2720	12160	880

Table 3. Segment sizes for each TS scale model.

SCALE	EQUATORIAL ZONE		TEMPERATE ZONES	
	SEGMENT HEIGHT (deg lat)	SEGMENT WIDTH (deg lon)	SEGMENT HEIGHT (deg lat)	SEGMENT WIDTH (deg lon)
1:2M	0.92307692	0.94736842	0.92307692	1.18421053
1:1M	0.46153846	0.47368421	0.46153846	0.59210526
1:500K	0.23076923	0.23684211	0.23076923	0.29605263
1:250K	0.11538462	0.11842105	0.11538462	0.14802632
1:100K	0.04615385	0.04736842	0.04615385	0.05921053
1:50K	0.02307692	0.02368421	0.02307692	0.02960526

In each scale model, an overlap region is defined at the intersections of the zones. This overlap consists of an extension of one zone into the adjacent zone by two rows of segments. Thus, for example, two additional rows of temperate-zone-sized segments are added to the temperate zones at 31.385°N and 31.385°S and extend into the equatorial zone. Similarly, two additional rows of equatorial-zone-sized segments are added to the equatorial zone at 31.385°N and 31.385°S and extend into the temperate zones. The CAC database contains two forms of chart data for these overlap regions—once as part of one zone and again as part of the adjacent zone.

Each segment is subdivided into 256 rows and 256 columns of spherical rectangles. In the equatorial and temperate zones, these subdivisions are bounded by lines of constant latitude and longitude, and the latitudinal or longitudinal length of a subdivision is equal to 1/256 times the segment's latitudinal or longitudinal length, respectively. This subdivision is the smallest entity in the TS model and is represented graphically as a pixel. The CAC image data ascribe a red, green and blue (RGB) color value to each pixel. Conceptually, a CAC pixel is defined as the spherically rectangular subdivision. To be more precise, the pixel is the lower left corner point of the subdivision, as shown in Figure 4.

For the polar zones, the subdivisional boundaries of the equatorial regions can be rotated into the polar zone. However, due to the complexity of the rotation,

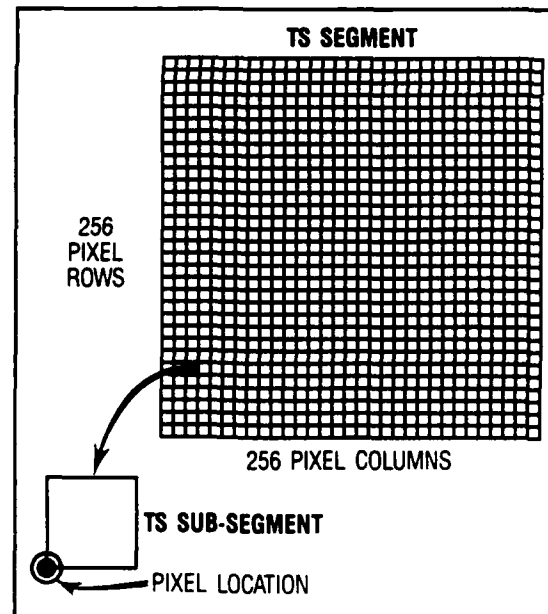


Figure 4. Pixel location within TS segment.

it is more practical to rotate the centers of the subdivisions and treat them as pixel locations rather than rotate the boundaries. The transformation from the coordinates in the polar zone to corresponding rotated equatorial coordinates is accomplished with two equations. Given a pair of polar zone coordinates (plat,plon), the coordinates (rlat,rlon) of the corresponding point in the rotated equatorial zone are as follows:

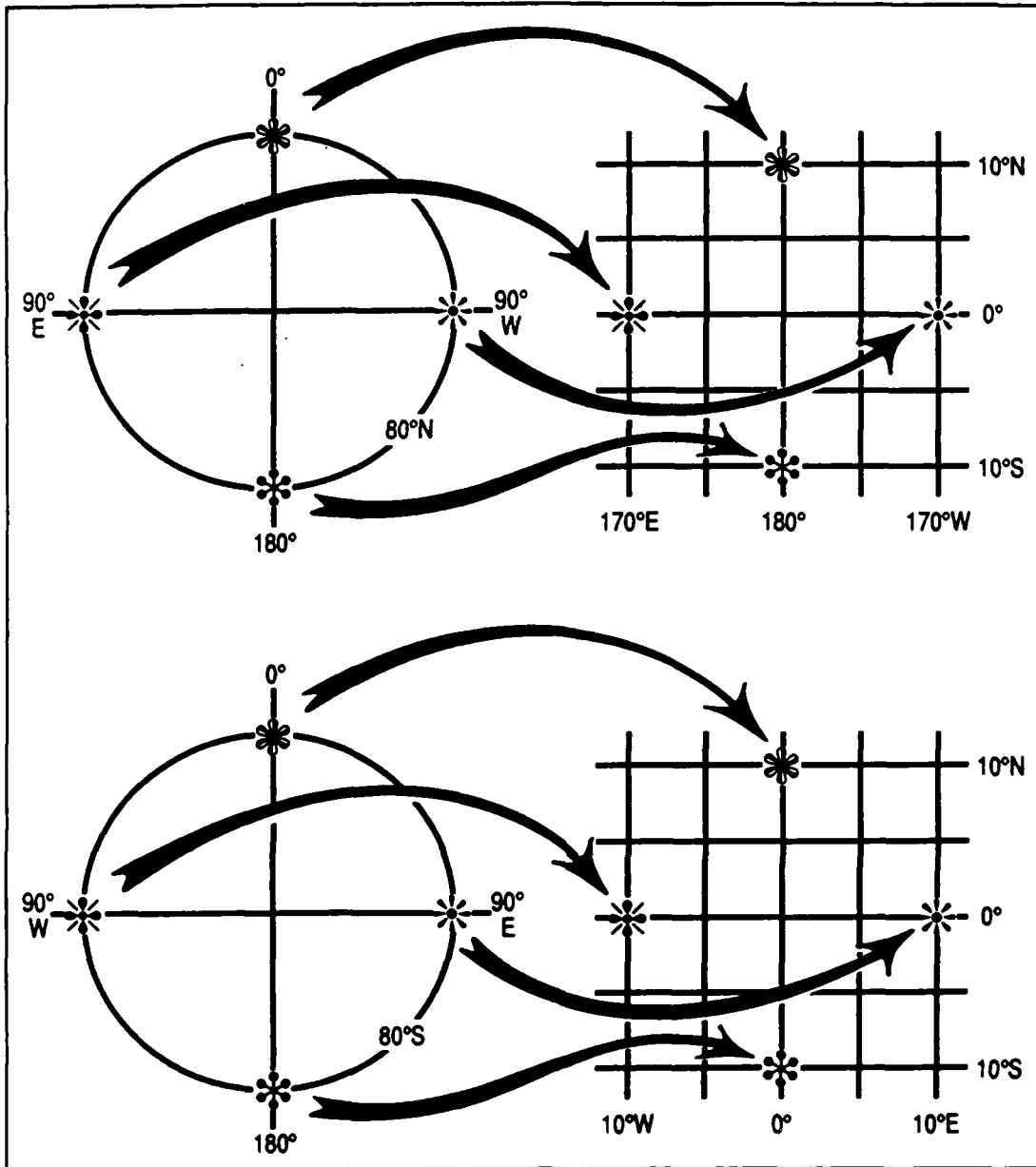


Figure 5. Transformation from polar zone to equatorial coordinates.

**North Polar:**

If  $plat = 90^\circ$ , then  $rlat = 0^\circ$  and  $r lon = 180^\circ$ .

Otherwise,  $r lat = \arcsin(\cos(plat)\cos(plon))$ ;  
 $r lon = \arctan(-\cos(plat)\sin(plon) / \sin(plat)) + 180^\circ$ .

**South Polar:**

If  $plat = -90^\circ$ , then  $r lat = 0^\circ$  and  $r lon = 0^\circ$ .

Otherwise,  $r lat = \arcsin(\cos(plat)\cos(plon))$ ;  
 $r lon = \arctan(-\cos(plat)\sin(plon) / \sin(plat))$ .

**Special case:**

If  $plat = 0^\circ$ , then

- If  $plon < 0^\circ$ , then  $r lon = -90^\circ$ ;
- If  $plon \geq 0^\circ$ , then  $r lon = 90^\circ$ .

Although this special case is not applicable (since the polar zone only extends from  $\pm 90^\circ$  to approximately

$\pm 51.7^\circ$  in latitude), it is included for completeness. Figure 5 illustrates such a transformation for several points.

The transformation from equatorial coordinates to corresponding polar zone coordinates is also accomplished with two equations. Given a pair of equatorial zone coordinates  $(r lat, r lon)$ , the coordinates  $(plat, plon)$  of the corresponding point in the polar zone are as follows:

**North Polar:**

$$plat = \arcsin(\cos(r lat)\cos(r lon - 180^\circ))$$

If  $r lat > 0^\circ$ , then

$$plon = \arctan(\cos(r lat)\sin(r lon) / \sin(r lat)).$$

If  $r lat < 0^\circ$ , then

$$plon = \arctan(\cos(r lat)\sin(r lon) / \sin(r lat)) + 180^\circ.$$

If rlat = 0° and rlon > 180°, then plon = -90°.  
 If rlat = 0° and rlon < 180°, then plon = 90°.

South Polar:

plat = arcsin(-cos(rlat)cos(rlon))  
 If rlat > 0°, then  
 plon = arctan(cos(rlat)sin(rlon)/sin(rlat)).  
 If rlat < 0°, then  
 plon = arctan(cos(rlat)sin(rlon)/sin(rlat)) + 180°.  
 If rlat = 0° and rlon > 0°, then plon = 90°.  
 If rlat = 0° and rlon < 0°, then plon = -90°.

Appendix C lists the corners of each segment in the polar zones for one-quarter of the 1:2M scale model.

## Chart Image Representation

Chart data contained in each segment file have been compressed and must be decompressed for display. Compression from the original ADRG into CAC is a three-stage process: transformation from ARC to TS, color compression, and spatial compression. A 4:1 change in resolution occurs during the map projection transformation. This resolution change is required for compatibility with the aircraft's DMS display. Color compression replaces each 3 bytes of RGB data with a 1-byte code. While information is certainly lost in this step, the loss is perceived as a normalization of the map colors and does not seriously compromise the image quality. Finally, spatial compression substitutes a 1-byte code word for each group of 2 x 2 pixels (4 bytes) of map data. Again, while information is lost here, image quality is not seriously impaired.

Prior to color and spatial compression, a segment of map data consisted of 196,608 bytes; prior to the conversion from ARC to TS, an equivalent section of map data consisted of about 786,432 bytes. The final compressed segment, excluding the color palette and decompression code book created during color and spatial compression, consists of 16,384 bytes. The total compression ratio is 48:1 (4:1 in projection transformation, 3:1 in color compression, and 4:1 in spatial compression). For a more detailed discussion of compression techniques used to create the CAC database, refer to Shaw et al. (1989) and Lohrenz et al. (1990).

Decompression of a compressed segment is a two-stage process: spatial decompression and color decompression. The entire decompression process requires the compressed chart data, a decompression code book, and the appropriate color map. Each compressed segment file consists of 17,408 bytes. The first 1024 bytes contain the decompression code book, and the remaining 16,384 bytes contain the compressed data. The color palette occupies the entire color palette file and consists of 2048 bytes.

## Spatial Decompression

The decompression code book contains 256 sequential 4-byte code words. Each code word represents a 2 x 2 pixel square that is used to reconstruct the spatially decompressed image. The first byte corresponds to the upper-left pixel in the 2 x 2 square, the second to the upper right, the third to the lower left, and the fourth to the lower right. Each of the 16,384 bytes in the compressed data file contains an index into the code book. Spatial decompression is accomplished by performing a lookup into the code book. Each byte of the compressed data is indexed into this code book, and each of the resulting code word's four bytes are then placed into the appropriate location in a 256 x 256 matrix representing the pixels of the reconstructed image.

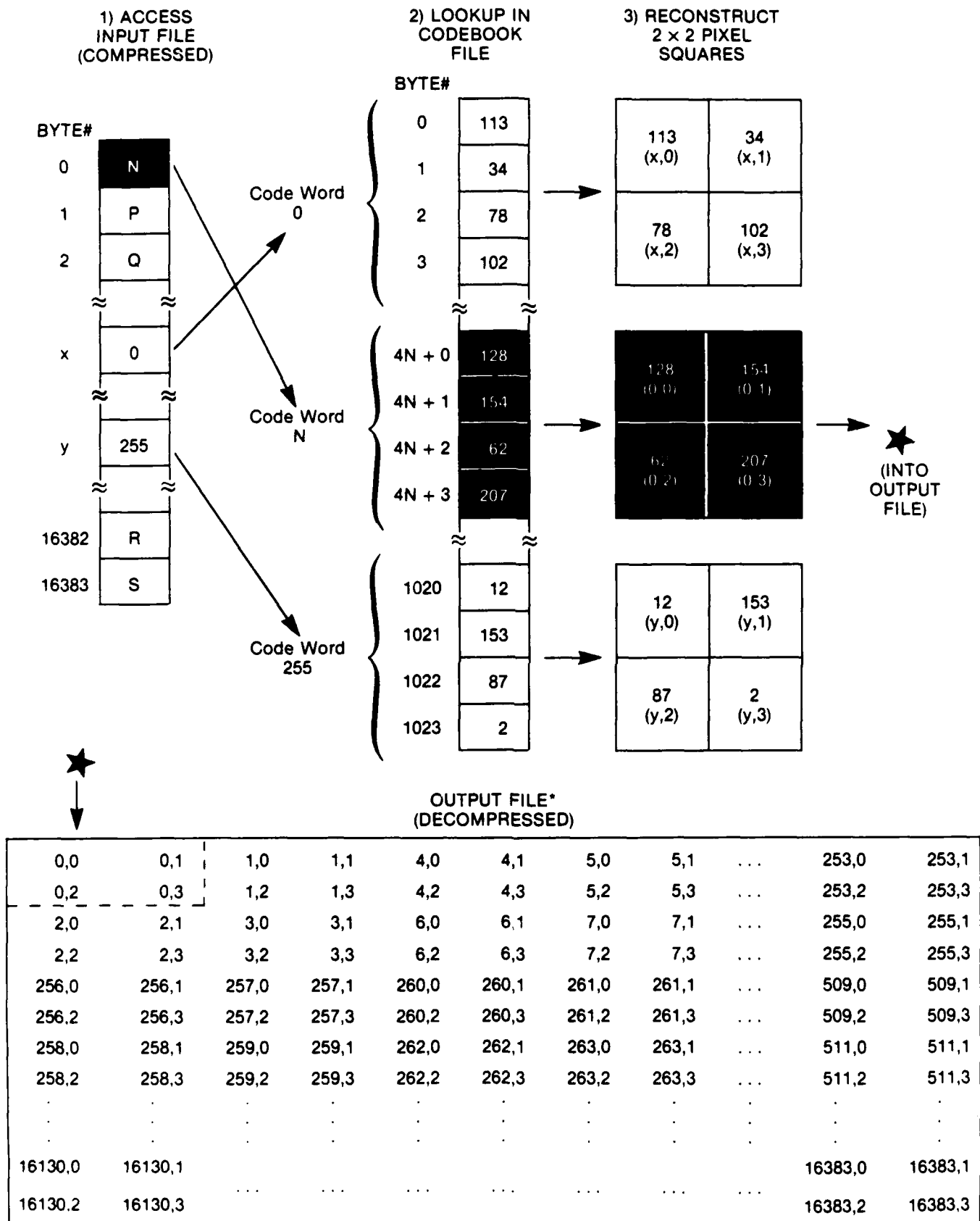
In the lookup portion of spatial decompression, each byte of the compressed image data is treated as an unsigned integer from 0 to 255 and represents a particular code word. The code words are numbered from 0 to 255, and the bytes in the code book are numbered from 0 to 1023. If a compressed data byte contains the value N, then the code word represented by this value is located in byte positions 4N, 4N + 1, 4N + 2, and 4N + 3. This lookup procedure is illustrated in Figure 6.

After a compressed data byte is used to index the appropriate code word, the code word's four bytes are placed in the 256 x 256 element matrix in unique positions, which are determined by the compressed data byte's position in the compressed data sequence. If the rows and columns of the matrix are numbered from 0 to 255 and the compressed data bytes are numbered from 0 to 16383, then the northwest (NW), northeast (NE), southwest (SW), and southeast (SE) bytes of the code word, represented by compressed data byte number m, is placed as follows:

$$\begin{aligned} \text{row}(m, \text{NW}) &= \{ [m' - (m' \text{ modulo } 128)] / 64 \} + R \\ \text{col}(m, \text{NW}) &= (m' \text{ modulo } 128) \times 2 \\ \text{row}(m, \text{NE}) &= \text{row}(m, \text{NW}) \\ \text{col}(m, \text{NE}) &= \text{col}(m, \text{NW}) + 1 \\ \text{row}(m, \text{SE}) &= \text{row}(m, \text{NE}) + 1 \\ \text{col}(m, \text{SE}) &= \text{col}(m, \text{NE}) \\ \text{row}(m, \text{SW}) &= \text{row}(m, \text{SE}) \\ \text{col}(m, \text{SW}) &= \text{col}(m, \text{NW}) \end{aligned}$$

$$\begin{aligned} \text{where if } (m \text{ modulo } 4) < 2 \\ \text{then } m' &= \text{trunc}(m/2) + (m \text{ modulo } 4) \\ \text{and } R &= \text{trunc}(m/256) \times 2 \\ \text{otherwise } m' &= \text{trunc}((m-2)/2) + ((m-2) \text{ modulo } 4) \\ \text{and } R &= 2 + (\text{trunc}(m/256) \times 2) \end{aligned}$$

The result of spatial decompression is a 256 x 256 matrix of one-byte elements. Each of these resultant bytes are then subjected to color decompression.



\*In output file, (x,y) points to a value between 0 and 255 derived from the code book, where x = byte# from input file (0 through 16383), which contains the code word number, and y = byte# within code word (0 through 3).

Figure 6. Spatial code book lookup procedure.

## Color Decompression

The RGB color palette consists of 256 three-byte code words, 240 of which are used for the image data and 16 of which are reserved for graphic overlays and checksums. One byte of each code word represents the red intensity level, a second is the green, and a third is the blue. Each byte that resulted from the spatial decompression process is used as an index into this color palette. The code word resulting from this lookup procedure consists of three bytes representing the RGB intensities for the particular pixel in the matrix. Each byte in the spatially decompressed matrix is treated as an unsigned integer from 0 to 239 and represents a particular code word in the color palette. The code words are numbered from 0 to 239, and the bytes in the color palette are numbered from 0 to 2047. A value of  $m$  in the spatially decompressed matrix refers to the code word located in byte positions  $2m + 512$  (red intensity),  $2m + 1$  (green), and  $2m + 513$  (blue). This lookup procedure is illustrated in Figure 7.

The first 1024 bytes in the color palette file contain color values for day-mode operations; the last 1024 bytes contain the night-mode palette. Currently, only one palette is required by the aircraft, so the day and night palettes are identical. Likewise, the color palette contains byte fields for both RGB and monochrome, although only RGB is currently required by the aircraft.

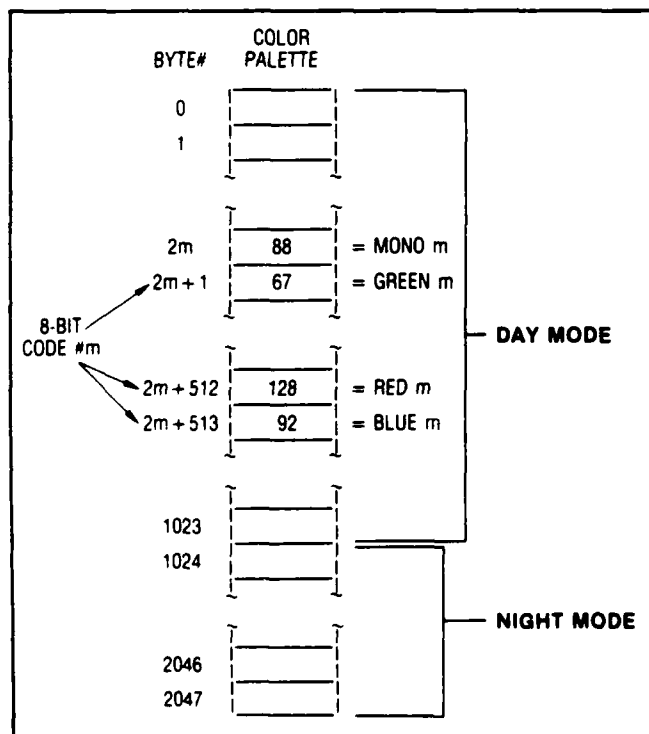


Figure 7. Color table lookup procedure: If a byte in the  $256 \times 256$  spatially decompressed matrix contains the value  $m$ , then the color for that pixel, as shown in this example, would have a red intensity of 128, a green intensity of 67, and a blue intensity of 92 (which would produce dark brown).

Monochrome values in the file have been computed as follows:

$$\text{Mono} = (0.30 * \text{Red}) + (0.59 * \text{Green}) + (0.11 * \text{Blue})$$

Intensity levels range from 0 (no intensity) to 255 (maximum intensity). The layout of the daytime portion of the color palette file, including the relative byte positions of monochrome and RGB code words, is presented in Table D-6 of Appendix D.

## Legend Image Representation

Legend image data have also been compressed and must be decompressed for display. Although the legend segments have been color compressed, they have not been spatially compressed, so the legend image decompression requires a single table lookup process. The compressed legend data and the appropriate color map file are required for decompression. The number of rows and columns of pixels in the legend image is contained in the legend image header file. The compressed legend image file contains one byte for each pixel, stored in row-major order. The first byte represents the top-left pixel of the image. Legend images' color palette files are organized in the same way as normal images' color palette files.

Decompression of a legend image is accomplished similarly to color decompression of chart images. The legend image's color palette file consists of 256 three-byte code words, 240 of which are used for the legend image data. One byte of each code word represents the red intensity level, a second is the green, and a third is the blue. Color decompression consists of constructing a matrix of the size specified in the legend image header file; performing a series of lookups, using the data in the legend image data file as indices into the color palette; and placing the RGB values resulting from each lookup into the proper location in the matrix. The lookup procedure for compressed legend images is the same as that for chart image data.

## CAC CD-ROM Data

### Content

Each CAC CD-ROM contains compressed chart image data at only one of the six scales listed in Table 1. In addition, each CD-ROM contains identification data and supplementary data from the source ADRG CD-ROMs, including compressed versions of the legend images. All of the data resident in the ADRG source CD-ROMs are included on the CAC CD-ROM, except data pertinent only to the source CD-ROMs (such as overview images and related data). Table 4 shows what data on the source CD-ROMs has been preserved and what has been deleted.

Image data are compressed. Intensity levels of 0 are used for pixels where image data are unavailable, resulting in an output color of black for these areas.

Table 4. ADRG data passed on to the CAC.

ADRG RECORD	CAC STATUS
Transmittal Description Record	Fixed Format
Security and Update Record	Fixed Format
Test Patch Data Record	Not Included
Transmittal Filenames Record	Not Included
Test Patch Image Record	Not Included
Data Set Description Record	Fixed Format
Overview Record	Not Included
General Information Record	Not Included
Quality Record	Fixed Format
Horizontal Accuracy Record	Fixed Format
Vertical Accuracy Record	Fixed Format
Overview Image Record	Not Included
Zone Distribution Rectangle Image Record	Compressed TS
Source Record	Fixed Format
Legend Record	Not Included
Metric Support Data Record	Fixed Format
Supplemental Text Record	Fixed Format
Legend Image Record	Color Compressed

Character and numerical data are stored in a fixed format and have been stripped of the International Standard Organization (ISO) 8211 transfer file structure to ease the processing of CAC into aircraft optical disk images.

### Storage Requirements

Although as much as 650 Mbytes of data could be copied to a CD-ROM, it would require placing data all the way to the edge of the disk. This practice is discouraged by some mastering facilities to safeguard against possible data corruption due to everyday handling and wear. Therefore, each CD-ROM in the CAC library contains a maximum of 600 Mbytes.

Three types of data are stored on each CAC CD-ROM: map data, legend data, and supplementary data. Supplementary data storage requirements are insignificant, amounting to less than 1 Mbyte. The amount of legend data is approximately 10% of the amount of map data. Thus, as a conservative estimate, each CAC CD-ROM contains about 500 Mbytes of map data and 50 Mbytes of legend data. Using this amount of data still allows 50 Mbytes for zone overlap coverage, while staying well under the recommended maximum of 600 Mbytes.

A follow-up study is currently underway to determine the specific storage requirements and data content (in terms of source DMA charts) for each CAC CD-ROM in this library. The results of this study will be published in a future report.

### Format

Character data on the CAC CD-ROMs are stored in American National Standard Code for Information

Interchange (ASCII) format. Integer data are stored as two's complement integers, as unsigned 1-byte integers, or as scaled integer format. All scaled integers are scaled to  $\pm 180$  and stored with 32-bit accuracy. In other words,  $-180$  represents the largest negative number, equivalent to '80000000'X, and  $+179.999999$  represents the largest positive number, equivalent to '7fffffff'X. The formula for computing a scaled integer (I) from its equivalent floating point representation (F) is thus as follows:

If  $F < 0$ , then  $I = F * ('80000000'X / -180)$ .

If  $F \geq 0$ , then  $I = F * ('7fffffff'X / 179.999999)$ .

Multibyte data are stored with the most significant byte first and least significant byte last.

### CAC CD-ROM Directory Structure

Files stored on the CAC CD-ROMs conform to ISO 9660 specifications. Any computer system equipped with a standard ISO 9660 drive and software driver can access the files contained on the CAC CD-ROMs. The CAC CD-ROM directory and file structures are illustrated in Figure 8.

#### Root Directory

Each CAC CD-ROM's root directory contains a map data subdirectory and an identification subdirectory. These two subdirectories are described with their included files and subdirectories in the following sections.

#### Map Data Subdirectory

The map data subdirectory is called MAPx.DIR, where  $x$  denotes the map scale. Each CD-ROM

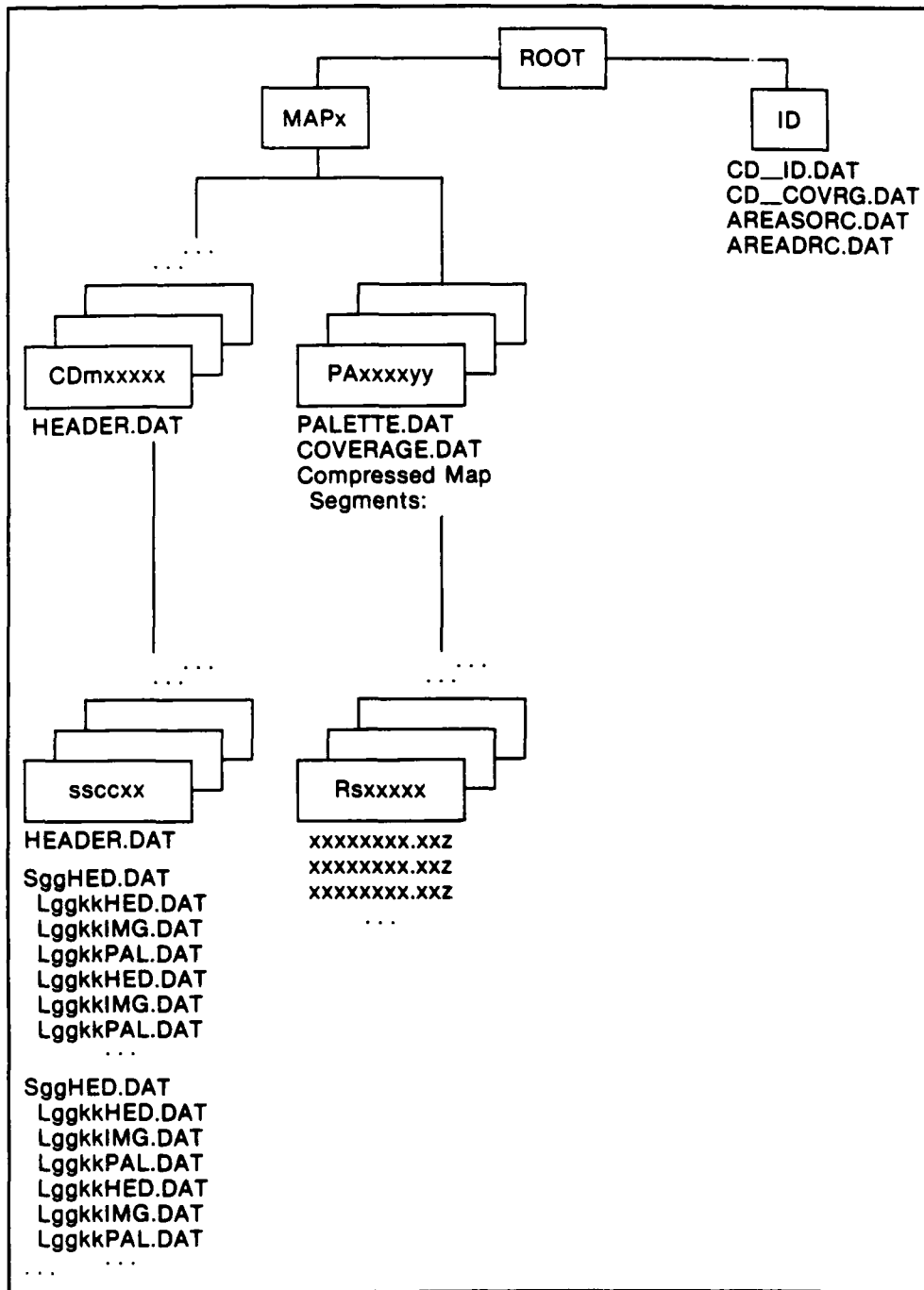


Figure 8. CAC CD-ROM directory and file structure.

contains map data for a single scale only. Valid scale values for x are shown in Table 5. The MAPx subdirectory contains a source CD-ROM identification subdirectory for each source ADRG CD-ROM and one or more chart area subdirectories.

**Source ADRG CD-ROM Identification Subdirectory**

Each source CD-ROM identification subdirectory is labeled CDmxxxxx.DIR, where m is a number that designates the mastering facility at which it was created (0 through 9), and where xxxxx is the input CD-ROM number (00001 through 99999), a unique number

assigned by the MDFF to each source CD-ROM it processes. Each of these subdirectories contains a file labeled HEADER.DAT and one or more distribution rectangle (DR) subdirectories labeled sscxx.DIR.

HEADER.DAT contains data from the Transmittal Description Record and the Security and Update Record from the Transmittal Header file of the source ADRG CD-ROM. Table D-1 in Appendix D illustrates the layout of this header file.

There is a DR subdirectory for each DMA DR from the source ADRG CD-ROM. The DR subdirectories are labeled sscxx.DIR, where ss is the DMA chart

series code, cc is the DMA country code, and xx is the DMA DR number. The codes, numbering schemes, and files in these subdirectories are consistent with those defined in the latest version of the DMA Product Specifications for ADRG (DMA, 1989). Each DR subdirectory contains a DR header file, a source graphics header file, and optional sets of legend information.

HEADER.DAT describes the contents of the DMA DR. This file contains the appropriate Data Set Description Record of the General Information File and the Quality File from the source ADRG CD-ROM. Table D-1 in Appendix D illustrates the layout of this file.

For each source graphic used by DMA in creating the DR, the DR subdirectory contains a set of files that describes the source graphic and that contains its legend images in compressed form. Each set of source graphic files includes a header file labeled SggHED.DAT; each legend image includes files LggkkHED.DAT,

LggkkIMG.DAT, and LggkkPAL.DAT. The designation "gg" in the header and legend image files identifies the source chart for this DR. If, for example, three source graphics are contained in a DR, then there will be three such sets, one with gg = 00, one with gg = 01, and one with gg = 02. The designation "kk" identifies the type of legend image contained in or supported by the file. Table 6 lists valid values for kk. File SggHED.DAT contains the Source, Metric Support Data, and Supplemental Text Records from the ADRG source file.

Each legend image is presented in color compressed form. LggkkHED.DAT contains the number of rows and columns of pixels in the legend image, LggkkIMG.DAT contains the compressed legend image, and LggkkPAL.DAT contains the color palette. Bytes contained in LggkkIMG.DAT are stored in row-major order. Rows in the image are numbered from left to right, and columns are numbered from top to bottom. Tables D-2 through D-6 in Appendix D illustrate the layout of these files.

Table 5. Valid scale values for CD-ROM scanned chart data.

x	SCALE	x	SCALE
0	1:50,000	3	1:500,000
1	1:100,000	4	1:1,000,000
2	1:250,000	5	1:2,000,000

#### Chart Area Subdirectories

For each contiguous area of map data on the CD-ROM that uses a common color palette, there is a separate chart area subdirectory and a map area number that is unique on that CD-ROM. The chart

Table 6. Valid types of legend images supported.

CHART SERIES	LEGEND IMAGE TYPE	kk FIELD IN LEGEND FILES
JNC	Index Diagram	IN
	Elevation/Depth Tint Diagram	EL
	Vertical Accuracy Diagrams	VA, AC
	Geographic Reference Diagram	GE
ONC	Index Diagram	IN
	Elevation Tint Diagram	EL
	Geographic Reference Diagram	GE
	Glossary	GL
	Landmark Feature Symbols	LS
TPC	Index Diagram	IN
	Elevation Tint Diagram	EL
	Geographic Reference Diagram	GE
	Grid Reference Diagram	GR
	Glossary	GL
	Landmark Feature Symbols	LS
JOG	Index Diagram	IN
	Elevation Tint Diagram	EL
	Accuracy Diagrams	VA, AC, HA
	Geographic Reference Diagram	GE
	Grid Reference Diagram	GR
	Glossary	GL
1:100K	Not Available	
TLM	Index Diagram	IN
	Elevation Tint Diagram	EL
	Slope Diagram	SL
	Boundary Diagram	BN
	Grid Reference Diagram	GR
	Glossary	GL



area subdirectories are labeled PAxxxxyy.DIR, where xxxx is the color palette identifier and yy is the map area number. The color palette identifier is unique, consisting of four digits (xxxx). Identical color palette identifiers, whether on the same or different CD-ROMs, reference identical palettes. The map area number consists of two digits (yy) that correspond to different chart areas on the CD-ROM. Only three map areas are allowed per map scale (and only one map scale is resident on a CD-ROM); therefore, a maximum of three PAxxxxyy subdirectories may coexist under the CD-ROM's MAPx subdirectory.

Each chart area subdirectory contains a file named PALETTE.DAT and a file named COVERAGE.DAT. PALETTE.DAT contains the actual RGB values for the color palette. It is in the same format as the legend color palette file, LggkkPAL.DAT, (described previously) and is illustrated in Table D-6 of Appendix D. COVERAGE.DAT (illustrated in Table D-7) defines the area covered by the segment data in the subdirectory and corresponds to that subdirectory's PALETTE.DAT file.

In addition to PALETTE.DAT and COVERAGE.DAT, each chart area subdirectory contains all the compressed map segment files for the area defined by COVERAGE.DAT. Map segments are filed in row-based subdirectories named Rsxxxx, where xxxx designates the row number of the segments in that subdirectory, and s represents the sign. If s is 1, the row number is negative; if s is 0, the row number is non-negative. All the segments in a given row are contained in the same directory. Each map segment file consists of a 1024-byte decompression code book followed by a 16,384-byte set of indices into the code book. After decompression, each file will produce a 256 x 256 byte map segment in 8-bit TS format. The compressed map segment files are labeled xxxxxxxx.xx.z, where xxxxxxxx.xx represents the subdirectory key derived from the segment's TS row and column values, and z defines the TS zone in which the map segment resides. Valid zone values for z are shown in Table 7. Table D-8 in Appendix D illustrates the layout of the compressed map segment files.

### CAC CD-ROM Identification Subdirectory

The CAC CD-ROM identification subdirectory is labeled ID.DIR; it contains a file labeled CD\_ID.DAT, which identifies the CD-ROM with a

Table 7. Valid TS zone values.

z	ZONE
0	South Polar (90.00000000°S - 51.69230769°S)
1	South Temperate (51.69230769°S - 31.38461538°S)
2	Equatorial (31.38461538°S - 31.38461538°N)
3	North Temperate (31.38461538°N - 51.69230769°N)
4	North Polar (51.69230769°N - 90.00000000°N)

unique CD-ROM volume name, and a file labeled CD\_COVRG.DAT, which defines the overall data coverage of the CD-ROM. In addition, two files define the relationship between the source ADRG CD-ROM and the CAC CD-ROM: AREASORC.DAT and AREADRC.DAT. AREASORC.DAT defines the correlation between the source graphics from the source ADRG CD-ROM and the chart area subdirectories on the CAC CD-ROM. AREADRC.DAT defines the correlation between the DRs from the source ADRG CD-ROM and the chart area subdirectories on the CAC CD-ROM. Tables D-9 through D-12 in Appendix D illustrate these files' layouts.

## CAC CD-ROM Library

### Indexing

NOARL will index each output CD-ROM in a library so that updates, additions, and replacements may be made easily. Each CD-ROM will be assigned the number CD-yyyy-v-dddd-nnnnn, which corresponds to the fields in the file CD\_ID.DAT:

- yyyy = Calendar Year of creation (e.g., "1990")
- v = Version ("A" through "Z") of this CAC CD-ROM (as data is added to or modified for a particular CAC CD-ROM)
- dddd = Data Type ("MAPx") where x denotes the scale, as listed in Table 5
- nnnnn = CD-ROM Number ("00001 through 99999").

### Labeling and Distribution

CAC CD-ROMs are packaged in standard storage cases known as jewel boxes. As shown in Figure 9, each CD-ROM jewel box has a location label that identifies the approximate geographic coverage of the data contained on that CD-ROM, the CD-ROM index number, the data type and the scale. A DMA stock number is also included on the label.

The CD-ROMs are imprinted with data distribution information. By arrangement with DMA, the CAC CD-ROMs produced by the MDFP are distributed to Department of Defense (DoD) programs from the DMA Combat Support Center (CSC). DoD programs requesting the CD-ROMs will be expected to comply with DMA/CSC procedures (related to maintaining accounts and justifying both quantities and coverage) when ordering the CAC product. Some CD-ROMs will be limited in distribution (Fig. 9 a); however, others will be available for public distribution. Contact DMA for further information.

## Summary and Future Work

This report describes the library of CAC data that is being created by NOARL's MDFP primarily for input to naval aircraft mission planning systems and

DMSs. The CAC library, consisting of up to six scales of processed aeronautical chart imagery derived from ADRG, is stored as a library of CD-ROMs and distributed by DMA. The development and creation of this library is part of a NOARL effort to provide the Fleet with Navy standard, digital, MC&G products when DMA products are unusable in their original form.

There has been a tremendous effort involved in researching and developing the CAC for the Fleet. Over three years were required to design and develop the MDFF, which produces the CAC. State-of-the-art computer hardware was acquired, installed, and tested on-site; the TS projection system was developed by

Honeywell, as were the transformation and compression software; prototype CAC data were supplied by NOARL to the AV-8B program office for flight tests; contracts were put into place for mastering thousands of CD-ROMs; a distribution plan was organized by DMA/CSC. And finally, the first installment of the CAC library was delivered to the Fleet in mid-fiscal year 1990.

Although the CAC was originally conceived as a digital aeronautical chart product, it could easily be extended to include nonaeronautical chart data. If other data are to be added in one of the CAC's currently supported scales, no modifications would be necessary to the transformation, compression, or

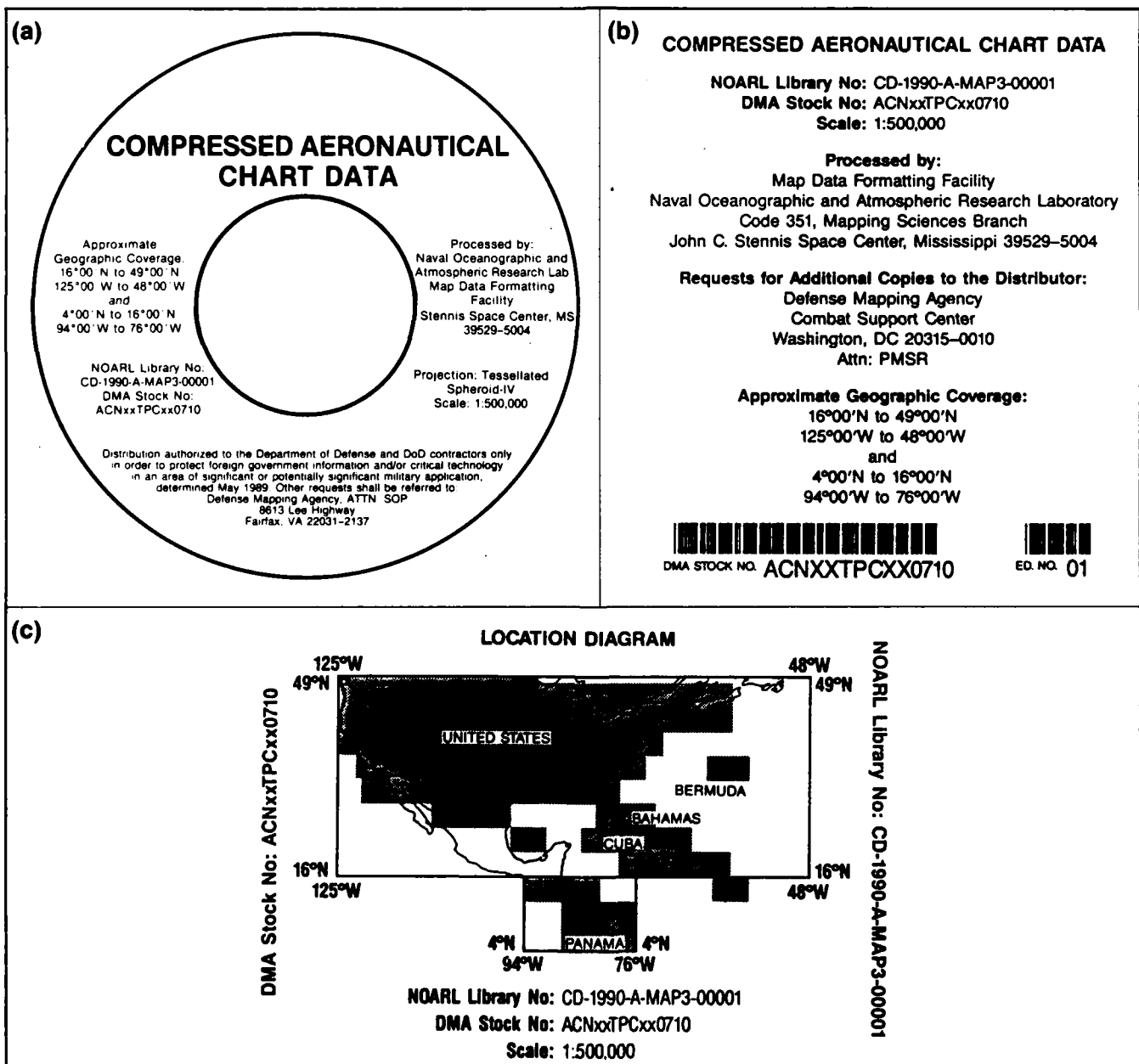


Figure 9. CAC CD-ROM labels: (a) Imprint on CD-ROM, (b) front label of jewel box, and (c) back and side labels of jewel box.

decompression software. Minor modifications would be required to accommodate other scales.

Related studies are currently underway to determine the precise storage requirements for each CD-ROM in the CAC library. Each CD-ROM's data contents (in terms of geographic areas and source DMA charts) are also being charted and indexed. In addition, the exact locations of all TS segments are being plotted globally for each supported scale. Results will be published in a future report.

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## **Appendix A**

### **Segment Row Limits for Equatorial and Temperate Zones (Including Overlaps) in the 1:2M TS-4 Scale Model**

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1. NORTH TEMPERATE ZONE (Rows 57 through 32)
2. EQUATORIAL ZONE (Rows 35 through -36)
3. SOUTH TEMPERATE ZONE (Rows -33 through -58)

1. NORTH TEMPERATE ZONE (Rows 57 through 32)

ROW	BOUNDARIES IN DEGREES OF LAT		
	LOWER	UPPER	
57	52.61538462	53.53846154	
56	51.69230769	52.61538462	
-----			ZONE OVERLAP
55	50.76923077	51.69230769	
54	49.84615385	50.76923077	
53	48.92307692	49.84615385	
52	48.00000000	48.92307692	
51	47.07692308	48.00000000	
50	46.15384616	47.07692308	
49	45.23076923	46.15384616	
48	44.30769231	45.23076923	
47	43.38461539	44.30769231	
46	42.46153846	43.38461539	
45	41.53846154	42.46153846	
44	40.61538462	41.53846154	
43	39.69230769	40.61538462	
42	38.76923077	39.69230769	
41	37.84615385	38.76923077	
40	36.92307693	37.84615385	
39	36.00000000	36.92307693	
38	35.07692308	36.00000000	
37	34.15384616	35.07692308	
36	33.23076923	34.15384616	
35	32.30769230	33.23076923	
34	31.38461538	32.30769230	
-----			ZONE OVERLAP
33	30.46153846	31.38461538	
32	29.53846154	30.46153846	

2. EQUATORIAL ZONE (Rows 35 through -36)

ROW	BOUNDARIES IN DEGREES OF LAT	
	LOWER	UPPER
35	32.30769230	33.23076923
34	31.38461538	32.30769230
----- ZONE OVERLAP -----		
33	30.46153846	31.38461538
32	29.53846154	30.46153846
31	28.61538461	29.53846154
30	27.69230769	28.61538461
29	26.76923077	27.69230769
28	25.84615384	26.76923077
27	24.92307692	25.84615384
26	24.00000000	24.92307692
25	23.07692307	24.00000000
24	22.15384615	23.07692307
23	21.23076923	22.15384615
22	20.30769231	21.23076923
21	19.38461538	20.30769231
20	18.46153846	19.38461538
19	17.53846154	18.46153846
18	16.61538461	17.53846154
17	15.69230769	16.61538461
16	14.76923077	15.69230769
15	13.84615384	14.76923077
14	12.92307692	13.84615384
13	12.00000000	12.92307692
12	11.07692308	12.00000000
11	10.15384615	11.07692308
10	9.23076923	10.15384615
9	8.30769231	9.23076923
8	7.38461538	8.30769231
7	6.46153846	7.38461538
6	5.53846154	6.46153846
5	4.61538462	5.53846154
4	3.69230769	4.61538462
3	2.76923077	3.69230769
2	1.84615385	2.76923077
1	0.92307692	1.84615385
0	0.00000000	0.92307692
-1	-0.92307692	0.00000000
-2	-1.84615385	-0.92307692
-3	-2.76923077	-1.84615385
-4	-3.69230769	-2.76923077
-5	-4.61538461	-3.69230769
-6	-5.53846154	-4.61538461
-7	-6.46153846	-5.53846154
-8	-7.38461538	-6.46153846
-9	-8.30769231	-7.38461538
-10	-9.23076923	-8.30769231
-11	-10.15384615	-9.23076923
-12	-11.07692308	-10.15384615
-13	-12.00000000	-11.07692308
-14	-12.92307692	-12.00000000

<----- Row 0

-15	-13.84615384	-12.92307692
-16	-14.76923077	-13.84615384
-17	-15.69230769	-14.76923077
-18	-16.61538461	-15.69230769
-19	-17.53846154	-16.61538461
-20	-18.46153846	-17.53846154
-21	-19.38461538	-18.46153846
-22	-20.30769231	-19.38461538
-23	-21.23076923	-20.30769231
-24	-22.15384615	-21.23076923
-25	-23.07692307	-22.15384615
-26	-24.00000000	-23.07692307
-27	-24.92307692	-24.00000000
-28	-25.84615384	-24.92307692
-29	-26.76923077	-25.84615384
-30	-27.69230769	-26.76923077
-31	-28.61538461	-27.69230769
-32	-29.53846154	-28.61538461
-33	-30.46153846	-29.53846154
-34	-31.38461538	-30.46153846

----- ZONE OVERLAP

-35	-32.30769230	-31.38461538
-36	-33.23076923	-32.30769230

3. SOUTH TEMPERATE ZONE (Rows -33 through -58)

ROW	BOUNDARIES IN DEGREES OF LAT	
	LOWER	UPPER
-33	-30.46153846	-29.53846154
-34	-31.38461538	-30.46153846
----- ZONE OVERLAP		
-35	-32.30769230	-31.38461538
-36	-33.23076923	-32.30769230
-37	-34.15384616	-33.23076923
-38	-35.07692308	-34.15384616
-39	-36.00000000	-35.07692308
-40	-36.92307692	-36.00000000
-41	-37.84615385	-36.92307692
-42	-38.76923077	-37.84615385
-43	-39.69230769	-38.76923077
-44	-40.61538462	-39.69230769
-45	-41.53846154	-40.61538462
-46	-42.46153846	-41.53846154
-47	-43.38461539	-42.46153846
-48	-44.30769231	-43.38461539
-49	-45.23076923	-44.30769231
-50	-46.15384615	-45.23076923
-51	-47.07692308	-46.15384615
-52	-48.00000000	-47.07692308
-53	-48.92307692	-48.00000000
-54	-49.84615385	-48.92307692
-55	-50.76923077	-49.84615385
-56	-51.69230769	-50.76923077
----- ZONE OVERLAP		
-57	-52.61538462	-51.69230769
-58	-53.53846154	-52.61538462



**Appendix B**  
**Segment Column Limits for Equatorial and Temperate Zones**  
**in the 1:2M TS-4 Scale Model**

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1. NORTH & SOUTH TEMPERATE ZONE (Columns -152 through 151)
2. EQUATORIAL ZONE (Columns -190 through 189)

1. NORTH AND SOUTH TEMPERATE ZONE (Columns -152 through 151)

COL	BOUNDARIES IN DEGREES OF LNG	
	WEST	EAST
-152	-180.00000000	-178.81578943
-151	-178.81578943	-177.63157890
-150	-177.63157890	-176.44736837
-149	-176.44736837	-175.26315785
-148	-175.26315785	-174.07894732
-147	-174.07894732	-172.89473680
-146	-172.89473680	-171.71052627
-145	-171.71052627	-170.52631574
-144	-170.52631574	-169.34210522
-143	-169.34210522	-168.15789469
-142	-168.15789469	-166.97368417
-141	-166.97368417	-165.78947364
-140	-165.78947364	-164.60526311
-139	-164.60526311	-163.42105259
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-127	-150.39473680	-149.21052628
-126	-149.21052628	-148.02631575
-125	-148.02631575	-146.84210522
-124	-146.84210522	-145.65789470
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-121	-143.28947365	-142.10526312
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-119	-140.92105259	-139.73684207
-118	-139.73684207	-138.55263154
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-95	-112.49999997	-111.31578944
-94	-111.31578944	-110.13157892
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-92	-108.94736839	-107.76315787
-91	-107.76315787	-106.57894734
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-88	-104.21052629	-103.02631576
-87	-103.02631576	-101.84210524
-86	-101.84210524	-100.65789471
-85	-100.65789471	-99.47368418
-84	-99.47368418	-98.28947366
-83	-98.28947366	-97.10526313
-82	-97.10526313	-95.92105261
-81	-95.92105261	-94.73684208
-80	-94.73684208	-93.55263155
-79	-93.55263155	-92.36842103
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-73	-86.44736840	-85.26315787
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-69	-81.71052629	-80.52631577
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-67	-79.34210524	-78.15789472
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-65	-76.97368419	-75.78947366
-64	-75.78947366	-74.60526314
-63	-74.60526314	-73.42105261
-62	-73.42105261	-72.23684209
-61	-72.23684209	-71.05263156
-60	-71.05263156	-69.86842103
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-58	-68.68421051	-67.49999998
-57	-67.49999998	-66.31578946
-56	-66.31578946	-65.13157893
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-54	-63.94736840	-62.76315788
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-48	-56.84210525	-55.65789472	
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-46	-54.47368420	-53.28947367	
-45	-53.28947367	-52.10526314	
-44	-52.10526314	-50.92105262	
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-29	-34.34210525	-33.15789473	
-28	-33.15789473	-31.97368420	
-27	-31.97368420	-30.78947368	
-26	-30.78947368	-29.60526315	
-25	-29.60526315	-28.42105262	
-24	-28.42105262	-27.23684210	
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-19	-22.49999999	-21.31578947	
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-17	-20.13157894	-18.94736842	
-16	-18.94736842	-17.76315789	
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-14	-16.57894736	-15.39473684	
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-8	-9.47368421	-8.28947368	
-7	-8.28947368	-7.10526316	
-6	-7.10526316	-5.92105263	
-5	-5.92105263	-4.73684210	
-4	-4.73684210	-3.55263158	
-3	-3.55263158	-2.36842105	
-2	-2.36842105	-1.18421053	
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0	0.00000000	1.18421053	<----- Column 0
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2	2.36842105	3.55263158	
3	3.55263158	4.73684210	

4	4.73684210	5.92105263
5	5.92105263	7.10526316
6	7.10526316	8.28947368
7	8.28947368	9.47368421
8	9.47368421	10.65789473
9	10.65789473	11.84210526
10	11.84210526	13.02631579
11	13.02631579	14.21052631
12	14.21052631	15.39473684
13	15.39473684	16.57894736
14	16.57894736	17.76315789
15	17.76315789	18.94736842
16	18.94736842	20.13157894
17	20.13157894	21.31578947
18	21.31578947	22.49999999
19	22.49999999	23.68421052
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21	24.86842105	26.05263157
22	26.05263157	27.23684210
23	27.23684210	28.42105262
24	28.42105262	29.60526315
25	29.60526315	30.78947368
26	30.78947368	31.97368420
27	31.97368420	33.15789473
28	33.15789473	34.34210525
29	34.34210525	35.52631578
30	35.52631578	36.71052631
31	36.71052631	37.89473683
32	37.89473683	39.07894736
33	39.07894736	40.26315788
34	40.26315788	41.44736841
35	41.44736841	42.63157894
36	42.63157894	43.81578946
37	43.81578946	44.99999999
38	44.99999999	46.18421051
39	46.18421051	47.36842104
40	47.36842104	48.55263157
41	48.55263157	49.73684209
42	49.73684209	50.92105262
43	50.92105262	52.10526314
44	52.10526314	53.28947367
45	53.28947367	54.47368420
46	54.47368420	55.65789472
47	55.65789472	56.84210525
48	56.84210525	58.02631577
49	58.02631577	59.21052630
50	59.21052630	60.39473683
51	60.39473683	61.57894735
52	61.57894735	62.76315788
53	62.76315788	63.94736840
54	63.94736840	65.13157893
55	65.13157893	66.31578946
56	66.31578946	67.49999998
57	67.49999998	68.68421051
58	68.68421051	69.86842103
59	69.86842103	71.05263156

60	71.05263156	72.23684209
61	72.23684209	73.42105261
62	73.42105261	74.60526314
63	74.60526314	75.78947366
64	75.78947366	76.97368419
65	76.97368419	78.15789472
66	78.15789472	79.34210524
67	79.34210524	80.52631577
68	80.52631577	81.71052629
69	81.71052629	82.89473682
70	82.89473682	84.07894735
71	84.07894735	85.26315787
72	85.26315787	86.44736840
73	86.44736840	87.63157892
74	87.63157892	88.81578945
75	88.81578945	89.99999998
76	89.99999998	91.18421050
77	91.18421050	92.36842103
78	92.36842103	93.55263155
79	93.55263155	94.73684208
80	94.73684208	95.92105261
81	95.92105261	97.10526313
82	97.10526313	98.28947366
83	98.28947366	99.47368418
84	99.47368418	100.65789471
85	100.65789471	101.84210524
86	101.84210524	103.02631576
87	103.02631576	104.21052629
88	104.21052629	105.39473681
89	105.39473681	106.57894734
90	106.57894734	107.76315787
91	107.76315787	108.94736839
92	108.94736839	110.13157892
93	110.13157892	111.31578944
94	111.31578944	112.49999997
95	112.49999997	113.68421050
96	113.68421050	114.86842102
97	114.86842102	116.05263155
98	116.05263155	117.23684207
99	117.23684207	118.42105260
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101	119.60526313	120.78947365
102	120.78947365	121.97368418
103	121.97368418	123.15789470
104	123.15789470	124.34210523
105	124.34210523	125.52631576
106	125.52631576	126.71052628
107	126.71052628	127.89473681
108	127.89473681	129.07894733
109	129.07894733	130.26315786
110	130.26315786	131.44736839
111	131.44736839	132.63157891
112	132.63157891	133.81578944
113	133.81578944	134.99999996
114	134.99999996	136.18421049
115	136.18421049	137.36842102

116	137.36842102	138.55263154
117	138.55263154	139.73684207
118	139.73684207	140.92105259
119	140.92105259	142.10526312
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121	143.28947365	144.47368417
122	144.47368417	145.65789470
123	145.65789470	146.84210522
124	146.84210522	148.02631575
125	148.02631575	149.21052628
126	149.21052628	150.39473680
127	150.39473680	151.57894733
128	151.57894733	152.76315785
129	152.76315785	153.94736838
130	153.94736838	155.13157891
131	155.13157891	156.31578943
132	156.31578943	157.49999996
133	157.49999996	158.68421048
134	158.68421048	159.86842101
135	159.86842101	161.05263154
136	161.05263154	162.23684206
137	162.23684206	163.42105259
138	163.42105259	164.60526311
139	164.60526311	165.78947364
140	165.78947364	166.97368417
141	166.97368417	168.15789469
142	168.15789469	169.34210522
143	169.34210522	170.52631574
144	170.52631574	171.71052627
145	171.71052627	172.89473680
146	172.89473680	174.07894732
147	174.07894732	175.26315785
148	175.26315785	176.44736837
149	176.44736837	177.63157890
150	177.63157890	178.81578943
151	178.81578943	180.00000000

2. EQUATORIAL ZONE (Columns -190 through 189)

COL	BOUNDARIES IN DEGREES OF LNG	
	WEST	EAST
-190	-180.00000000	-179.05263157
-189	-179.05263157	-178.10526315
-188	-178.10526315	-177.15789473
-187	-177.15789473	-176.21052631
-186	-176.21052631	-175.26315789
-185	-175.26315789	-174.31578946
-184	-174.31578946	-173.36842104
-183	-173.36842104	-172.42105262
-182	-172.42105262	-171.47368420
-181	-171.47368420	-170.52631578
-180	-170.52631578	-169.57894736
-179	-169.57894736	-168.63157894
-178	-168.63157894	-167.68421052
-177	-167.68421052	-166.73684210
-176	-166.73684210	-165.78947368
-175	-165.78947368	-164.84210525
-174	-164.84210525	-163.89473683
-173	-163.89473683	-162.94736841
-172	-162.94736841	-161.99999999
-171	-161.99999999	-161.05263157
-170	-161.05263157	-160.10526315
-169	-160.10526315	-159.15789473
-168	-159.15789473	-158.21052631
-167	-158.21052631	-157.26315789
-166	-157.26315789	-156.31578947
-165	-156.31578947	-155.36842104
-164	-155.36842104	-154.42105262
-163	-154.42105262	-153.47368420
-162	-153.47368420	-152.52631578
-161	-152.52631578	-151.57894736
-160	-151.57894736	-150.63157894
-159	-150.63157894	-149.68421052
-158	-149.68421052	-148.73684210
-157	-148.73684210	-147.78947368
-156	-147.78947368	-146.84210526
-155	-146.84210526	-145.89473683
-154	-145.89473683	-144.94736841
-153	-144.94736841	-143.99999999
-152	-143.99999999	-143.05263157
-151	-143.05263157	-142.10526315
-150	-142.10526315	-141.15789473
-149	-141.15789473	-140.21052631
-148	-140.21052631	-139.26315789
-147	-139.26315789	-138.31578947
-146	-138.31578947	-137.36842105
-145	-137.36842105	-136.42105262
-144	-136.42105262	-135.47368420
-143	-135.47368420	-134.52631578
-142	-134.52631578	-133.57894736
-141	-133.57894736	-132.63157894
-140	-132.63157894	-131.68421052



-139	-131.68421052	-130.73684210
-138	-130.73684210	-129.78947368
-137	-129.78947368	-128.84210526
-136	-128.84210526	-127.89473684
-135	-127.89473684	-126.94736841
-134	-126.94736841	-125.99999999
-133	-125.99999999	-125.05263157
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-127	-120.31578947	-119.36842105
-126	-119.36842105	-118.42105263
-125	-118.42105263	-117.47368420
-124	-117.47368420	-116.52631578
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-122	-115.57894736	-114.63157894
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-115	-108.94736842	-107.99999999
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-113	-107.05263157	-106.10526315
-112	-106.10526315	-105.15789473
-111	-105.15789473	-104.21052631
-110	-104.21052631	-103.26315789
-109	-103.26315789	-102.31578947
-108	-102.31578947	-101.36842105
-107	-101.36842105	-100.42105263
-106	-100.42105263	-99.47368421
-105	-99.47368421	-98.52631578
-104	-98.52631578	-97.57894736
-103	-97.57894736	-96.63157894
-102	-96.63157894	-95.68421052
-101	-95.68421052	-94.73684210
-100	-94.73684210	-93.78947368
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-96	-90.94736842	-90.00000000
-95	-90.00000000	-89.05263157
-94	-89.05263157	-88.10526315
-93	-88.10526315	-87.15789473
-92	-87.15789473	-86.21052631
-91	-86.21052631	-85.26315789
-90	-85.26315789	-84.31578947
-89	-84.31578947	-83.36842105
-88	-83.36842105	-82.42105263
-87	-82.42105263	-81.47368421
-86	-81.47368421	-80.52631579
-85	-80.52631579	-79.57894736
-84	-79.57894736	-78.63157894

-83	-78.63157894	-77.68421052
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-81	-76.73684210	-75.78947368
-80	-75.78947368	-74.84210526
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-76	-72.00000000	-71.05263158
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-68	-64.42105263	-63.47368421
-67	-63.47368421	-62.52631579
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-57	-54.00000000	-53.05263158
-56	-53.05263158	-52.10526316
-55	-52.10526316	-51.15789473
-54	-51.15789473	-50.21052631
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-49	-46.42105263	-45.47368421
-48	-45.47368421	-44.52631579
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-45	-42.63157895	-41.68421052
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-32	-30.31578947	-29.36842105
-31	-29.36842105	-28.42105263
-30	-28.42105263	-27.47368421
-29	-27.47368421	-26.52631579
-28	-26.52631579	-25.57894737

-27	-25.57894737	-24.63157895	
-26	-24.63157895	-23.68421053	
-25	-23.68421053	-22.73684210	
-24	-22.73684210	-21.78947368	
-23	-21.78947368	-20.84210526	
-22	-20.84210526	-19.89473684	
-21	-19.89473684	-18.94736842	
-20	-18.94736842	-18.00000000	
-19	-18.00000000	-17.05263158	
-18	-17.05263158	-16.10526316	
-17	-16.10526316	-15.15789474	
-16	-15.15789474	-14.21052632	
-15	-14.21052632	-13.26315789	
-14	-13.26315789	-12.31578947	
-13	-12.31578947	-11.36842105	
-12	-11.36842105	-10.42105263	
-11	-10.42105263	-9.47368421	
-10	-9.47368421	-8.52631579	
-9	-8.52631579	-7.57894737	
-8	-7.57894737	-6.63157895	
-7	-6.63157895	-5.68421053	
-6	-5.68421053	-4.73684211	
-5	-4.73684211	-3.78947368	
-4	-3.78947368	-2.84210526	
-3	-2.84210526	-1.89473684	
-2	-1.89473684	-0.94736842	
-1	-0.94736842	0.00000000	
0	0.00000000	0.94736842	<----- Column 0
1	0.94736842	1.89473684	
2	1.89473684	2.84210526	
3	2.84210526	3.78947368	
4	3.78947368	4.73684210	
5	4.73684210	5.68421053	
6	5.68421053	6.63157895	
7	6.63157895	7.57894737	
8	7.57894737	8.52631579	
9	8.52631579	9.47368421	
10	9.47368421	10.42105263	
11	10.42105263	11.36842105	
12	11.36842105	12.31578947	
13	12.31578947	13.26315789	
14	13.26315789	14.21052631	
15	14.21052631	15.15789474	
16	15.15789474	16.10526316	
17	16.10526316	17.05263158	
18	17.05263158	18.00000000	
19	18.00000000	18.94736842	
20	18.94736842	19.89473684	
21	19.89473684	20.84210526	
22	20.84210526	21.78947368	
23	21.78947368	22.73684210	
24	22.73684210	23.68421052	
25	23.68421052	24.63157895	
26	24.63157895	25.57894737	
27	25.57894737	26.52631579	
28	26.52631579	27.47368421	

29	27.47368421	28.42105263
30	28.42105263	29.36842105
31	29.36842105	30.31578947
32	30.31578947	31.26315789
33	31.26315789	32.21052631
34	32.21052631	33.15789473
35	33.15789473	34.10526316
36	34.10526316	35.05263158
37	35.05263158	36.00000000
38	36.00000000	36.94736842
39	36.94736842	37.89473684
40	37.89473684	38.84210526
41	38.84210526	39.78947368
42	39.78947368	40.73684210
43	40.73684210	41.68421052
44	41.68421052	42.63157894
45	42.63157894	43.57894737
46	43.57894737	44.52631579
47	44.52631579	45.47368421
48	45.47368421	46.42105263
49	46.42105263	47.36842105
50	47.36842105	48.31578947
51	48.31578947	49.26315789
52	49.26315789	50.21052631
53	50.21052631	51.15789473
54	51.15789473	52.10526315
55	52.10526315	53.05263158
56	53.05263158	54.00000000
57	54.00000000	54.94736842
58	54.94736842	55.89473684
59	55.89473684	56.84210526
60	56.84210526	57.78947368
61	57.78947368	58.73684210
62	58.73684210	59.68421052
63	59.68421052	60.63157894
64	60.63157894	61.57894736
65	61.57894736	62.52631579
66	62.52631579	63.47368421
67	63.47368421	64.42105263
68	64.42105263	65.36842105
69	65.36842105	66.31578947
70	66.31578947	67.26315789
71	67.26315789	68.21052631
72	68.21052631	69.15789473
73	69.15789473	70.10526315
74	70.10526315	71.05263157
75	71.05263157	72.00000000
76	72.00000000	72.94736842
77	72.94736842	73.89473684
78	73.89473684	74.84210526
79	74.84210526	75.78947368
80	75.78947368	76.73684210
81	76.73684210	77.68421052
82	77.68421052	78.63157894
83	78.63157894	79.57894736
84	79.57894736	80.52631578

85	80.52631578	81.47368421
86	81.47368421	82.42105263
87	82.42105263	83.36842105
88	83.36842105	84.31578947
89	84.31578947	85.26315789
90	85.26315789	86.21052631
91	86.21052631	87.15789473
92	87.15789473	88.10526315
93	88.10526315	89.05263157
94	89.05263157	89.99999999
95	89.99999999	90.94736842
96	90.94736842	91.89473684
97	91.89473684	92.84210526
98	92.84210526	93.78947368
99	93.78947368	94.73684210
100	94.73684210	95.68421052
101	95.68421052	96.63157894
102	96.63157894	97.57894736
103	97.57894736	98.52631578
104	98.52631578	99.47368420
105	99.47368420	100.42105263
106	100.42105263	101.36842105
107	101.36842105	102.31578947
108	102.31578947	103.26315789
109	103.26315789	104.21052631
110	104.21052631	105.15789473
111	105.15789473	106.10526315
112	106.10526315	107.05263157
113	107.05263157	107.99999999
114	107.99999999	108.94736841
115	108.94736841	109.89473684
116	109.89473684	110.84210526
117	110.84210526	111.78947368
118	111.78947368	112.73684210
119	112.73684210	113.68421052
120	113.68421052	114.63157894
121	114.63157894	115.57894736
122	115.57894736	116.52631578
123	116.52631578	117.47368420
124	117.47368420	118.42105262
125	118.42105262	119.36842105
126	119.36842105	120.31578947
127	120.31578947	121.26315789
128	121.26315789	122.21052631
129	122.21052631	123.15789473
130	123.15789473	124.10526315
131	124.10526315	125.05263157
132	125.05263157	125.99999999
133	125.99999999	126.94736841
134	126.94736841	127.89473683
135	127.89473683	128.84210526
136	128.84210526	129.78947368
137	129.78947368	130.73684210
138	130.73684210	131.68421052
139	131.68421052	132.63157894
140	132.63157894	133.57894736

141	133.57894736	134.52631578
142	134.52631578	135.47368420
143	135.47368420	136.42105262
144	136.42105262	137.36842104
145	137.36842104	138.31578947
146	138.31578947	139.26315789
147	139.26315789	140.21052631
148	140.21052631	141.15789473
149	141.15789473	142.10526315
150	142.10526315	143.05263157
151	143.05263157	143.99999999
152	143.99999999	144.94736841
153	144.94736841	145.89473683
154	145.89473683	146.84210525
155	146.84210525	147.78947368
156	147.78947368	148.73684210
157	148.73684210	149.68421052
158	149.68421052	150.63157894
159	150.63157894	151.57894736
160	151.57894736	152.52631578
161	152.52631578	153.47368420
162	153.47368420	154.42105262
163	154.42105262	155.36842104
164	155.36842104	156.31578946
165	156.31578946	157.26315789
166	157.26315789	158.21052631
167	158.21052631	159.15789473
168	159.15789473	160.10526315
169	160.10526315	161.05263157
170	161.05263157	161.99999999
171	161.99999999	162.94736841
172	162.94736841	163.89473683
173	163.89473683	164.84210525
174	164.84210525	165.78947367
175	165.78947367	166.73684210
176	166.73684210	167.68421052
177	167.68421052	168.63157894
178	168.63157894	169.57894736
179	169.57894736	170.52631578
180	170.52631578	171.47368420
181	171.47368420	172.42105262
182	172.42105262	173.36842104
183	173.36842104	174.31578946
184	174.31578946	175.26315788
185	175.26315788	176.21052631
186	176.21052631	177.15789473
187	177.15789473	178.10526315
188	178.10526315	179.05263157
189	179.05263157	180.00000000

**Appendix C**  
**Segment Corners for Polar Zones in the 1:2M TS-4 Scale Model**

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The following pages list the coordinates of the TS segment corners along the upper boundaries of all segment rows in one quadrant of the north polar zone. The quadrant is oriented with  $90^{\circ}\text{N}$  latitude in the center,  $0^{\circ}$  longitude vectoring up, and  $90^{\circ}\text{E}$  longitude vectoring to the right (as shown in Fig. C-1). In this list, EQUAT LAT and EQUAT LON are the values of the corner points in the rotated equatorial coordinate system; POLAR LAT and POLAR LON are the points' values in the original coordinate system.

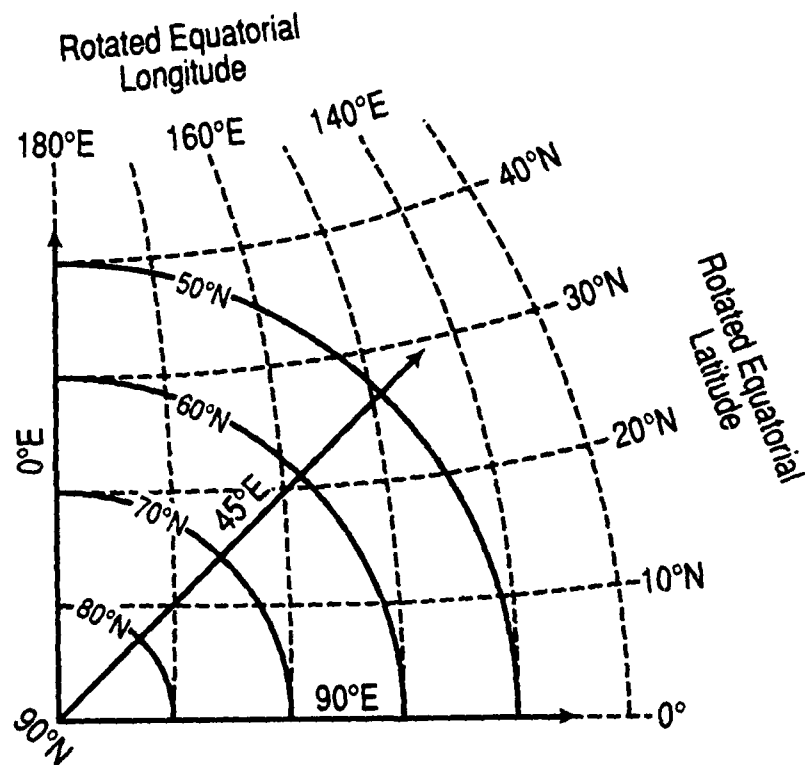


Figure C-1. One quadrant of the north polar zone with a rotated equatorial grid (dashed lines) overlaid on the original polar zone grid (solid lines).



ROW	0 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	0.00000000	180.00000000	90.00000000	90.00000000
	0.00000000	179.05263158	89.05263158	90.00000000
	0.00000000	178.10526316	88.10526316	90.00000000
	0.00000000	177.15789474	87.15789474	90.00000000
	0.00000000	176.21052632	86.21052632	90.00000000
	0.00000000	175.26315790	85.26315790	90.00000000
	0.00000000	174.31578947	84.31578947	90.00000000
	0.00000000	173.36842105	83.36842105	90.00000000
	0.00000000	172.42105263	82.42105263	90.00000000
	0.00000000	171.47368421	81.47368421	90.00000000
	0.00000000	170.52631579	80.52631579	90.00000000
	0.00000000	169.57894737	79.57894737	90.00000000
	0.00000000	168.63157895	78.63157895	90.00000000
	0.00000000	167.68421053	77.68421053	90.00000000
	0.00000000	166.73684211	76.73684211	90.00000000
	0.00000000	165.78947369	75.78947369	90.00000000
	0.00000000	164.84210526	74.84210526	90.00000000
	0.00000000	163.89473684	73.89473684	90.00000000
	0.00000000	162.94736842	72.94736842	90.00000000
	0.00000000	162.00000000	72.00000000	90.00000000
	0.00000000	161.05263158	71.05263158	90.00000000
	0.00000000	160.10526316	70.10526316	90.00000000
	0.00000000	159.15789474	69.15789474	90.00000000
	0.00000000	158.21052632	68.21052632	90.00000000
	0.00000000	157.26315790	67.26315790	90.00000000
	0.00000000	156.31578948	66.31578948	90.00000000
	0.00000000	155.36842105	65.36842105	90.00000000
	0.00000000	154.42105263	64.42105263	90.00000000
	0.00000000	153.47368421	63.47368421	90.00000000
	0.00000000	152.52631579	62.52631579	90.00000000
	0.00000000	151.57894737	61.57894737	90.00000000
	0.00000000	150.63157895	60.63157895	90.00000000
	0.00000000	149.68421053	59.68421053	90.00000000
	0.00000000	148.73684211	58.73684211	90.00000000
	0.00000000	147.78947369	57.78947369	90.00000000
	0.00000000	146.84210527	56.84210527	90.00000000
	0.00000000	145.89473684	55.89473684	90.00000000
	0.00000000	144.94736842	54.94736842	90.00000000
	0.00000000	144.00000000	54.00000000	90.00000000
	0.00000000	143.05263158	53.05263158	90.00000000
	0.00000000	142.10526316	52.10526316	90.00000000
	0.00000000	141.15789474	51.15789474	90.00000000
	0.00000000	140.21052632	50.21052632	90.00000000

ROW	1 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	0.92307692	180.00000000	89.07697898	0.00000000
	0.92307692	179.05263158	88.67735224	45.74027634
	0.92307692	178.10526316	87.89246947	64.01953888
	0.92307692	177.15789474	87.01188500	71.99855042
	0.92307692	176.21052632	86.09989283	76.29920197
	0.92307692	175.26315790	85.17426700	78.95967102
	0.92307692	174.31578947	84.24157833	80.76040649
	0.92307692	173.36842105	83.30477788	82.05750275
	0.92307692	172.42105263	82.36537911	83.03517914

0.92307692	171.47368421	81.42423587	83.79788208
0.92307692	170.52631579	80.48186563	84.40914154
0.92307692	169.57894737	79.53859999	84.90975189
0.92307692	168.63157895	78.59466112	85.32709503
0.92307692	167.68421053	77.65020341	85.68022156
0.92307692	166.73684211	76.70533744	85.98279572
0.92307692	165.78947369	75.76014451	86.24485016
0.92307692	164.84210526	74.81468569	86.47395325
0.92307692	163.89473684	73.86900774	86.67588043
0.92307692	162.94736842	72.92314709	86.85514069
0.92307692	162.00000000	71.97713251	87.01530457
0.92307692	161.05263158	71.03098706	87.15921783
0.92307692	160.10526316	70.08472941	87.28919983
0.92307692	159.15789474	69.13837483	87.40713501
0.92307692	158.21052632	68.19193597	87.51458740
0.92307692	157.26315790	67.24542337	87.61287689
0.92307692	156.31578948	66.29884587	87.70307922
0.92307692	155.36842105	65.35221097	87.78614044
0.92307692	154.42105263	64.40552505	87.86283875
0.92307692	153.47368421	63.45879360	87.93386078
0.92307692	152.52631579	62.51202134	87.99978638
0.92307692	151.57894737	61.56521236	88.06111908
0.92307692	150.63157895	60.61837024	88.11830902
0.92307692	149.68421053	59.67149809	88.17173767
0.92307692	148.73684211	58.72459866	88.22174835
0.92307692	147.78947369	57.77767438	88.26863098
0.92307692	146.84210527	56.83072740	88.31265259
0.92307692	145.89473684	55.88375962	88.35405731
0.92307692	144.94736842	54.93677275	88.39305115
0.92307692	144.00000000	53.98976833	88.42982483
0.92307692	143.05263158	53.04274771	88.46453857
0.92307692	142.10526316	52.09571213	88.49735260
0.92307692	141.15789474	51.14866271	88.52839661
0.92307692	140.21052632	50.20160046	88.55780029

ROW	2 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	1.84615385	180.00000000	88.15389806	0.00000000
	1.84615385	179.05263158	87.92508104	27.15587044
	1.84615385	178.10526316	87.35483884	45.72892761
	1.84615385	177.15789474	86.61136329	56.97355270
	1.84615385	176.21052632	85.78535506	64.00134277
	1.84615385	175.26315790	84.91689103	68.67815399
	1.84615385	174.31578947	84.02445380	71.97343445
	1.84615385	173.36842105	83.11736255	74.40518951
	1.84615385	172.42105263	82.20072866	76.26688385
	1.84615385	171.47368421	81.27756016	77.73471069
	1.84615385	170.52631579	80.34973227	78.91996765
	1.84615385	169.57894737	79.41847064	79.89604187
	1.84615385	168.63157895	78.48460838	80.71317291
	1.84615385	167.68421053	77.54873068	81.40680695
	1.84615385	166.73684211	76.61126025	82.00264740
	1.84615385	165.78947369	75.67250980	82.51976776
	1.84615385	164.84210526	74.73271550	82.97260284
	1.84615385	163.89473684	73.79205899	83.37228394
	1.84615385	162.94736842	72.85068223	83.72750854
	1.84615385	162.00000000	71.90869772	84.04518890

1.84615385	161.05263158	70.96619575	84.33087158
1.84615385	160.10526316	70.02324965	84.58908081
1.84615385	159.15789474	69.07991953	84.82350159
1.84615385	158.21052632	68.13625517	85.03721619
1.84615385	157.26315790	67.19229813	85.23277283
1.84615385	156.31578948	66.24808338	85.41233063
1.84615385	155.36842105	65.30364055	85.57772064
1.84615385	154.42105263	64.35899492	85.73050690
1.84615385	153.47368421	63.41416818	85.87200928
1.84615385	152.52631579	62.46917905	86.00339508
1.84615385	151.57894737	61.52404377	86.12567139
1.84615385	150.63157895	60.57877651	86.23970032
1.84615385	149.68421053	59.63338966	86.34624481
1.84615385	148.73684211	58.68789414	86.44599152
1.84615385	147.78947369	57.74229958	86.53952026
1.84615385	146.84210527	56.79661452	86.62735748
1.84615385	145.89473684	55.85084656	86.70998383
1.84615385	144.94736842	54.90500249	86.78780365
1.84615385	144.00000000	53.95908837	86.86119080
1.84615385	143.05263158	53.01310967	86.93048859
1.84615385	142.10526316	52.06707130	86.99599457
1.84615385	141.15789474	51.12097770	87.05797577
1.84615385	140.21052632	50.17483290	87.11668396

ROW	3 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	2.76923077	180.00000000	87.23076801	0.00000000
	2.76923077	179.05263158	87.07332035	18.87162209
	2.76923077	178.10526316	86.64502199	34.35467911
	2.76923077	177.15789474	86.03264365	45.71000290
	2.76923077	176.21052632	85.30771166	53.80064011
	2.76923077	175.26315790	84.51467077	59.64086914
	2.76923077	174.31578947	83.67910483	63.97097397
	2.76923077	173.36842105	82.81583651	67.27399445
	2.76923077	172.42105263	81.93375535	69.86009979
	2.76923077	171.47368421	81.03841495	71.93148804
	2.76923077	170.52631579	80.13342441	73.62337494
	2.76923077	169.57894737	79.22121428	75.02864838
	2.76923077	168.63157895	78.30347374	76.21280670
	2.76923077	167.68421053	77.38140954	77.22315216
	2.76923077	166.73684211	76.45590484	78.09458160
	2.76923077	165.78947369	75.52761983	78.85336304
	2.76923077	164.84210526	74.59705734	79.51961517
	2.76923077	163.89473684	73.66460671	80.10895538
	2.76923077	162.94736842	72.73057396	80.63373566
	2.76923077	162.00000000	71.79520274	81.10378265
	2.76923077	161.05263158	70.85868944	81.52706909
	2.76923077	160.10526316	69.92119401	81.91007233
	2.76923077	159.15789474	68.98284805	82.25814819
	2.76923077	158.21052632	68.04376075	82.57575226
	2.76923077	157.26315790	67.10402349	82.86659241
	2.76923077	156.31578948	66.16371331	83.13382721
	2.76923077	155.36842105	65.22289561	83.38011932
	2.76923077	154.42105263	64.28162624	83.60774994
	2.76923077	153.47368421	63.33995321	83.81868744
	2.76923077	152.52631579	62.39791800	84.01462555
	2.76923077	151.57894737	61.45555665	84.19703674

2.76923077	150.63157895	60.51290059	84.36720276
2.76923077	149.68421053	59.56997737	84.52626801
2.76923077	148.73684211	58.62681128	84.67520905
2.76923077	147.78947369	57.68342374	84.81490326
2.76923077	146.84210527	56.73983379	84.94614410
2.76923077	145.89473684	55.79605834	85.06961060
2.76923077	144.94736842	54.85211253	85.18592072
2.76923077	144.00000000	53.90800991	85.29563141
2.76923077	143.05263158	52.96376265	85.39923859
2.76923077	142.10526316	52.01938174	85.49719238
2.76923077	141.15789474	51.07487708	85.58989716
2.76923077	140.21052632	50.13025768	85.67771149

ROW	4 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	3.69230769	180.00000000	86.30768796	0.00000000
	3.69230769	179.05263158	86.18825075	14.37073517
	3.69230769	178.10526316	85.85051515	27.12851143
	3.69230769	177.15789474	85.34172308	37.53708267
	3.69230769	176.21052632	84.71101248	45.68349457
	3.69230769	175.26315790	83.99668774	51.99386978
	3.69230769	174.31578947	83.22514585	56.91408157
	3.69230769	173.36842105	82.41382456	60.80374146
	3.69230769	172.42105263	81.57420735	63.92839432
	3.69230769	171.47368421	80.71396659	66.47874451
	3.69230769	170.52631579	79.83833884	68.59143829
	3.69230769	169.57894737	78.95098197	70.36525726
	3.69230769	168.63157895	78.05450978	71.87255859
	3.69230769	167.68421053	77.15083028	73.16718292
	3.69230769	166.73684211	76.24136379	74.28978729
	3.69230769	165.78947369	75.32718662	75.27153778
	3.69230769	164.84210526	74.40912764	76.13665009
	3.69230769	163.89473684	73.48783458	76.90419006
	3.69230769	162.94736842	72.56382034	77.58936310
	3.69230769	162.00000000	71.63749598	78.20439148
	3.69230769	161.05263158	70.70919456	78.75924683
	3.69230769	160.10526316	69.77918864	79.26209259
	3.69230769	159.15789474	68.84770333	79.71971130
	3.69230769	158.21052632	67.91492609	80.13775635
	3.69230769	157.26315790	66.98101427	80.52098083
	3.69230769	156.31578948	66.04610085	80.87342834
	3.69230769	155.36842105	65.11029899	81.19851685
	3.69230769	154.42105263	64.17370555	81.49919891
	3.69230769	153.47368421	63.23640395	81.77800751
	3.69230769	152.52631579	62.29846635	82.03714752
	3.69230769	151.57894737	61.35995554	82.27852631
	3.69230769	150.63157895	60.42092640	82.50381470
	3.69230769	149.68421053	59.48142706	82.71448517
	3.69230769	148.73684211	58.54149997	82.91182709
	3.69230769	147.78947369	57.60118268	83.09699249
	3.69230769	146.84210527	56.66050850	83.27100372
	3.69230769	145.89473684	55.71950715	83.43475342
	3.69230769	144.94736842	54.77820516	83.58906555
	3.69230769	144.00000000	53.83662635	83.73465729
	3.69230769	143.05263158	52.89479211	83.87217712
	3.69230769	142.10526316	51.95272174	84.00222015
	3.69230769	141.15789474	51.01043271	84.12532043

	3.69230769	140.21052632	50.06794083	84.24195099
<b>ROW</b>	<b>5 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	4.61538462	180.00000000	85.38462989	0.00000000
	4.61538462	179.05263158	85.28860891	11.57466030
	4.61538462	178.10526316	85.01162352	22.27220726
	4.61538462	177.15789474	84.58135425	31.55845451
	4.61538462	176.21052632	84.03085690	39.30646133
	4.61538462	175.26315790	83.39010290	45.64938736
	4.61538462	174.31578947	82.68276494	50.81779861
	4.61538462	173.36842105	81.92632472	55.04492569
	4.61538462	172.42105263	81.13334083	58.53010178
	4.61538462	171.47368421	80.31278371	61.43206787
	4.61538462	170.52631579	79.47109839	63.87353897
	4.61538462	169.57894737	78.61296941	65.94843292
	4.61538462	168.63157895	77.74185006	67.72867584
	4.61538462	167.68421053	76.86032411	69.26965332
	4.61538462	166.73684211	75.97035347	70.61434937
	4.61538462	165.78947369	75.07344894	71.79645538
	4.61538462	164.84210526	74.17078953	72.84264374
	4.61538462	163.89473684	73.26330675	73.77422333
	4.61538462	162.94736842	72.35174506	74.60838318
	4.61538462	162.00000000	71.43670576	75.35912323
	4.61538462	161.05263158	70.51867929	76.03794098
	4.61538462	160.10526316	69.59806932	76.65433502
	4.61538462	159.15789474	68.67521087	77.21623993
	4.61538462	158.21052632	67.75038416	77.73031616
	4.61538462	157.26315790	66.82382525	78.20220947
	4.61538462	156.31578948	65.89573434	78.63668823
	4.61538462	155.36842105	64.96628228	79.03787231
	4.61538462	154.42105263	64.03561568	79.40927124
	4.61538462	153.47368421	63.10386109	79.75393677
	4.61538462	152.52631579	62.17112824	80.07452393
	4.61538462	151.57894737	61.23751279	80.37333679
	4.61538462	150.63157895	60.30309844	80.65239716
	4.61538462	149.68421053	59.36795877	80.91350555
	4.61538462	148.73684211	58.43215874	81.15821075
	4.61538462	147.78947369	57.49575586	81.38793182
	4.61538462	146.84210527	56.55880127	81.60388947
	4.61538462	145.89473684	55.62134058	81.80719757
	4.61538462	144.94736842	54.68341458	81.99885559
	4.61538462	144.00000000	53.74505991	82.17974091
	4.61538462	143.05263158	52.80630952	82.35064697
	4.61538462	142.10526316	51.86719316	82.51231384
	4.61538462	141.15789474	50.92773774	82.66538239
	4.61538462	140.21052632	49.98796768	82.81044006

<b>ROW</b>	<b>6 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	5.53846154	180.00000000	84.46154457	0.00000000
	5.53846154	179.05263158	84.38135263	9.67654133
	5.53846154	178.10526316	84.14736583	18.82818985
	5.53846154	177.15789474	83.77690815	27.08287811
	5.53846154	176.21052632	83.29255402	34.27759552
	5.53846154	175.26315790	82.71699234	40.41860199
	5.53846154	174.31578947	82.07005841	45.60766602
	5.53846154	173.36842105	81.36778452	49.98152161

5.53846154	172.42105263	80.62259610	53.67682266
5.53846154	171.47368421	79.84393560	56.81472778
5.53846154	170.52631579	79.03893464	59.49664688
5.53846154	169.57894737	78.21298929	61.80509186
5.53846154	168.63157895	77.37020846	63.80632019
5.53846154	167.68421053	76.51374857	65.55332184
5.53846154	166.73684211	75.64605852	67.08853149
5.53846154	165.78947369	74.76905804	68.44601440
5.53846154	164.84210526	73.88426764	69.65332794
5.53846154	163.89473684	72.99290363	70.73284912
5.53846154	162.94736842	72.09594839	71.70291901
5.53846154	162.00000000	71.19420254	72.57863617
5.53846154	161.05263158	70.28832411	73.37253571
5.53846154	160.10526316	69.37885834	74.09509277
5.53846154	159.15789474	68.46626036	74.75508881
5.53846154	158.21052632	67.55091279	75.35997772
5.53846154	157.26315790	66.63313938	75.91607666
5.53846154	156.31578948	65.71321576	76.42881012
5.53846154	155.36842105	64.79137798	76.90281677
5.53846154	154.42105263	63.86782927	77.34211731
5.53846154	153.47368421	62.94274546	77.75020599
5.53846154	152.52631579	62.01627948	78.13011932
5.53846154	151.57894737	61.08856485	78.48451233
5.53846154	150.63157895	60.15971871	78.81572723
5.53846154	149.68421053	59.22984422	79.12582397
5.53846154	148.73684211	58.29903257	79.41663361
5.53846154	147.78947369	57.36736463	79.68977356
5.53846154	146.84210527	56.43491244	79.94668579
5.53846154	145.89473684	55.50174028	80.18865967
5.53846154	144.94736842	54.56790576	80.41686249
5.53846154	144.00000000	53.63346065	80.63231659
5.53846154	143.05263158	52.69845157	80.83597565
5.53846154	142.10526316	51.76292064	81.02867889
5.53846154	141.15789474	50.82690600	81.21118927
5.53846154	140.21052632	49.89044229	81.38420868

ROW	7 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	6.46153846	180.00000000	83.53846768	0.00000000
	6.46153846	179.05263158	83.46967852	8.30581093
	6.46153846	178.10526316	83.26752690	16.27440834
	6.46153846	177.15789474	82.94346519	23.64398384
	6.46153846	176.21052632	82.51330760	30.26578903
	6.46153846	175.26315790	81.99413798	36.09732437
	6.46153846	174.31578947	81.40206612	41.17068481
	6.46153846	173.36842105	80.75108250	45.55830383
	6.46153846	172.42105263	80.05274714	49.34735107
	6.46153846	171.47368421	79.31634201	52.62450790
	6.46153846	170.52631579	78.54921022	55.46858215
	6.46153846	169.57894737	77.75712701	57.94786835
	6.46153846	168.63157895	76.94463376	60.12002563
	6.46153846	167.68421053	76.11531372	62.03304672
	6.46153846	166.73684211	75.27200984	63.72663879
	6.46153846	165.78947369	74.41699298	65.23358154
	6.46153846	164.84210526	73.55209043	66.58095551
	6.46153846	163.89473684	72.67878375	67.79121399
	6.46153846	162.94736842	71.79828337	68.88301086

6.46153846	162.00000000	70.91158553	69.87196350
6.46153846	161.05263158	70.01951612	70.77114868
6.46153846	160.10526316	69.12276450	71.59163666
6.46153846	159.15789474	68.22190990	72.34278107
6.46153846	158.21052632	67.31744199	73.03257751
6.46153846	157.26315790	66.40977724	73.66785431
6.46153846	156.31578948	65.49927179	74.25451660
6.46153846	155.36842105	64.58623183	74.79763031
6.46153846	154.42105263	63.67092191	75.30161285
6.46153846	153.47368421	62.75357168	75.77030945
6.46153846	152.52631579	61.83438140	76.20709991
6.46153846	151.57894737	60.91352641	76.61492157
6.46153846	150.63157895	59.99116088	76.99639893
6.46153846	149.68421053	59.06742086	77.35382843
6.46153846	148.73684211	58.14242686	77.68924713
6.46153846	147.78947369	57.21628595	78.00449371
6.46153846	146.84210527	56.28909363	78.30119324
6.46153846	145.89473684	55.36093528	78.58078766
6.46153846	144.94736842	54.43188752	78.84459686
6.46153846	144.00000000	53.50201924	79.09378815
6.46153846	143.05263158	52.57139262	79.32943726
6.46153846	142.10526316	51.64006385	79.55249023
6.46153846	141.15789474	50.70808389	79.76382446

ROW	8	EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
		7.38461538	180.00000000	82.61538722	0.00000000
		7.38461538	179.05263158	82.55520063	7.27009630
		7.38461538	178.10526316	82.37749178	14.31147671
		7.38461538	177.15789474	82.09017798	20.93575287
		7.38461538	176.21052632	81.70464040	27.01891327
		7.38461538	175.26315790	81.23382961	32.50386810
		7.38461538	174.31578947	80.69067500	37.38759995
		7.38461538	173.36842105	80.08706175	41.70281601
		7.38461538	172.42105263	79.43334643	45.50127792
		7.38461538	171.47368421	78.73825128	48.84175110
		7.38461538	170.52631579	78.00897102	51.78256607
		7.38461538	169.57894737	77.25137177	54.37769318
		7.38461538	168.63157895	76.47021068	56.67510986
		7.38461538	167.68421053	75.66934119	58.71646118
		7.38461538	166.73684211	74.85188979	60.53738022
		7.38461538	165.78947369	74.02040200	62.16814423
		7.38461538	164.84210526	73.17695992	63.63437653
		7.38461538	163.89473684	72.32327564	64.95774078
		7.38461538	162.94736842	71.46076498	66.15657043
		7.38461538	162.00000000	70.59060561	67.24642181
		7.38461538	161.05263158	69.71378278	68.24050903
		7.38461538	160.10526316	68.83112554	69.15013123
		7.38461538	159.15789474	67.94333538	69.98493958
		7.38461538	158.21052632	67.05100907	70.75324249
		7.38461538	157.26315790	66.15465696	71.46221924
		7.38461538	156.31578948	65.25471761	72.11805725
		7.38461538	155.36842105	64.35156976	72.72617340
		7.38461538	154.42105263	63.44554190	73.29125977
		7.38461538	153.47368421	62.53692023	73.81745911
		7.38461538	152.52631579	61.62595508	74.30838776
		7.38461538	151.57894737	60.71286630	74.76724243

7.38461538	150.63157895	59.79784770	75.19685364
7.38461538	149.68421053	58.88107069	75.59973145
7.38461538	148.73684211	57.96268746	75.97811127
7.38461538	147.78947369	57.04283350	76.33397675
7.38461538	146.84210527	56.12162985	76.66912842
7.38461538	145.89473684	55.19918495	76.98515320
7.38461538	144.94736842	54.27559622	77.28350830
7.38461538	144.00000000	53.35095143	77.56547546
7.38461538	143.05263158	52.42532984	77.83224487
7.38461538	142.10526316	51.49880321	78.08486938
7.38461538	141.15789474	50.57143669	78.32432556

ROW	9	EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
		8.30769231	180.00000000	81.69231722	0.00000000
		8.30769231	179.05263158	81.63885167	6.46006680
		8.30769231	178.10526316	81.48046804	12.75825405
		8.30769231	177.15789474	81.22284446	18.75569534
		8.30769231	176.21052632	80.87438232	24.35194016
		8.30769231	175.26315790	80.44501538	29.48943138
		8.30769231	174.31578947	79.94510335	34.14884567
		8.30769231	173.36842105	79.38460886	38.33959579
		8.30769231	172.42105263	78.77260223	42.08958054
		8.30769231	171.47368421	78.11704074	45.43655777
		8.30769231	170.52631579	77.42473515	48.42192078
		8.30769231	169.57894737	76.70142377	51.08673859
		8.30769231	168.63157895	75.95189612	53.46950912
		8.30769231	167.68421053	75.18013046	55.60511398
		8.30769231	166.73684211	74.38942582	57.52449036
		8.30769231	165.78947369	73.58251958	59.25468445
		8.30769231	164.84210526	72.76168788	60.81918335
		8.30769231	163.89473684	71.92882944	62.23825455
		8.30769231	162.94736842	71.08553412	63.52938461
		8.30769231	162.00000000	70.23313893	64.70762634
		8.30769231	161.05263158	69.37277324	65.78596497
		8.30769231	160.10526316	68.50539544	66.77561188
		8.30769231	159.15789474	67.63182259	67.68626404
		8.30769231	158.21052632	66.75275438	68.52634430
		8.30769231	157.26315790	65.86879276	69.30318451
		8.30769231	156.31578948	64.98045776	70.02315521
		8.30769231	155.36842105	64.08820057	70.69187164
		8.30769231	154.42105263	63.19241425	71.31422424
		8.30769231	153.47368421	62.29344254	71.89454651
		8.30769231	152.52631579	61.39158717	72.43664551
		8.30769231	151.57894737	60.48711397	72.94390869
		8.30769231	150.63157895	59.58025794	73.41934204
		8.30769231	149.68421053	58.67122751	73.86560822
		8.30769231	148.73684211	57.76020812	74.28511047
		8.30769231	147.78947369	56.84736529	74.67996216
		8.30769231	146.84210527	55.93284715	75.05210876
		8.30769231	145.89473684	55.01678668	75.40325165
		8.30769231	144.94736842	54.09930352	75.73496246
		8.30769231	144.00000000	53.18050567	76.04864502
		8.30769231	143.05263158	52.26049077	76.34557343
		8.30769231	142.10526316	51.33934737	76.62690735
		8.30769231	141.15789474	50.41715593	76.89369202



ROW	10	EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
		9.23076923	180.00000000	80.76922099	0.00000000
		9.23076923	179.05263158	80.72115259	5.80913877
		9.23076923	178.10526316	80.57841881	11.49971294
		9.23076923	177.15789474	80.34521752	16.96700478
		9.23076923	176.21052632	80.02789398	22.13018417
		9.23076923	175.26315790	79.63417145	26.93654060
		9.23076923	174.31578947	79.17238168	31.36028671
		9.23076923	173.36842105	78.65083126	35.39781189
		9.23076923	172.42105263	78.07736116	39.06158066
		9.23076923	171.47368421	77.45909291	42.37428665
		9.23076923	170.52631579	76.80232206	45.36410522
		9.23076923	169.57894737	76.11251132	48.06124115
		9.23076923	168.63157895	75.39434251	50.49565887
		9.23076923	167.68421053	74.65179716	52.69574356
		9.23076923	166.73684211	73.88824659	54.68758774
		9.23076923	165.78947369	73.10654013	56.49472046
		9.23076923	164.84210526	72.30908580	58.13809586
		9.23076923	163.89473684	71.49792118	59.63619995
		9.23076923	162.94736842	70.67477414	61.00527954
		9.23076923	162.00000000	69.84111397	62.25956726
		9.23076923	161.05263158	68.99819414	63.41150665
		9.23076923	160.10526316	68.14708772	64.47198486
		9.23076923	159.15789474	67.28871668	65.45051575
		9.23076923	158.21052632	66.42387611	66.35546112
		9.23076923	157.26315790	65.55325429	67.19413757
		9.23076923	156.31578948	64.67744918	67.97298431
		9.23076923	155.36842105	63.79698223	68.69769287
		9.23076923	154.42105263	62.91230975	69.37326050
		9.23076923	153.47368421	62.02383247	70.00413513
		9.23076923	152.52631579	61.13190345	70.59426117
		9.23076923	151.57894737	60.23683482	71.14714050
		9.23076923	150.63157895	59.33890335	71.66590881
		9.23076923	149.68421053	58.43835524	72.15336609
		9.23076923	148.73684211	57.53541009	72.61199951
		9.23076923	147.78947369	56.63026439	73.04408264
		9.23076923	146.84210527	55.72309436	73.45162964
		9.23076923	145.89473684	54.81405853	73.83647156
		9.23076923	144.94736842	53.90329982	74.20025635
		9.23076923	144.00000000	52.99094740	74.54449463
		9.23076923	143.05263158	52.07711830	74.87053680
		9.23076923	142.10526316	51.16191881	75.17961121
		9.23076923	141.15789474	50.24544562	75.47286224

ROW	11	EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
		10.15384615	180.00000000	79.84615028	0.00000000
		10.15384615	179.05263158	79.80251230	5.27450562
		10.15384615	178.10526316	79.67270476	10.45970058
		10.15384615	177.15789474	79.45991115	15.47498035
		10.15384615	176.21052632	79.16902206	20.25513840
		10.15384615	175.26315790	78.80612476	24.75383568
		10.15384615	174.31578947	78.37796342	28.94380379
		10.15384615	173.36842105	77.89146028	32.81459045
		10.15384615	172.42105263	77.35334762	36.36901093
		10.15384615	171.47368421	76.76992254	39.61933136
		10.15384615	170.52631579	76.14691013	42.58379745

10.15384615	169.57894737	75.48940989	45.28388977
10.15384615	168.63157895	74.80189863	47.74229050
10.15384615	167.68421053	74.08826752	49.98152161
10.15384615	166.73684211	73.35187671	52.02306747
10.15384615	165.78947369	72.59561650	53.88692856
10.15384615	164.84210526	71.82196829	55.59136963
10.15384615	163.89473684	71.03306140	57.15289688
10.15384615	162.94736842	70.23072426	58.58629227
10.15384615	162.00000000	69.41652911	59.90471649
10.15384615	161.05263158	68.59183072	61.11986160
10.15384615	160.10526316	67.75779926	62.24208832
10.15384615	159.15789474	66.91544822	63.28056335
10.15384615	158.21052632	66.06565793	64.24341583
10.15384615	157.26315790	65.20919537	65.13782501
10.15384615	156.31578948	64.34673084	65.97017670
10.15384615	155.36842105	63.47885191	66.74613953
10.15384615	154.42105263	62.60607526	67.47073364
10.15384615	153.47368421	61.72885659	68.14846802
10.15384615	152.52631579	60.84759900	68.78332520
10.15384615	151.57894737	59.96266014	69.37889862
10.15384615	150.63157895	59.07435822	69.93840027
10.15384615	149.68421053	58.18297711	70.46469879
10.15384615	148.73684211	57.28877078	70.96039581
10.15384615	147.78947369	56.39196702	71.42781830
10.15384615	146.84210527	55.49277062	71.86908722
10.15384615	145.89473684	54.59136619	72.28610229
10.15384615	144.94736842	53.68792053	72.68058777
10.15384615	144.00000000	52.78258466	73.05413055
10.15384615	143.05263158	51.87549567	73.40815735
10.15384615	142.10526316	50.96677822	73.74396515
10.15384615	141.15789474	50.05654593	74.06274414

ROW	12 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	11.07692308	180.00000000	78.92308435	0.00000000
	11.07692308	179.05263158	78.88314985	4.82741737
	11.07692308	178.10526316	78.76419803	9.58596802
	11.07692308	177.15789474	78.56869565	14.21246719
	11.07692308	176.21052632	78.30048017	18.65397263
	11.07692308	175.26315790	77.96441258	22.87048721
	11.07692308	174.31578947	77.56599428	26.83566093
	11.07692308	173.36842105	77.11100708	30.53582954
	11.07692308	172.42105263	76.60521545	33.96799850
	11.07692308	171.47368421	76.05414736	37.13739777
	11.07692308	170.52631579	75.46295232	40.05503845
	11.07692308	169.57894737	74.83632452	42.73562622
	11.07692308	168.63157895	74.17847508	45.19586182
	11.07692308	167.68421053	73.49313813	47.45318604
	11.07692308	166.73684211	72.78359777	49.52492905
	11.07692308	165.78947369	72.05272625	51.42774200
	11.07692308	164.84210526	71.30302688	53.17724991
	11.07692308	163.89473684	70.53667718	54.78790283
	11.07692308	162.94736842	69.75557002	56.27289581
	11.07692308	162.00000000	68.96135114	57.64419556
	11.07692308	161.05263158	68.15545277	58.91259003
	11.07692308	160.10526316	67.33912318	60.08776474
	11.07692308	159.15789474	66.51345224	61.17840958

11.07692308	158.21052632	65.67939364	62.19228745
11.07692308	157.26315790	64.83778374	63.13635635
11.07692308	156.31578948	63.98935790	64.01682281
11.07692308	155.36842105	63.13476427	64.83925629
11.07692308	154.42105263	62.27457559	65.60864258
11.07692308	153.47368421	61.40929935	66.32943726
11.07692308	152.52631579	60.53938630	67.00565338
11.07692308	151.57894737	59.66523789	67.64090729
11.07692308	150.63157895	58.78721253	68.23842621
11.07692308	149.68421053	57.90563103	68.80115509
11.07692308	148.73684211	57.02078119	69.33172607
11.07692308	147.78947369	56.13292188	69.83252716
11.07692308	146.84210527	55.24228641	70.30574036
11.07692308	145.89473684	54.34908560	70.75332642
11.07692308	144.94736842	53.45351032	71.17707062
11.07692308	144.00000000	52.55573376	71.57860565
11.07692308	143.05263158	51.65591339	71.95941162
11.07692308	142.10526316	50.75419268	72.32085419
11.07692308	141.15789474	49.85070261	72.66417694

ROW	13 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	12.00000000	180.00000000	78.00000694	0.00000000
	12.00000000	179.05263158	77.96321561	4.44785881
	12.00000000	178.10526316	77.85351034	8.84155560
	12.00000000	177.15789474	77.67283801	13.13075638
	12.00000000	176.21052632	77.42425752	17.27212906
	12.00000000	175.26315790	77.11169834	21.23141098
	12.00000000	174.31578947	76.73968479	24.98423004
	12.00000000	173.36842105	76.31306510	28.51578712
	12.00000000	172.42105263	75.83677420	31.81976318
	12.00000000	171.47368421	75.31564607	34.89676285
	12.00000000	170.52631579	74.75427948	37.75264740
	12.00000000	169.57894737	74.15695289	40.39698792
	12.00000000	168.63157895	73.52757964	42.84169388
	12.00000000	167.68421053	72.86969352	45.09997559
	12.00000000	166.73684211	72.18645539	47.18552780
	12.00000000	165.78947369	71.48067311	49.11195374
	12.00000000	164.84210526	70.75482902	50.89240265
	12.00000000	163.89473684	70.01111076	52.53930283
	12.00000000	162.94736842	69.25144264	54.06425476
	12.00000000	162.00000000	68.47751593	55.47796249
	12.00000000	161.05263158	67.69081697	56.79021835
	12.00000000	160.10526316	66.89265277	58.00995636
	12.00000000	159.15789474	66.08417378	59.14527512
	12.00000000	158.21052632	65.26639412	60.20349884
	12.00000000	157.26315790	64.44020914	61.19125366
	12.00000000	156.31578948	63.60641089	62.11450958
	12.00000000	155.36842105	62.76570138	62.97865677
	12.00000000	154.42105263	61.91870415	63.78856277
	12.00000000	153.47368421	61.06597424	64.54860687
	12.00000000	152.52631579	60.20800680	65.26276398
	12.00000000	151.57894737	59.34524453	65.93461609
	12.00000000	150.63157895	58.47808411	66.56740570
	12.00000000	149.68421053	57.60688178	67.16406250
	12.00000000	148.73684211	56.73195815	67.72725677
	12.00000000	147.78947369	55.85360236	68.25941467

12.00000000	146.84210527	54.97207577	68.76273346
12.00000000	145.89473684	54.08761506	69.23921967
12.00000000	144.94736842	53.20043502	69.69070435
12.00000000	144.00000000	52.31073096	70.11885071
12.00000000	143.05263158	51.41868083	70.52519989
12.00000000	142.10526316	50.52444704	70.91113281

<b>ROW</b>	<b>14 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	12.92307692	180.00000000	77.07691999	0.00000000
	12.92307692	179.05263158	77.04283086	4.12147379
	12.92307692	178.10526316	76.94109751	8.19962597
	12.92307692	177.15789474	76.77328107	12.19378185
	12.92307692	176.21052632	76.54185400	16.06817245
	12.92307692	175.26315790	76.25002867	19.79350853
	12.92307692	174.31578947	75.90155622	23.34775543
	12.92307692	173.36842105	75.50052160	26.71614838
	12.92307692	172.42105263	75.05115593	29.89061165
	12.92307692	171.47368421	74.55767949	32.86880875
	12.92307692	170.52631579	74.02418114	35.65300751
	12.92307692	169.57894737	73.45453377	38.24895096
	12.92307692	168.63157895	72.85234170	40.66482162
	12.92307692	167.68421053	72.22091371	42.91036224
	12.92307692	166.73684211	71.56325570	44.99618149
	12.92307692	165.78947369	70.88207679	46.93320847
	12.92307692	164.84210526	70.17980442	48.73232269
	12.92307692	163.89473684	69.45860446	50.40406418
	12.92307692	162.94736842	68.72040395	51.95847321
	12.92307692	162.00000000	67.96691430	53.40499115
	12.92307692	161.05263158	67.19965405	54.75239944
	12.92307692	160.10526316	66.41997026	56.00881195
	12.92307692	159.15789474	65.62905819	57.18168259
	12.92307692	158.21052632	64.82797920	58.27783585
	12.92307692	157.26315790	64.01767672	59.30349731
	12.92307692	156.31578948	63.19899040	60.26433945
	12.92307692	155.36842105	62.37266874	61.16551971
	12.92307692	154.42105263	61.53937998	62.01172638
	12.92307692	153.47368421	60.69972179	62.80723190
	12.92307692	152.52631579	59.85422973	63.55590057
	12.92307692	151.57894737	59.00338455	64.26126099
	12.92307692	150.63157895	58.14761863	64.92651367
	12.92307692	149.68421053	57.28732162	65.55457306
	12.92307692	148.73684211	56.42284532	66.14810944
	12.92307692	147.78947369	55.55450795	66.70954132
	12.92307692	146.84210527	54.68259792	67.24108124
	12.92307692	145.89473684	53.80737710	67.74475098
	12.92307692	144.94736842	52.92908370	68.22241211
	12.92307692	144.00000000	52.04793481	68.67575073
	12.92307692	143.05263158	51.16412862	69.10633087
	12.92307692	142.10526316	50.27784636	69.51557159

<b>ROW</b>	<b>15 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	13.84615384	180.00000000	76.15385194	0.00000000
	13.84615384	179.05263158	76.12211173	3.83770037
	13.84615384	178.10526316	76.02732383	7.64023924
	13.84615384	177.15789474	75.87075748	11.37433243
	13.84615384	176.21052632	75.65443593	15.01020241

13.84615384	175.26315790	75.38101250	18.52278519
13.84615384	174.31578947	75.05362178	21.89240837
13.84615384	173.36842105	74.67572367	25.10494995
13.84615384	172.42105263	74.25095507	28.15157318
13.84615384	171.47368421	73.78300034	31.02814102
13.84615384	170.52631579	73.27548609	33.73446655
13.84615384	169.57894737	72.73190206	36.27349854
13.84615384	168.63157895	72.15554652	38.65055847
13.84615384	167.68421053	71.54949274	40.87260437
13.84615384	166.73684211	70.91657253	42.94768524
13.84615384	165.78947369	70.25937251	44.88442612
13.84615384	164.84210526	69.58023961	46.69168854
13.84615384	163.89473684	68.88129253	48.37828827
13.84615384	162.94736842	68.16443687	49.95281219
13.84615384	162.00000000	67.43138213	51.42346954
13.84615384	161.05263158	66.68365925	52.79803467
13.84615384	160.10526316	65.92263798	54.08379745
13.84615384	159.15789474	65.14954333	55.28753662
13.84615384	158.21052632	64.36547096	56.41553116
13.84615384	157.26315790	63.57140135	57.47356796
13.84615384	156.31578948	62.76821253	58.46697617
13.84615384	155.36842105	61.95669159	59.40063477
13.84615384	154.42105263	61.13754499	60.27902603
13.84615384	153.47368421	60.31140761	61.10623932
13.84615384	152.52631579	59.47885087	61.88602448
13.84615384	151.57894737	58.64038986	62.62181473
13.84615384	150.63157895	57.79648962	63.31673813
13.84615384	149.68421053	56.94757070	63.97366714
13.84615384	148.73684211	56.09401407	64.59523010
13.84615384	147.78947369	55.23616536	65.18382263
13.84615384	146.84210527	54.37433875	65.74166870
13.84615384	145.89473684	53.50882024	66.27077484
13.84615384	144.94736842	52.63987064	66.77301025
13.84615384	144.00000000	51.76772819	67.25007629
13.84615384	143.05263158	50.89261085	67.70355225
13.84615384	142.10526316	50.01471835	68.13486481

ROW	16 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	14.76923077	180.00000000	75.23076931	0.00000000
	14.76923077	179.05263158	75.20109077	3.58859468
	14.76923077	178.10526316	75.11241027	7.14828587
	14.76923077	177.15789474	74.96577228	10.65152740
	14.76923077	176.21052632	74.76285073	14.07332993
	14.76923077	175.26315790	74.50585779	17.39218903
	14.76923077	174.31578947	74.19743253	20.59065056
	14.76923077	173.36842105	73.84052110	23.65554237
	14.76923077	172.42105263	73.43825959	26.57786179
	14.76923077	171.47368421	72.99386771	29.35244560
	14.76923077	170.52631579	72.51055877	31.97747612
	14.76923077	169.57894737	71.99146813	34.45390320
	14.76923077	168.63157895	71.43960019	36.78486252
	14.76923077	167.68421053	70.85779226	38.97513580
	14.76923077	166.73684211	70.24869275	41.03065872
	14.76923077	165.78947369	69.61475077	42.95812988
	14.76923077	164.84210526	68.95821460	44.76464844
	14.76923077	163.89473684	68.28113628	46.45748901

14.76923077	162.94736842	67.58538055	48.04389954
14.76923077	162.00000000	66.87263639	49.53094101
14.76923077	161.05263158	66.14442994	50.92542267
14.76923077	160.10526316	65.40213799	52.23381042
14.76923077	159.15789474	64.64700137	53.46220779
14.76923077	158.21052632	63.88013784	54.61632919
14.76923077	157.26315790	63.10255424	55.70150757
14.76923077	156.31578948	62.31515774	56.72268677
14.76923077	155.36842105	61.51876618	57.68444443
14.76923077	154.42105263	60.71411746	58.59101105
14.76923077	153.47368421	59.90187793	59.44628525
14.76923077	152.52631579	59.08265006	60.25386047
14.76923077	151.57894737	58.25697920	61.01703644
14.76923077	150.63157895	57.42535961	61.73885727
14.76923077	149.68421053	56.58823990	62.42211914
14.76923077	148.73684211	55.74602780	63.06939316
14.76923077	147.78947369	54.89909443	63.68304825
14.76923077	146.84210527	54.04777805	64.26525879
14.76923077	145.89473684	53.19238749	64.81803131
14.76923077	144.94736842	52.33320506	65.34322357
14.76923077	144.00000000	51.47048926	65.84252930
14.76923077	143.05263158	50.60447712	66.31752014

ROW	17	EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
		15.69230769	180.00000000	74.30769562	0.00000000
		15.69230769	179.05263158	74.27984195	3.36806989
		15.69230769	178.10526316	74.19657564	6.71211290
		15.69230769	177.15789474	74.05876545	10.00910187
		15.69230769	176.21052632	73.86780989	13.23790646
		15.69230769	175.26315790	73.62556921	16.38000679
		15.69230769	174.31578947	73.33428089	19.41996956
		15.69230769	173.36842105	72.99646703	22.34567833
		15.69230769	172.42105263	72.61484138	25.14833260
		15.69230769	171.47368421	72.19222246	27.82225609
		15.69230769	170.52631579	71.73145730	30.36458015
		15.69230769	169.57894737	71.23535820	32.77484512
		15.69230769	168.63157895	70.70665331	35.05456543
		15.69230769	167.68421053	70.14795042	37.20681763
		15.69230769	166.73684211	69.56171247	39.23584747
		15.69230769	165.78947369	68.95024307	41.14672470
		15.69230769	164.84210526	68.31567993	42.94506454
		15.69230769	163.89473684	67.65999434	44.63678741
		15.69230769	162.94736842	66.98499511	46.22792435
		15.69230769	162.00000000	66.29233559	47.72449112
		15.69230769	161.05263158	65.58352254	49.13238144
		15.69230769	160.10526316	64.85992619	50.45727921
		15.69230769	159.15789474	64.12279069	51.70462036
		15.69230769	158.21052632	63.37324462	52.87956238
		15.69230769	157.26315790	62.61231116	53.98696518
		15.69230769	156.31578948	61.84091777	55.03137589
		15.69230769	155.36842105	61.05990529	56.01705551
		15.69230769	154.42105263	60.27003630	56.94795609
		15.69230769	153.47368421	59.47200283	57.82776260
		15.69230769	152.52631579	58.66643338	58.65988159
		15.69230769	151.57894737	57.85389925	59.44747543
		15.69230769	150.63157895	57.03492027	60.19346619

15.69230769	149.68421053	56.20996999	60.90055847
15.69230769	148.73684211	55.37948024	61.57124710
15.69230769	147.78947369	54.54384536	62.20784760
15.69230769	146.84210527	53.70342587	62.81249237
15.69230769	145.89473684	52.85855179	63.38715363
15.69230769	144.94736842	52.00952563	63.93365860
15.69230769	144.00000000	51.15662505	64.45369720
15.69230769	143.05263158	50.30010524	64.94883728

ROW	18 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	16.61538461	180.00000000	73.38461233	0.00000000
	16.61538461	179.05263158	73.35838611	3.17138290
	16.61538461	178.10526316	73.27995444	6.32259369
	16.61538461	177.15789474	73.15004679	9.43420982
	16.61538461	176.21052632	72.96984190	12.48823357
	16.61538461	175.26315790	72.74091629	15.46865463
	16.61538461	174.31578947	72.46517946	18.36183548
	16.61538461	173.36842105	72.14480167	21.15673256
	16.61538461	172.42105263	71.78213985	23.84494781
	16.61538461	171.47368421	71.37966671	26.42062950
	16.61538461	170.52631579	70.93990646	28.88027382
	16.61538461	169.57894737	70.46537983	31.22244835
	16.61538461	168.63157895	69.95855904	33.44747543
	16.61538461	167.68421053	69.42183317	35.55711746
	16.61538461	166.73684211	68.85748287	37.55427551
	16.61538461	165.78947369	68.26766355	39.44268799
	16.61538461	164.84210526	67.65439551	41.22670746
	16.61538461	163.89473684	67.01955974	42.91107941
	16.61538461	162.94736842	66.36489799	44.50077438
	16.61538461	162.00000000	65.69201614	46.00085449
	16.61538461	161.05263158	65.00238965	47.41636658
	16.61538461	160.10526315	64.29737063	48.75226212
	16.61538461	159.15789474	63.57819564	50.01334000
	16.61538461	158.21052632	62.84599397	51.20420837
	16.61538461	157.26315790	62.10179593	52.32925797
	16.61538461	156.31578948	61.34654099	53.39264679
	16.61538461	155.36842105	60.58108557	54.39828873
	16.61538461	154.42105263	59.80621043	55.34986115
	16.61538461	153.47368421	59.02262749	56.25080872
	16.61538461	152.52631579	58.23098624	57.10434723
	16.61538461	151.57894737	57.43187957	57.91346741
	16.61538461	150.63157895	56.62584906	58.68096542
	16.61538461	149.68421053	55.81338988	59.40943146
	16.61538461	148.73684211	54.99495519	60.10127640
	16.61538461	147.78947369	54.17096010	60.75873566
	16.61538461	146.84210527	53.34178527	61.38388824
	16.61538461	145.89473684	52.50778016	61.97866440
	16.61538461	144.94736842	51.66926596	62.54485321
	16.61538461	144.00000000	50.82653820	63.08411789
	16.61538461	143.05263158	49.97986914	63.59800720

ROW	19 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	17.53846154	180.00000000	72.46153771	0.00000000
	17.53846154	179.05263158	72.43677258	2.99478388
	17.53846154	178.10526316	72.36268602	5.97248220
	17.53846154	177.15789474	72.23989575	8.91657734

17.53846154	176.21052632	72.06940317	11.81164265
17.53846154	175.26315790	71.85255385	14.64377308
17.53846154	174.31578947	71.59098739	17.40091705
17.53846154	173.36842105	71.28658057	20.07306099
17.53846154	172.42105263	70.94138808	22.65231323
17.53846154	171.47368421	70.55758455	25.13286591
17.53846154	170.52631579	70.13741070	27.51086235
17.53846154	169.57894737	69.68312576	29.78422356
17.53846154	168.63157895	69.19696739	31.95241356
17.53846154	167.68421053	68.68111932	34.01619720
17.53846154	166.73684211	68.13768658	35.97740555
17.53846154	165.78947369	67.56867762	37.83869934
17.53846154	164.84210526	66.97599250	39.60338211
17.53846154	163.89473684	66.36141612	41.27519226
17.53846154	162.94736842	65.72661543	42.85817337
17.53846154	162.00000000	65.07313991	44.35654068
17.53846154	161.05263158	64.40242430	45.77457047
17.53846154	160.10526316	63.71579305	47.11653519
17.53846154	159.15789474	63.01446583	48.38663864
17.53846154	158.21052632	62.29956382	49.58896255
17.53846154	157.26315790	61.57211620	50.72743607
17.53846154	156.31578948	60.83306686	51.80582809
17.53846154	155.36842105	60.08328091	52.82772064
17.53846154	154.42105263	59.32355104	53.79649734
17.53846154	153.47368421	58.55460353	54.71535873
17.53846154	152.52631579	57.77710393	55.58731461
17.53846154	151.57894737	56.99166230	56.41518021
17.53846154	150.63157895	56.19883818	57.20160294
17.53846154	149.68421053	55.39914499	57.94905090
17.53846154	148.73684211	54.59305425	58.65983582
17.53846154	147.78947369	53.78099927	59.33610535
17.53846154	146.84210527	52.96337866	59.97986603
17.53846154	145.89473684	52.14055938	60.59299850
17.53846154	144.94736842	51.31287962	61.17724228
17.53846154	144.00000000	50.48065137	61.73422623

ROW	20 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	18.46153846	180.00000000	71.53846401	0.00000000
	18.46153846	179.05263158	71.51501853	2.83526897
	18.46153846	178.10526316	71.44486002	5.65595198
	18.46153846	177.15789474	71.32851558	8.44789886
	18.46153846	176.21052632	71.16684203	11.19780254
	18.46153846	175.26315790	70.96099532	13.89354038
	18.46153846	174.31578947	70.71239129	16.52444267
	18.46153846	173.36842105	70.42266059	19.08146095
	18.46153846	172.42105263	70.09360110	21.55725670
	18.46153846	171.47368421	69.72713029	23.94619179
	18.46153846	170.52631579	69.32524025	26.24426460
	18.46153846	169.57894737	68.88995681	28.44898415
	18.46153846	168.63157895	68.42330418	30.55919838
	18.46153846	167.68421053	67.92727539	32.57493210
	18.46153846	166.73684211	67.40380868	34.49718094
	18.46153846	165.78947369	66.85476962	36.32774353
	18.46153846	164.84210526	66.28193820	38.06904221
	18.46153846	163.89473684	65.68700044	39.72397614
	18.46153846	162.94736842	65.07154360	41.29578400



18.46153846	162.00000000	64.43705443	42.78792953
18.46153846	161.05263158	63.78491973	44.20401001
18.46153846	160.10526316	63.11642866	45.54767227
18.46153846	159.15789474	62.43277631	46.82256699
18.46153846	158.21052632	61.73506816	48.03227615
18.46153846	157.26315790	61.02432504	49.18030548
18.46153846	156.31578948	60.30148846	50.27003098
18.46153846	155.36842105	59.56742591	51.30470276
18.46153846	154.42105263	58.82293623	52.28742599
18.46153846	153.47368421	58.06875480	53.22114944
18.46153846	152.52631579	57.30555846	54.10866165
18.46153846	151.57894737	56.53397024	54.95260239
18.46153846	150.63157895	55.75456378	55.75546265
18.46153846	149.68421053	54.96786742	56.51957703
18.46153846	148.73684211	54.17436804	57.24714279
18.46153846	147.78947369	53.37451454	57.94021606
18.46153846	146.84210527	52.56872114	58.60072708
18.46153846	145.89473684	51.75737028	59.23048401
18.46153846	144.94736842	50.94081539	59.83117294
18.46153846	144.00000000	50.11938335	60.40438080

ROW	21 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	19.38461538	180.00000000	70.61538414	0.00000000
	19.38461538	179.05263158	70.59313704	2.69040394
	19.38461538	178.10526316	70.52654841	5.36826611
	19.38461538	177.15789474	70.41607112	8.02138519
	19.38461538	176.21052632	70.26244306	10.63821602
	19.38461538	175.26315790	70.06666319	13.20814610
	19.38461538	174.31578947	69.82996055	15.72171211
	19.38461538	173.36842105	69.55375833	18.17074966
	19.38461538	172.42105263	69.23963532	20.54847717
	19.38461538	171.47368421	68.88928683	22.84951401
	19.38461538	170.52631579	68.50448700	25.06984329
	19.38461538	169.57894737	68.08705389	27.20672798
	19.38461538	168.63157895	67.63881849	29.25860596
	19.38461538	167.68421053	67.16159809	31.22494125
	19.38461538	166.73684211	66.65717432	33.10609055
	19.38461538	165.78947369	66.12727575	34.90316391
	19.38461538	164.84210526	65.57356472	36.61786270
	19.38461538	163.89473684	64.99762793	38.25238419
	19.38461538	162.94736842	64.40097035	39.80927277
	19.38461538	162.00000000	63.78501184	41.29134750
	19.38461538	161.05263158	63.15108603	42.70159531
	19.38461538	160.10526316	62.50044089	44.04310226
	19.38461538	159.15789474	61.83424070	45.31900787
	19.38461538	158.21052632	61.15356893	46.53244019
	19.38461538	157.26315790	60.45943187	47.68648911
	19.38461538	156.31578948	59.75276264	48.78417206
	19.38461538	155.36842105	59.03442547	49.82841492
	19.38461538	154.42105263	58.30522008	50.82203674
	19.38461538	153.47368421	57.56588603	51.76774216
	19.38461538	152.52631579	56.81710701	52.66810608
	19.38461538	151.57894737	56.05951494	53.52558136
	19.38461538	150.63157895	55.29369388	54.34249115
	19.38461538	149.68421053	54.52018377	55.12104034
	19.38461538	148.73684211	53.73948389	55.86330032

19.38461538	147.78947369	52.95205610	56.57123184
19.38461538	146.84210527	52.15832786	57.24666977
19.38461538	145.89473684	51.35869502	57.89135361
19.38461538	144.94736842	50.55352438	58.50690842

ROW	22 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	20.30769231	180.00000000	69.69231118	0.00000000
	20.30769231	179.05263158	69.67115769	2.55819535
	20.30769231	178.10526316	69.60782906	5.10553741
	20.30769231	177.15789474	69.50271680	7.63143969
	20.30769231	176.21052632	69.35646013	10.12583447
	20.30769231	175.26315790	69.16992705	12.57939434
	20.30769231	174.31578947	68.94418967	14.98370647
	20.30769231	173.36842105	68.68049537	17.33140945
	20.30769231	172.42105263	68.38023538	19.61626053
	20.30769231	171.47368421	68.04491264	21.83318329
	20.30769231	170.52631579	67.67611020	23.97822952
	20.30769231	169.57894737	67.27546142	26.04854965
	20.30769231	168.63157895	66.84462302	28.04229927
	20.30769231	167.68421053	66.38525129	29.95854759
	20.30769231	166.73684211	65.89898197	31.79715919
	20.30769231	165.78947369	65.38741374	33.55869675
	20.30769231	164.84210526	64.85209523	35.24428558
	20.30769231	163.89473684	64.29451517	36.85552979
	20.30769231	162.94736842	63.71609549	38.39439392
	20.30769231	162.00000000	63.11818681	39.86312866
	20.30769231	161.05263158	62.50206601	41.26419067
	20.30769231	160.10526316	61.86893554	42.60017014
	20.30769231	159.15789474	61.21992397	43.87373734
	20.30769231	158.21052632	60.55608765	45.08760452
	20.30769231	157.26315790	59.87841311	46.24447632
	20.30769231	156.31578948	59.18781993	47.34703064
	20.30769231	155.36842105	58.48516409	48.39787674
	20.30769231	154.42105263	57.77124144	49.39957047
	20.30769231	153.47368421	57.04679130	50.35456467
	20.30769231	152.52631579	56.31250003	51.26522827
	20.30769231	151.57894737	55.56900460	52.13382721
	20.30769231	150.63157895	54.81689603	52.96252060
	20.30769231	149.68421053	54.05672263	53.75336075
	20.30769231	148.73684211	53.28899319	54.50830841
	20.30769231	147.78947369	52.51417991	55.22920990
	20.30769231	146.84210527	51.73272115	55.91780853
	20.30769231	145.89473684	50.94502406	56.57576370
	20.30769231	144.94736842	50.15146694	57.20463181

ROW	23 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	21.23076923	180.00000000	68.76922715	0.00000000
	21.23076923	179.05263158	68.74907617	2.43699479
	21.23076923	178.10526316	68.68873776	4.86454201
	21.23076923	177.15789474	68.58855228	7.27340603
	21.23076923	176.21052632	68.44907645	9.65476418
	21.23076923	175.26315790	68.27106828	12.00038624
	21.23076923	174.31578947	68.05546723	14.30277824
	21.23076923	173.36842105	67.80337091	16.55529594
	21.23076923	172.42105263	67.51600939	18.75221825
	21.23076923	171.47368421	67.19471862	20.88877869

21.23076923	170.52631579	66.84091393	22.96116829
21.23076923	169.57894737	66.45606464	24.96650124
21.23076923	168.63157895	66.04167061	26.90276718
21.23076923	167.68421053	65.59924125	28.76874733
21.23076923	166.73684211	65.13027723	30.56394577
21.23076923	165.78947369	64.63625510	32.28849030
21.23076923	164.84210526	64.11861477	33.94304657
21.23076923	163.89473684	63.57874967	35.52872467
21.23076923	162.94736842	63.01799933	37.04700470
21.23076923	162.00000000	62.43764420	38.49965668
21.23076923	161.05263158	61.83890232	39.88866425
21.23076923	160.10526316	61.22292756	41.21617508
21.23076923	159.15789474	60.59080913	42.48445511
21.23076923	158.21052632	59.94357220	43.69582748
21.23076923	157.26315790	59.28217923	44.85263824
21.23076923	156.31578948	58.60753197	45.95724869
21.23076923	155.36842105	57.92047382	47.01198578
21.23076923	154.42105263	57.22179258	48.01913071
21.23076923	153.47368421	56.51222330	48.98091125
21.23076923	152.52631579	55.79245124	49.89948654
21.23076923	151.57894737	55.06311489	50.77693176
21.23076923	150.63157895	54.32480890	51.61524963
21.23076923	149.68421053	53.57808695	52.41634750
21.23076923	148.73684211	52.82346454	53.18205643
21.23076923	147.78947369	52.06142166	53.91410828
21.23076923	146.84210527	51.29240529	54.61416245
21.23076923	145.89473684	50.51683174	55.28377914

ROW	24 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	22.15384615	180.00000000	67.84615258	0.00000000
	22.15384615	179.05263158	67.82692439	2.32542777
	22.15384615	178.10526316	67.76933979	4.64258766
	22.15384615	177.15789474	67.67369622	6.94338179
	22.15384615	176.21052632	67.54048095	9.22004318
	22.15384615	175.26315790	67.37035897	11.46528339
	22.15384615	174.31578947	67.16415698	13.67241001
	22.15384615	173.36842105	66.92284438	15.83542442
	22.15384615	172.42105263	66.64751227	17.94908714
	22.15384615	171.47368421	66.33935125	20.00895309
	22.15384615	170.52631579	65.9962925	22.01137924
	22.15384615	169.57894737	65.62966985	23.95351219
	22.15384615	168.63157895	65.23083200	25.83324623
	22.15384615	167.68421053	64.80449147	27.64917564
	22.15384615	166.73684211	64.35202446	29.40052986
	22.15384615	165.78947369	63.87479342	31.08710670
	22.15384615	164.84210526	63.37413519	32.70919800
	22.15384615	163.89473684	62.85135143	34.26752090
	22.15384615	162.94736842	62.30770103	35.76313782
	22.15384615	162.00000000	61.74439452	37.19741058
	22.15384615	161.05263158	61.16259012	38.57192230
	22.15384615	160.10526316	60.56339120	39.88843536
	22.15384615	159.15789474	59.94784504	41.14883804
	22.15384615	158.21052632	59.31694252	42.35510635
	22.15384615	157.26315790	58.67161863	43.50927734
	22.15384615	156.31578948	58.01275367	44.61340714
	22.15384615	155.36842105	57.34117483	45.66954803

22.15384615	154.42105263	56.65765822	46.67974091
22.15384615	153.47368421	55.96293109	47.64598465
22.15384615	152.52631579	55.25767420	48.57023621
22.15384615	151.57894737	54.54252430	49.45439911
22.15384615	150.63157895	53.81807664	50.30030441
22.15384615	149.68421053	53.08488740	51.10972214
22.15384615	148.73684211	52.34347618	51.88434982
22.15384615	147.78947369	51.59432832	52.62582016
22.15384615	146.84210527	50.83789714	53.33567429
22.15384615	145.89473684	50.07460612	54.01540375

ROW	25 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	23.07692307	180.00000000	66.92307830	0.00000000
	23.07692307	179.05263158	66.90470273	2.22233891
	23.07692307	178.10526316	66.84966373	4.43740702
	23.07692307	177.15789474	66.75822246	6.63807058
	23.07692307	176.21052632	66.63080731	8.81746387
	23.07692307	175.26315790	66.46800416	10.96910954
	23.07692307	174.31578947	66.27054331	13.08701515
	23.07692307	173.36842105	66.03928397	15.16576195
	23.07692307	172.42105263	65.77519684	17.20055389
	23.07692307	171.47368421	65.47934574	19.18726158
	23.07692307	170.52631579	65.15286880	21.12242889
	23.07692307	169.57894737	64.79696009	23.00327301
	23.07692307	168.63157895	64.41285201	24.82765198
	23.07692307	167.68421053	64.00179903	26.59404182
	23.07692307	166.73684211	63.56506302	28.30147552
	23.07692307	165.78947369	63.10390034	29.94949722
	23.07692307	164.84210526	62.61955079	31.53810501
	23.07692307	163.89473684	62.11322837	33.06769180
	23.07692307	162.94736842	61.58611388	34.53898239
	23.07692307	162.00000000	61.03934904	35.95298386
	23.07692307	161.05263158	60.47403222	37.31093979
	23.07692307	160.10526316	59.89121535	38.61427307
	23.07692307	159.15789474	59.29190206	39.86454391
	23.07692307	158.21052632	58.67704668	41.06342316
	23.07692307	157.26315790	58.04755413	42.21264648
	23.07692307	156.31578948	57.40428035	43.31400299
	23.07692307	155.36842105	56.74803330	44.36929321
	23.07692307	154.42105263	56.07957430	45.38032532
	23.07692307	153.47368421	55.39961971	46.34888840
	23.07692307	152.52631579	54.70884276	47.27674484
	23.07692307	151.57894737	54.00787558	48.16562653
	23.07692307	150.63157895	53.29731121	49.01720428
	23.07692307	149.68421053	52.57770572	49.83311081
	23.07692307	148.73684211	51.84958032	50.61491776
	23.07692307	147.78947369	51.11342337	51.36413574
	23.07692307	146.84210527	50.36969243	52.08221817

ROW	26 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	24.00000000	180.00000000	65.99999606	0.00000000
	24.00000000	179.05263158	65.98241106	2.12674999
	24.00000000	178.10526316	65.92973337	4.24707699
	24.00000000	177.15789474	65.84219324	6.35467005
	24.00000000	176.21052632	65.72016890	8.44343662
	24.00000000	175.26315790	65.56417853	10.50759983

24.00000000	174.31578947	65.37486965	12.54178429
24.00000000	173.36842105	65.15300627	14.54108429
24.00000000	172.42105263	64.89945449	16.50111389
24.00000000	171.47368421	64.61516714	18.41804695
24.00000000	170.52631579	64.30116791	20.28862190
24.00000000	169.57894737	63.95853563	22.11015320
24.00000000	168.63157895	63.58838910	23.88050842
24.00000000	167.68421053	63.19187280	25.59809303
24.00000000	166.73684211	62.77014389	27.26180458
24.00000000	165.78947369	62.32436043	28.87099838
24.00000000	164.84210526	61.85567130	30.42544174
24.00000000	163.89473684	61.36520737	31.92526436
24.00000000	162.94736842	60.85407440	33.37091064
24.00000000	162.00000000	60.32334712	34.76310349
24.00000000	161.05263158	59.77406473	36.10278320
24.00000000	160.10526316	59.20722753	37.39107513
24.00000000	159.15789474	58.62379455	38.62926102
24.00000000	158.21052632	58.02468209	39.81873322
24.00000000	157.26315790	57.41076304	40.96096420
24.00000000	156.31578948	56.78286674	42.05749512
24.00000000	155.36842105	56.14177942	43.10989380
24.00000000	154.42105263	55.48824505	44.11975098
24.00000000	153.47368421	54.82296647	45.08866501
24.00000000	152.52631579	54.14660675	46.01821136
24.00000000	151.57894737	53.45979078	46.90995026
24.00000000	150.63157895	52.76310690	47.76540756
24.00000000	149.68421053	52.05710866	48.58607864
24.00000000	148.73684211	51.34231658	49.37340927
24.00000000	147.78947369	50.61921992	50.12879562
24.00000000	146.84210527	49.88827843	50.85359955

ROW	27 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	24.92307692	180.00000000	65.07692278	0.00000000
	24.92307692	179.05263158	65.06007319	2.03782725
	24.92307692	178.10526316	65.00959282	4.06995726
	24.92307692	177.15789474	64.92568551	6.09078455
	24.92307692	176.21052632	64.80868645	8.09488201
	24.92307692	175.26315790	64.65905564	10.07708359
	24.92307692	174.31578947	64.47736910	12.03255463
	24.92307692	173.36842105	64.26430829	13.95684814
	24.92307692	172.42105263	64.02064812	15.84595490
	24.92307692	171.47368421	63.74724401	17.69632912
	24.92307692	170.52631579	63.44501849	19.50491142
	24.92307692	169.57894737	63.11494778	21.26912880
	24.92307692	168.63157895	62.75804865	22.98689079
	24.92307692	167.68421053	62.37536597	24.65656662
	24.92307692	166.73684211	61.96796109	26.27696800
	24.92307692	165.78947369	61.53690134	27.84731102
	24.92307692	164.84210526	61.08325070	29.36718559
	24.92307692	163.89473684	60.60806166	30.83651161
	24.92307692	162.94736842	60.11236832	32.25550842
	24.92307692	162.00000000	59.59718070	33.62464523
	24.92307692	161.05263158	59.06348014	34.94461823
	24.92307692	160.10526316	58.51221570	36.21630096
	24.92307692	159.15789474	57.94430152	37.44072342
	24.92307692	158.21052632	57.36061501	38.61902618

24.92307692	157.26315790	56.76199564	39.75245667
24.92307692	156.31578948	56.14924448	40.84232712
24.92307692	155.36842105	55.52312412	41.88999557
24.92307692	154.42105263	54.88435903	42.89685440
24.92307692	153.47368421	54.23363633	43.86431122
24.92307692	152.52631579	53.57160665	44.79377365
24.92307692	151.57894737	52.89888539	45.68664932
24.92307692	150.63157895	52.21605396	46.54431152
24.92307692	149.68421053	51.52366121	47.36812592
24.92307692	148.73684211	50.82222489	48.15942001
24.92307692	147.78947369	50.11223315	48.91947937

ROW	28 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	25.84615384	180.00000000	64.15384932	0.00000000
	25.84615384	179.05263158	64.13768591	1.95485580
	25.84615384	178.10526316	64.08925641	3.90463877
	25.84615384	177.15789474	64.00874194	5.84435129
	25.84615384	176.21052632	63.89644059	7.76914406
	25.84615384	175.26315790	63.75276209	9.67438316
	25.84615384	174.31578947	63.57822049	11.55570793
	25.84615384	173.36842105	63.37342536	13.40908432
	25.84615384	172.42105263	63.13907178	15.23084354
	25.84615384	171.47368421	62.87592947	17.01770782
	25.84615384	170.52631579	62.58483137	18.76680946
	25.84615384	169.57894737	62.26666221	20.47570419
	25.84615384	168.63157895	61.92234708	22.14235687
	25.84615384	167.68421053	61.55284062	23.76513863
	25.84615384	166.73684211	61.15911668	25.34280586
	25.84615384	165.78947369	60.74215897	26.87447548
	25.84615384	164.84210526	60.30295249	28.35960388
	25.84615384	163.89473684	59.84247607	29.79794693
	25.84615384	162.94736842	59.36169581	31.18953323
	25.84615384	162.00000000	58.86155965	32.53463745
	25.84615384	161.05263158	58.34299272	33.83373642
	25.84615384	160.10526316	57.80689378	35.08748627
	25.84615384	159.15789474	57.25413228	36.29670334
	25.84615384	158.21052632	56.68554636	37.46231461
	25.84615384	157.26315790	56.10194130	38.58535385
	25.84615384	156.31578948	55.50408868	39.66693497
	25.84615384	155.36842105	54.89272596	40.70821762
	25.84615384	154.42105263	54.26855647	41.71042252
	25.84615384	153.47368421	53.63224973	42.67477798
	25.84615384	152.52631579	52.98444207	43.60253525
	25.84615384	151.57894737	52.32573742	44.49494553
	25.84615384	150.63157895	51.65670831	45.35326004
	25.84615384	149.68421053	50.97789694	46.17870331
	25.84615384	148.73684211	50.28981641	46.97248840

ROW	29 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	26.76923077	180.00000000	63.23076756	0.00000000
	26.76923077	179.05263158	63.21524620	1.87721837
	26.76923077	178.10526316	63.16873625	3.74990392
	26.76923077	177.15789474	63.09139914	5.61358643
	26.76923077	176.21052632	62.98350089	7.46391821
	26.76923077	175.26315790	62.84540755	9.29673100
	26.76923077	174.31578947	62.67757922	11.10808468

26.76923077	173.36842105	62.48056264	12.89431286
26.76923077	172.42105263	62.25498282	14.65205574
26.76923077	171.47368421	62.00153382	16.37828445
26.76923077	170.52631579	61.72096910	18.07032204
26.76923077	169.57894737	61.41409164	19.72584915
26.76923077	168.63157895	61.08174414	21.34290695
26.76923077	167.68421053	60.72479948	22.91988373
26.76923077	166.73684211	60.34415169	24.45551109
26.76923077	165.78947369	59.94070748	25.94884300
26.76923077	164.84210526	59.51537861	27.39923286
26.76923077	163.89473684	59.06907490	28.80630684
26.76923077	162.94736842	58.60269821	30.16994667
26.76923077	162.00000000	58.11713717	31.49025536
26.76923077	161.05263158	57.61326277	32.76753235
26.76923077	160.10526316	57.09192468	34.00225830
26.76923077	159.15789474	56.55394835	35.19504929
26.76923077	158.21052632	56.00013269	36.34664917
26.76923077	157.26315790	55.43124841	37.45790482
26.76923077	156.31578948	54.84803685	38.52975082
26.76923077	155.36842105	54.25120928	39.56317520
26.76923077	154.42105263	53.64144658	40.55923080
26.76923077	153.47368421	53.01939923	41.51898575
26.76923077	152.52631579	52.38568765	42.44355011
26.76923077	151.57894737	51.74090267	43.33403015
26.76923077	150.63157895	51.08560621	44.19154358
26.76923077	149.68421053	50.42033215	45.01720428

ROW	30 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	27.69230769	180.00000000	62.30769230	0.00000000
	27.69230769	179.05263158	62.29277328	1.80438077
	27.69230769	178.10526316	62.24806461	3.60469794
	27.69230769	177.15789474	62.17371066	5.39694023
	27.69230769	176.21052632	62.06994950	7.17719841
	27.69230769	175.26315790	61.93710914	8.94171333
	27.69230769	174.31578947	61.77560248	10.68691730
	27.69230769	173.36842105	61.58592119	12.40947247
	27.69230769	172.42105263	61.36862854	14.10630035
	27.69230769	171.47368421	61.12435167	15.77460289
	27.69230769	170.52631579	60.85377332	17.41188240
	27.69230769	169.57894737	60.55762338	19.01595116
	27.69230769	168.63157895	60.23667036	20.58492851
	27.69230769	167.68421053	59.89171311	22.11724281
	27.69230769	166.73684211	59.52357280	23.61161804
	27.69230769	165.78947369	59.13308541	25.06706810
	27.69230769	164.84210526	58.72109481	26.48287201
	27.69230769	163.89473684	58.28844640	27.85856056
	27.69230769	162.94736842	57.83598152	29.19389343
	27.69230769	162.00000000	57.36453248	30.48884010
	27.69230769	161.05263158	56.87491831	31.74355125
	27.69230769	160.10526316	56.36794117	32.95834732
	27.69230769	159.15789474	55.84438341	34.13368225
	27.69230769	158.21052632	55.30500519	35.27013779
	27.69230769	157.26315790	54.75054261	36.36840057
	27.69230769	156.31578948	54.18170639	37.42924118
	27.69230769	155.36842105	53.59918090	38.45349121
	27.69230769	154.42105263	53.00362363	39.44205475

27.69230769	153.47368421	52.39566490	40.39585495
27.69230769	152.52631579	51.77590792	41.31586456
27.69230769	151.57894737	51.14492903	42.20306015
27.69230769	150.63157895	50.50327812	43.05844116
27.69230769	149.68421053	49.85147926	43.88300705

ROW	31 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	28.61538461	180.00000000	61.38461510	0.00000000
	28.61538461	179.05263158	61.37026258	1.73587656
	28.61538461	178.10526316	61.32724839	3.46809936
	28.61538461	177.15789474	61.25570201	5.19305801
	28.61538461	176.21052632	61.15583711	6.90722799
	28.61538461	175.26315790	61.02794838	8.60721111
	28.61538461	174.31578947	60.87240736	10.28976917
	28.61538461	173.36842105	60.68965719	11.95185947
	28.61538461	172.42105263	60.48020663	13.59065819
	28.61538461	171.47368421	60.24462344	15.20358181
	28.61538461	170.52631579	59.98352734	16.78830338
	28.61538461	169.57894737	59.69758273	18.34276009
	28.61538461	168.63157895	59.38749128	19.86515999
	28.61538461	167.68421053	59.05398473	21.35397720
	28.61538461	166.73684211	58.69781779	22.80794716
	28.61538461	165.78947369	58.31976147	24.22606468
	28.61538461	164.84210526	57.92059686	25.60755539
	28.61538461	163.89473684	57.50110932	26.95188141
	28.61538461	162.94736842	57.06208335	28.25870323
	28.61538461	162.00000000	56.60429791	29.52788162
	28.61538461	161.05263158	56.12852245	30.75944328
	28.61538461	160.10526316	55.63551336	31.95357513
	28.61538461	159.15789474	55.12601110	33.11059570
	28.61538461	158.21052632	54.60073776	34.23094559
	28.61538461	157.26315790	54.06039515	35.31516647
	28.61538461	156.31578948	53.50566326	36.36388397
	28.61538461	155.36842105	52.93719920	37.37779617
	28.61538461	154.42105263	52.35563642	38.35766220
	28.61538461	153.47368421	51.76158423	39.30428696
	28.61538461	152.52631579	51.15562765	40.21850204
	28.61538461	151.57894737	50.53832738	41.10117722
	28.61538461	150.63157895	49.91022009	41.95319366

ROW	32 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	29.53846154	180.00000000	60.46153544	0.00000000
	29.53846154	179.05263158	60.44771694	1.67129803
	29.53846154	178.10526316	60.40630044	3.33930135
	29.53846154	177.15789474	60.33740237	5.00075150
	29.53846154	176.21052632	60.24121499	6.65246344
	29.53846154	175.26315790	60.11800375	8.29135609
	29.53846154	174.31578947	59.96810374	9.91448784
	29.53846154	173.36842105	59.79191525	11.51907730
	29.53846154	172.42105263	59.58989876	13.10253429
	29.53846154	171.47368421	59.36256922	14.66247177
	29.53846154	170.52631579	59.11049006	16.19672203
	29.53846154	169.57894737	58.83426689	17.70334816
	29.53846154	168.63157895	58.53454112	19.18064499
	29.53846154	167.68421053	58.21198359	20.62714195
	29.53846154	166.73684211	57.86728839	22.04159737



29.53846154	165.78947369	57.50116689	23.42300034
29.53846154	164.84210526	57.11434216	24.77054596
29.53846154	163.89473684	56.70754370	26.08363914
29.53846154	162.94736842	56.28150274	27.36187172
29.53846154	162.00000000	55.83694793	28.60501289
29.53846154	161.05263158	55.37460149	29.81299019
29.53846154	160.10526316	54.89517596	30.98587799
29.53846154	159.15789474	54.39937127	32.12387466
29.53846154	158.21052632	53.88787240	33.22730637
29.53846154	157.26315790	53.36134736	34.29657745
29.53846154	156.31578948	52.82044565	35.33219910
29.53846154	155.36842105	52.26579696	36.33473969
29.53846154	154.42105263	51.69801033	37.30484009
29.53846154	153.47368421	51.11767347	38.24317932
29.53846154	152.52631579	50.52535245	39.15048599
29.53846154	151.57894737	49.92159147	40.02750778

ROW	33 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	30.46153846	180.00000000	59.53845961	0.00000000
	30.46153846	179.05263158	59.52514563	1.61028647
	30.46153846	178.10526316	59.48523883	3.21759415
	30.46153846	177.15789474	59.41884417	4.81897497
	30.46153846	176.21052632	59.32613508	6.41154289
	30.46153846	175.26315790	59.20735121	7.99249983
	30.46153846	174.31578947	59.06279545	9.55916595
	30.46153846	173.36842105	58.89283018	11.10899830
	30.46153846	172.42105263	58.69787293	12.63961601
	30.46153846	171.47368421	58.47839159	14.14881325
	30.46153846	170.52631579	58.23489921	15.63457298
	30.46153846	169.57894737	57.96794856	17.09507751
	30.46153846	168.63157895	57.67812661	18.52870750
	30.46153846	167.68421053	57.36604895	19.93405724
	30.46153846	166.73684211	57.03235433	21.30991554
	30.46153846	165.78947369	56.67769937	22.65527153
	30.46153846	164.84210526	56.30275357	23.96931076
	30.46153846	163.89473684	55.90819455	25.25139618
	30.46153846	162.94736842	55.49470371	26.50106621
	30.46153846	162.00000000	55.06296229	27.71801758
	30.46153846	161.05263158	54.61364778	28.90209770
	30.46153846	160.10526316	54.14743077	30.05328560
	30.46153846	159.15789474	53.66497221	31.17168617
	30.46153846	158.21052632	53.16692106	32.25751114
	30.46153846	157.26315790	52.65391228	33.31106567
	30.46153846	156.31578948	52.12656522	34.33274460
	30.46153846	155.36842105	51.58548230	35.32300949
	30.46153846	154.42105263	51.03124799	36.28238678
	30.46153846	153.47368421	50.46442806	37.21145248
	30.46153846	152.52631579	49.88556907	38.11083221

ROW	34 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	31.38461538	180.00000000	58.61538680	0.00000000
	31.38461538	179.05263158	58.60255046	1.55252528
	31.38461538	178.10526316	58.56407316	3.10235095
	31.38461538	177.15789474	58.50004974	4.64680290
	31.38461538	176.21052632	58.41063700	6.18326044
	31.38461538	175.26315790	58.29605177	7.70917749

31.38461538	174.31578947	58.15656841	9.22210693
31.38461538	173.36842105	57.99251559	10.71972275
31.38461538	172.42105263	57.80427264	12.19983196
31.38461538	171.47368421	57.59226536	13.66039753
31.38461538	170.52631579	57.35696163	15.09954071
31.38461538	169.57894737	57.09886664	16.51555824
31.38461538	168.63157895	56.81851813	17.90692139
31.38461538	167.68421053	56.51648149	19.27227974
31.38461538	166.73684211	56.19334494	20.61046600
31.38461538	165.78947369	55.84971487	21.92048264
31.38461538	164.84210526	55.48621132	23.20150757
31.38461538	163.89473684	55.10346375	24.45288086
31.38461538	162.94736842	54.70210704	25.67410088
31.38461538	162.00000000	54.28277788	26.86480904
31.38461538	161.05263158	53.84611142	28.02478600
31.38461538	160.10526316	53.39273833	29.15393448
31.38461538	159.15789474	52.92328217	30.25227547
31.38461538	158.21052632	52.43835710	31.31993103
31.38461538	157.26315790	51.93856589	32.35711288
31.38461538	156.31578948	51.42449835	33.36411667
31.38461538	155.36842105	50.89672989	34.34130859
31.38461538	154.42105263	50.35582048	35.28912354

ROW	35 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	32.30769230	180.00000000	57.69231008	0.00000000
	32.30769230	179.05263158	57.67992680	1.49773383
	32.30769230	178.10526316	57.64280571	2.99301505
	32.30769230	177.15789474	57.58103267	4.48341370
	32.30769230	176.21052632	57.49474974	5.96654367
	32.30769230	175.26315790	57.38415351	7.44008398
	32.30769230	174.31578947	57.24949297	8.90179825
	32.30769230	173.36842105	57.09106680	10.34955215
	32.30769230	172.42105263	56.90922016	11.78132725
	32.30769230	171.47368421	56.70434119	13.19523811
	32.30769230	170.52631579	56.47685716	14.58953857
	32.30769230	169.57894737	56.22723037	15.96263123
	32.30769230	168.63157895	55.95595397	17.31307411
	32.30769230	167.68421053	55.66354769	18.63957977
	32.30769230	166.73684211	55.35055362	19.94102097
	32.30769230	165.78947369	55.01753201	21.21642303
	32.30769230	164.84210526	54.66505729	22.46496964
	32.30769230	163.89473684	54.29371422	23.68598557
	32.30769230	162.94736842	53.90409431	24.87893867
	32.30769230	162.00000000	53.49679243	26.04343224
	32.30769230	161.05263158	53.07240379	27.17918968
	32.30769230	160.10526316	52.63152114	28.28605461
	32.30769230	159.15789474	52.17473229	29.36397552
	32.30769230	158.21052632	51.70261789	30.41299820
	32.30769230	157.26315790	51.21574957	31.43325424
	32.30769230	156.31578948	50.71468825	32.42495728
	32.30769230	155.36842105	50.19998279	33.38838959

ROW	36 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	33.23076923	180.00000000	56.76922963	0.00000000
	33.23076923	179.05263158	56.75727693	1.44566250
	33.23076923	178.10526316	56.72144489	2.88909221

33.23076923	177.15789474	56.66181142	4.32807589
33.23076923	176.21052632	56.57850548	5.76043701
33.23076923	175.26315790	56.47170564	7.18405628
33.23076923	174.31578947	56.34163830	8.59688568
33.23076923	173.36842105	56.18857531	9.99696350
33.23076923	172.42105263	56.01283129	11.38243294
33.23076923	171.47368421	55.81476057	12.75154591
33.23076923	170.52631579	55.59475384	14.10267830
33.23076923	169.57894737	55.35323465	15.43433475
33.23076923	168.63157895	55.09065573	16.74515533
33.23076923	167.68421053	54.80749527	18.03391647
33.23076923	166.73684211	54.50425315	19.29953384
33.23076923	165.78947369	54.18144728	20.54106522
33.23076923	164.84210526	53.83961002	21.75769615
33.23076923	163.89473684	53.47928468	22.94875145
33.23076923	162.94736842	53.10102233	24.11368179
33.23076923	162.00000000	52.70537869	25.25205231
33.23076923	161.05263158	52.29291133	26.36355400
33.23076923	160.10526316	51.86417705	27.44797134
33.23076923	159.15789474	51.41972957	28.50520134
33.23076923	158.21052632	50.96011744	29.53521919
33.23076923	157.26315790	50.48588217	30.53809357
33.23076923	156.31578948	49.99755664	31.51396179

ROW	37 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	34.15384615	180.00000000	55.84615198	0.00000000
	34.15384615	179.05263158	55.83460919	1.39608860
	34.15384615	178.10526316	55.80000452	2.79014063
	34.15384615	177.15789474	55.74240880	4.18013573
	34.15384615	176.21052632	55.66193929	5.56408596
	34.15384615	175.26315790	55.55875850	6.94005108
	34.15384615	174.31578947	55.43307261	8.30615330
	34.15384615	173.36842105	55.28512949	9.66058922
	34.15384615	172.42105263	55.11521635	11.00164509
	34.15384615	171.47368421	54.92365707	12.32770252
	34.15384615	170.52631579	54.71080939	13.63724899
	34.15384615	169.57894737	54.47706179	14.92888641
	34.15384615	168.63157895	54.22283032	16.20133209
	34.15384615	167.68421053	53.94855527	17.45342636
	34.15384615	166.73684211	53.65469796	18.68413353
	34.15384615	165.78947369	53.34173740	19.89253426
	34.15384615	164.84210526	53.01016710	21.07783508
	34.15384615	163.89473684	52.66049199	22.23936272
	34.15384615	162.94736842	52.29322547	23.37655449
	34.15384615	162.00000000	51.90888661	24.48895645
	34.15384615	161.05263158	51.50799756	25.57622528
	34.15384615	160.10526316	51.09108114	26.63810730
	34.15384615	159.15789474	50.65865865	27.67444801
	34.15384615	158.21052632	50.21124791	28.68517303

ROW	38 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	35.07692307	180.00000000	54.92307742	0.00000000
	35.07692307	179.05263158	54.91192554	1.34881294
	35.07692307	178.10526316	54.87849148	2.69576454
	35.07692307	177.15789474	54.82283973	4.03900766
	35.07692307	176.21052632	54.74507711	5.37672234

35.07692307	175.26315790	54.64535175	6.70713091
35.07692307	174.31578947	54.52385175	8.02850819
35.07692307	173.36842105	54.38080343	9.33919430
35.07692307	172.42105263	54.21646933	10.63760662
35.07692307	171.47368421	54.03114594	11.92224312
35.07692307	170.52631579	53.82516120	13.19169903
35.07692307	169.57894737	53.59887182	14.44466305
35.07692307	168.63157895	53.35266046	15.67993164
35.07692307	167.68421053	53.08693292	16.89640427
35.07692307	166.73684211	52.80211517	18.09308815
35.07692307	165.78947369	52.49865045	19.26910210
35.07692307	164.84210526	52.17699648	20.42367172
35.07692307	163.89473684	51.83762260	21.55612755
35.07692307	162.94736842	51.48100715	22.66590500
35.07692307	162.00000000	51.10763492	23.75253677
35.07692307	161.05263158	50.71799479	24.81565094
35.07692307	160.10526316	50.31257748	25.85496712
35.07692307	159.15789474	49.89187352	26.87028885

ROW	39 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	36.00000000	180.00000000	54.00000080	0.00000000
	36.00000000	179.05263158	53.98922231	1.30365634
	36.00000000	178.10526316	53.95690650	2.60560846
	36.00000000	177.15789474	53.90311220	3.90416455
	36.00000000	176.21052632	53.82793687	5.19765615
	36.00000000	175.26315790	53.73151576	6.48445129
	36.00000000	174.31578947	53.61402069	7.76296329
	36.00000000	173.36842105	53.47565863	9.03166294
	36.00000000	172.42105263	53.31666990	10.28908443
	36.00000000	171.47368421	53.13732624	11.53383827
	36.00000000	170.52631579	52.93792861	12.76461315
	36.00000000	169.57894737	52.71880488	13.98018551
	36.00000000	168.63157895	52.48030737	15.17941952
	36.00000000	167.68421053	52.22281032	16.36127663
	36.00000000	166.73684211	51.94670735	17.52481079
	36.00000000	165.78947369	51.65240884	18.66917419
	36.00000000	164.84210526	51.34033941	19.79361534
	36.00000000	163.89473684	51.01093546	20.89747429
	36.00000000	162.94736842	50.66464271	21.98018837
	36.00000000	162.00000000	50.30191392	23.04128265
	36.00000000	161.05263158	49.92320672	24.08036804

ROW	40 EQUAT LAT	EQUAT LON	POLAR LAT	POLAR LON
	36.92307692	180.00000000	53.07692352	0.00000000
	36.92307692	179.05263158	53.06650222	1.26045763
	36.92307692	178.10526316	53.03525629	2.51935244
	36.92307692	177.15789474	52.98323945	3.77513194
	36.92307692	176.21052632	52.91054077	5.02626467
	36.92307692	175.26315790	52.81728390	6.27124977
	36.92307692	174.31578947	52.70362604	7.50862598
	36.92307692	173.36842105	52.56975670	8.73698235
	36.92307692	172.42105263	52.41589614	9.95496273
	36.92307692	171.47368421	52.24229370	11.16127682
	36.92307692	170.52631579	52.04922590	12.35470390
	36.92307692	169.57894737	51.83699439	13.53409863
	36.92307692	168.63157895	51.60592382	14.69839382

	36.92307692	167.68421053	51.35635962	15.84660721
	36.92307692	166.73684211	51.08866571	16.97783852
	36.92307692	165.78947369	50.80322224	18.09127617
	36.92307692	164.84210526	50.50042333	19.18618965
	36.92307692	163.89473684	50.18067480	20.26193810
<b>ROW</b>	<b>41 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	37.84615384	180.00000000	52.15384735	0.00000000
	37.84615384	179.05263158	52.14376826	1.21907115
	37.84615384	178.10526316	52.11354740	2.43670678
	37.84615384	177.15789474	52.06323393	3.65148044
	37.84615384	176.21052632	51.99290936	4.86198378
	37.84615384	175.26315790	51.90268689	6.06683493
	37.84615384	174.31578947	51.79271052	7.26468706
	37.84615384	173.36842105	51.66315398	8.45423508
	37.84615384	172.42105263	51.51421941	9.63422489
	37.84615384	171.47368421	51.34613585	10.80345726
	37.84615384	170.52631579	51.15915761	11.96079445
	37.84615384	169.57894737	50.95356249	13.10516453
	37.84615384	168.63157895	50.72964988	14.23556614
	37.84615384	167.68421053	50.48773884	15.35106945
	37.84615384	166.73684211	50.22816606	16.45082092
	37.84615384	165.78947369	49.95128387	17.53404236
<b>ROW</b>	<b>42 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	38.76923077	180.00000000	51.23076897	0.00000000
	38.76923077	179.05263158	51.22101818	1.17936492
	38.76923077	178.10526316	51.19178086	2.35740948
	38.76923077	177.15789474	51.14310205	3.53282094
	38.76923077	176.21052632	51.07505641	4.70430231
	38.76923077	175.26315790	50.98774771	5.87058020
	38.76923077	174.31578947	50.88130804	7.03041029
	38.76923077	173.36842105	50.75589686	8.18258667
	38.76923077	172.42105263	50.61169987	9.32594585
	38.76923077	171.47368421	50.44892768	10.45937347
	38.76923077	170.52631579	50.26781440	11.58180809
	38.76923077	169.57894737	50.06861610	12.69224834
	38.76923077	168.63157895	49.85160910	13.78975296
<b>ROW</b>	<b>43 EQUAT LAT</b>	<b>EQUAT LON</b>	<b>POLAR LAT</b>	<b>POLAR LON</b>
	39.69230769	180.00000000	50.30769125	0.00000000
	39.69230769	179.05263158	50.29825586	1.14121962
	39.69230769	178.10526316	50.26996350	2.28122282
	39.69230769	177.15789474	50.22285546	3.41880035
	39.69230769	176.21052632	50.15700025	4.55275583
	39.69230769	175.26315790	50.07249310	5.68191433
	39.69230769	174.31578947	49.96945530	6.80512571
	39.69230769	173.36842105	49.84803339	7.92127323

**Appendix D**  
**Layout of CAC CD-ROM Files**

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The layouts of all files contained on NOARL's output CD-ROMs are illustrated in this appendix. File names, byte counts, and field descriptions are taken from the Interface Control Document provided by Horizons Technology, Inc. (1989).

Table D-1. Input CD-ROM header file layout.

File Name: ROOT\MAPX\CDMXXXX\HEADER.DAT	
Byte Count	Field Description
5	TRANSMITTAL_DESCRIPTION_RECORD RECORD_ID_FIELD
238	TRANSMITTAL_HEADER_FIELD
55*N	DATA_SET_DESCRIPTION_FIELD (Where N = number of distribution rectangles as found in TRANSMITTAL_HEADER_FIELD above.)
5	SECURITY_AND_UPDATE_RECORD RECORD_ID_FIELD
214	SECURITY_AND_RELEASE_FIELD
132	VOLUME_UP_TO_DATENESS_FIELD

**Note:** For a detailed description of a record's field, refer to the DMA Product Specifications for ARC Digitized Raster Graphics, April 1989.

Table D-2. Distribution rectangle header file layout.

File Name: ROOT\MAPX\CDMXXXX\SSCCXX\HEADER.DAT	
Byte Count	Field Description
5	DATA_SET_DESCRIPTION_RECORD RECORD_ID_FIELD
8	DATA_SET_DESCRIPTION_FIELD
5	QUALITY_RECORD RECORD_ID_FIELD
214	SECURITY_AND_RELEASE_FIELD
206	UP_TO_DATENESS_FIELD
5	HORIZONTAL_ACCURACY_RECORD RECORD_ID_FIELD
16	HORIZONTAL_ACCURACY_FIELD
2	BOUNDING_POLYGON_COORDINATES_FIELD
21*NCP	Number of Coordinate Pairs = NCP Coordinate Pairs
5	VERTICAL_ACCURACY_RECORD RECORD_ID_FIELD
16	VERTICAL_ACCURACY_FIELD
2	BOUNDING_POLYGON_COORDINATES_FIELD
21*NCP	Number of Coordinate Pairs = NCP Coordinate Pairs

**Note:** For a detailed description of a record's field, refer to the DMA Product Specifications for ARC Digitized Raster Graphics, April 1989.

Table D-3. Source graphics header file layout.

File Name: ROOT\MAPX\CDMXXXXX\SSCCXX\SGGHED.DAT	
Byte Count	Field Description
	SOURCE_RECORD
5	RECORD_ID_FIELD
8	SOURCE_SUMMARY_FIELD
386	SOURCE_FIELD
	BOUNDING_POLYGON_COORDINATES_FIELD
2	Number of Coordinate Pairs = NCP
21-NCP	Coordinate Pairs
167	PROJECTION_FIELD
214	SECURITY_AND_RELEASE_FIELD
279-N	INSET_FIELD (Where N = number of inset fields as found in SOURCE_SUMMARY_FIELD above.)
200	COPYRIGHT_FIELD
	METRIC_SUPPORT_DATA_RECORD
5	RECORD_ID_FIELD
176	NORMALIZATION_CONSTANTS_FIELD
308	SOURCE_DATUM_COEFFICIENTS_FIELD
440	MAP_PROJECTION_COEFFICIENTS_FIELD
	SUPPLEMENTAL_TEXT_RECORD*
5	RECORD_ID_FIELD
	SUPPLEMENTAL_TEXT_FIELD
4	Supplementary Text Record Type
4	Supplementary Text Field Identifier
4	Number of ASCII Bytes of Free Text = NAB
1-NAB	Free Text

\*The SUPPLEMENTAL\_TEXT\_RECORD may repeat. The number of times this record may repeat is found in the SOURCE\_RECORD, SOURCE\_SUMMARY\_FIELD.

**Note:** For a detailed description of a record's field, refer to the DMA Product Specifications for ARC Digitized Raster Graphics, April 1989.

Table D-4. Legend header file layout.

File Name: ROOT\MAPX\CDMXXXXX\SSCCXX\LGGKKHED.DAT	
Byte Count	Field Description
4	Number of Legend Pixel Rows (R)
4	Number of Legend Pixel Columns (C)

Table D-5. Legend image file layout.

File Name: ROOT\MAPX\CDMXXXXX\SSCCXX\LGGKKIMG.DAT	
Row	Column 1 2 3 ..... C
1	
2	
3	
.	
.	
R	Legend Image

**Note:** The legend image is stored in row major order, beginning with the upper left pixel of the image, continuing across the top row, then by rows of pixels from top to bottom.



Table D-6. Color palette file layout.

File Names: ROOT\MAPX\CDMXXXXX\SSCCXX\LGGKKPAL.DAT ROOT\MAPX\PAXXXXY\PALETTE.DAT	
Byte	Field Description
0	Day Mono (Mono = 0.30 Red + 0.59 Green + 0.11 Blue)
1	Day Green
2	Day Mono
3	Day Green
.	.
.	.
478	Day Mono
479	Day Green
480	0
481	0
.	.
.	.
510	0
511	0
<hr/>	
512	Day Red
513	Day Blue
514	Day Red
515	Day Blue
.	.
.	.
990	Day Red
991	Day Blue
992	0
993	0
.	.
.	.
1020	0
1021	Edge of Map Hue
1022	Day Checksum Byte 1
1023	Day Checksum Byte 2

**Note:** The above 1024 bytes contain the day mode palette. The night mode palette has the same format but exists on bytes 1024 through 2047.

Table D-7. Map area coverage file layout.

File Name: ROOT\MAPX\PAXXXYY\COVERAGE.DAT	
Byte Count	Field Description
4	Left Longitude (Scaled Integer $\pm 180$ ) Value Range: $-180^\circ$ to $+180^\circ$
4	Right Longitude (Scaled Integer $\pm 180$ ) Value Range: $-180^\circ$ to $+180^\circ$
4	Bottom Latitude (Scaled Integer $\pm 180$ ) Value Range: $-90^\circ$ to $+90^\circ$
4	Top Latitude (Scaled Integer $\pm 180$ ) Value Range: $-90^\circ$ to $+90^\circ$

Table D-8. Compressed map segment file layout.

File Name: ROOT\MAPX\PAXXXYY\XXXXXXXX.XXZ	
Sector	
1	Decompression Codebook (1,024 Bytes)
2	
3	Compressed Map Segment (16,384 Bytes)
4	
.	
.	
.	
33	
34	

Note: Subdirectory Key =  $(2 \cdot \text{MaxRow} + 1) \cdot (\text{Col} + \text{MaxRow}) + \text{Row} + \text{MaxRow} + 1$   
 Where: MaxRow = 9000  
 Row, Col = Subdirectory Row, Column of segment

Table D-9. Output CD-ROM identification file layout.

File Name: ROOT\ID\CD_ID.DAT	
Byte Count	Field Description
2	"CD"
1	"_"
4	Year (e.g., "1989")
1	"_"
1	Version ("A" through "Z")
1	"_"
4	Data Type ("MAPX" or "DLMS").
1	"_"
5	CD-ROM Number ("00001" through "99999")

Note: In the Data Type field above, the X in "MAPX" denotes the scale of the map coverage contained on the output CD-ROM as listed in Table 5.

Table D-10. Output CD-ROM coverage file layout.

File Name: ROOT\ID\CD_COVRG.DAT	
Byte Count	Field Description
2	Number of Map Areas = NA
8	Map Area Subdirectory Name ("PAXXXYY")
16	Coverage Definition (See COVERAGE.DAT file layout.)
8	Map Area Subdirectory Name ("PAXXXYY")
16	Coverage Definition (See COVERAGE.DAT file layout.)
.	(Repeat NA times)
.	

Table D-11. Map area source graphics correlation file layout.

File Name: ROOT\ID\AREASORC.DAT	
Byte Count	Field Description
2	Number of Map Areas = NA
8	Map Area Subdirectory Name ("PAXXXYY")
2	Number of Source Graphics Used for this Area = NSG
22*NSG	Source Graphics Description Path Names ("CDMXXXXX\SSCCXX\SGGHED")
8	Map Area Subdirectory Name ("PAXXXYY")
2	Number of Source Graphics Used for this Area = NSG
22*NSG	Source Graphics Description Path Names ("CDMXXXXX\SSCCXX\SGGHED")
.	(Repeat NA times)
.	

Table D-12. Map area DR correlation file layout.

File Name: ROOT\ID\AREADRC.DAT	
Byte Count	Field Description
2	Number of Map Areas = NA
8	Map Area Subdirectory Name ("PAXXXYY")
2	Number of Distribution Rectangles Used for this Area = NDR
15*NDR	Distribution Rectangle Description Path Names ("CDMXXXXX\SSCCXX")
8	Map Area Subdirectory Name ("PAXXXYY")
2	Number of Distribution Rectangles Used for this Area = NDR
15*NDR	Distribution Rectangle Description Path Names ("CDMXXXXX\SSCCXX")
.	(Repeat NA times)
.	

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<b>13. Abstract</b> ( <i>Maximum 200 words</i> ).  This report describes the interface control criteria for the exchange of chart image data from NOARL's Map Data Formatting Facility to the Fleet's aircraft mission planning systems and digital moving map systems. The Compressed Aeronautical Chart database consists of compressed and otherwise transformed aeronautical chart images stored on Compact Disk-Read Only Memory optical disks. The Compressed Aeronautical Chart is created from standard mapping, charting, and geodesy products distributed by the Defense Mapping Agency.  The development and creation of this library is part of a NOARL effort to provide the Fleet with Navy standard digital mapping, charting, and geodesy products when the Defense Mapping Agency's products cannot be used in their original form. In a memorandum to the Commanding Officer of NOARL, the Chief of Naval Operations stated that the NOARL Map Data Formatting Facility is "now in the critical path for operational deployment of most advanced Navy aircraft" (ser 961/9U549195, dated 17 August 1989). As this statement emphasizes, the Compressed Aeronautical Chart data is now a mission requirement for the successful flights of an increasing number of U.S. Navy and U.S. Marine Corps aircraft. This report is required by the Naval Air Systems Command in order to ensure that future aircraft mission planning systems and digital moving map systems are built to be compatible with this Navy standard database. It is also required as an engineering aid in developing future databases that will be used with the Compressed Aeronautical Chart.			
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