National Mapping Program
Technical Instructions

Standards for Digital Raster Graphics

U.S. Department of the Interior
U.S. Geological Survey
National Mapping Program

CONTENTS

APPENDIX

National Mapping Program
Technical Instructions

Part 1
General

Standards for
Digital Raster Graphics

U. S. Department of the Interior
U.S. Geological Survey
National Mapping Division

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LIST OF PAGES

A complete and current copy of part 1 of the “Standards for Digital Raster Graphics” consists of the pages (and most recent creation or revision dates) listed below.

1. GENERAL

1.1 DEFINITION

The term "digital raster graphic" (DRG) is used throughout this document to refer to a georeferenced, rectified raster image of a scanned U.S. Geological Survey (USGS) topographic or planimetric map. The DRG is a product of the USGS.

1.2 OBJECTIVES

The USGS is the lead Federal agency for the collection and distribution of base cartographic data. This standard contains information about the collection, processing, and quality control of DRG data for use in NMD mapping operations.

The USGS intends to use DRG's in data collection, revision, and quality control processes on other digital base cartographic data. For example, the DRG could be used as a backdrop to check the registration of other digital products. In addition, the USGS intends to make the data available to the public by placing the data in the public domain.

The USGS identified opportunities in the public and private sectors to scan and produce raster image files of USGS topographic maps. Data meeting DRG specifications are produced under cooperative agreements between the USGS and private industry and other Federal, State, and local agencies.

The USGS recognizes that some agencies and producers have existing data or plan to produce data that meet or approximate DRG specifications. The USGS intends to take advantage of the availability of these DRG-like products. Cooperative agreements allow the USGS to offer some remittance for the rights to these data. These cooperative agreements, including the Innovative Partnership Program, are contingent on product inspection and approval by the USGS. Product uniformity, production expediency, and quality control considerations will determine whether these data will be of use to the USGS.

1.3 PRODUCT DESCRIPTION

DRG's retain the geometric and visual qualities of the source maps, except: (1) DRG's are georeferenced to Universal Transverse Mercator (UTM) ground coordinates and may exhibit distortions in the collar, inset, and overedge areas, and (2) the colors of the DRG can differ slightly from the original printed map.

DRG's characteristics include:

- Their sources are printed maps, color composites, or any other reasonably stable map material.

- Their areal extent may be the entire printed source extent including the map collar, legend, and any overedge or insets. Pertinent source and map information contained in the collar and legend may be unobtainable if the raster graphic is cropped at the neatlines.

- Scanning and output resolutions may vary. Major factors in determining scanning resolution are the product's intended use, scanner capability, and the quality and detail of the source map. File size or the desire to create a workable file size can be a determining factor for output resolution.

- DRG's and comparable products are generally cast and georeferenced on common, widely used projections and coordinate systems. The DRG is cast on the UTM projection and coordinate system, while many raster products created by State and local agencies employ their respective State plane coordinate system. Georeferencing allows the user the ability to fit other digital data to the DRG to perform any number of geospatial applications.

- DRG's will retain the datum of the source map.

- DRG's and comparable products will duplicate the horizontal accuracy of its source. Accuracy measurements or a

description of how the image was accuracy tested should accompany the data.

- DRG's and other raster products use a color palette to maintain color consistency across images within a given map series. This allows for uniform and visually consistent images throughout a series for the purpose of mosaicking, feature identification, and multiple image viewing.

- DRG's conform to tagged image file formats (TIFF).

- Metadata, data about the image, accompany the product. Metadata provide identification, georeferencing, accuracy, and source lineage data about the image. The DRG is accompanied by an Federal Geographic Data Committee (FGDC) compliant metadata file.

At the USGS, DRG's serve a variety of purposes: from use as backgrounds for other data in a GIS to a source for collecting or revising USGS base cartographic data. The DRG shows potential as a tool for validating and assessing other non-USGS digital data. The DRG can be easily formatted and combined with digital orthophoto quadrangle (DOQ), digital elevation model (DEM), and digital line graph (DLG) data, or combinations of these data can create several "hybrid" products, each with its own unique applications. DRG prototypes have been used as "browse images" on in-house data management systems and can serve similarly in production systems and sales data bases. Hard-copy output of the DRG is also being considered as a means to meet the demands for maps that are out of stock. Although a DRG can be made from any USGS map, the program is oriented toward the production of DRG's from 1:24,000-, 1:25,000-, 1:63,360-, 1:100,000-and 1:250,000-scale USGS topographic maps.

1.4 THE USGS DRG PROCESS DESCRIPTION

The production procedures, instrumentation, hardware, and software used in the collection of standard DRG products vary depending on systems used at the contractor, cooperator, or USGS production

sites. Because the majority of DRG data sets are acquired through government contract, the following describes the general processes used in the production of standard DRG data sets.

- A paper map is scanned on a high-resolution scanner.

- Screens are removed (descreening, see section 2.1) and colors quantized to reduce the number of colors in the raw scan file.

- The raw scan file is transformed and georeferenced using UTM coordinates.

- The output file is reduced in size via resampling to 250 dots-per-inch (dpi), converted to a TIFF 6.0 format, and compressed (no data loss due to compression).

- Prior to archiving, the DRG undergoes a series of quality assurance checks.

A more detailed explanation of the processes used in the construction of a DRG may be found in Data Quality Information Section of the Metadata Template (Appendix 2-A) under the 2.5.2.1 Process Description element.

National Mapping Program
Technical Instructions

Part 2
Specifications

Standards for
Digital Raster Graphics

U. S. Department of the Interior
U.S. Geological Survey
National Mapping Division

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TABLES

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LIST OF PAGES

A complete and current copy of Part 2 of "Standards for Digital Raster Graphics" consists of the pages (and most recent creation or revision dates) listed below.

2. SPECIFICATIONS

2.1 DEFINITIONS:

Color palette - a look-up table that describes how data values map to colors.

Compression - a method of encoding data to optimize storage or speed transmission by reducing the number of bits required to describe an image.

Descreening - the process of replacing or removing the lithographic screen (half-tone) pattern found on the source map and substituting, in digital raster graphic form, a solid area color of a light or transparent shade and hue. The area color may be represented within the raster graphic by a background color of much lighter shade and hue than the primary foreground feature colors. The intent is to replicate as closely as possible the original screened half-tone color found on the source map.

Georeference - to establish the relationship between an image (row, column) coordinate system and a map (x,y) coordinate system.

Half-tone - a technique of representing shading by dots produced by photographing the object from behind a fine screen.

Map collar/DRG collar - the area of the map that lies outside the neatlines.

Metadata - information about the content, quality, condition, and other characteristics of data.

Neatline - the latitude and longitude lines defining the extent of the mapped area.

Quantization - the process of converting from continuous values of information to a finite number of discrete values.

Rubber sheeting - a process that geometrically adjusts map features to "force" a digital map to fit a designated base. It is called rubber sheeting because the image is mathematically stretched to fit the base, given a set of known coordinate values whose locations are defined on both the base map and the image to be rubber sheeted. The process uses mathematical operations to minimize distortion (see transformation).

Transformation - the conversion of coordinates from one coordinate system to another. For the purpose of this standard, the conversion of x- and y- image coordinates of a scanner to X- and Y-coordinates of the UTM.

2.2 IMAGE FORMAT

The USGS DRG's employ an 8-bit PackBits compressed Tagged Image File Format (TIFF), palette color format. DRG's use GeoTIFF tag (the field identifier) specifications to describe the georeferencing or geocoding of the DRG raster images. (Refer to section 2.6, Projections and Georeferencing).

The TIFF palette color format is similar to a gray-scale image in that a single value is assigned to a pixel. However, in the palette color format, that value assigned to a pixel is used as an index to an RGB look-up table (refer to Section 2.9, Color Standardization).

The most recent revision of TIFF specifications is available via World Wide Web at:

http://mcmcweb.er.usgs.gov/ (look under DRG Product Information)

For other TIFF inquiries, e-mail:

esic@mcdgs01.er.usgs.gov

The orientation of data is by rows and columns. Row and column 1,1 of the DRG will be in the upper left-hand corner of the collar area, not the northwest neatline corner of the mapped area. Each row contains a series of pixels ordered from west to east. The order of

the rows is from north to south. When displayed on a computer graphics terminal, projection grid north is at the top. However, the image is displayed in its proper UTM configuration and, therefore, may not be parallel with the outer edges of the DRG collar. The text and figures within the collar area of the DRG may be distorted depending on how far the DRG lies from the central meridian of its respective UTM zone, that is, the closer to the central meridian, the less distortion in the collar area. The distortions are due to georeferencing the map image area (the area within the neatlines) to the UTM projection while the collar area remains aligned to geographic north. Stretching occurs and is manifested in distorted collar text.

2.3 SOURCES

The source for DRG's are the standard quadrangle format USGS topographic maps as described in the Federal Geographic Data Committee "Manual of Federal Geographic Data Products." They include 1:20,000-, 1:24,000-, 1:25,000-, 1:30,000-, 1:63,360-, 1:100,000- and 1:250,000-scale topographic maps. Included in the 1:24,000- and 1:25,000-scale series are provisional (P) maps and color orthophotomaps.

Paper maps, composite color proofs, or map separates from those map series can be used as the source for scanning the image. The USGS intends to scan paper maps to produce DRG's whenever possible. By scanning paper maps, as opposed to color composites or map separates, a considerable cost savings is realized in materials, labor, and scanning time. Concerns over distortions due to paper shrinkage and stretching are minimized by using high-quality printing materials and unfolded maps whenever possible. Although map separates may be employed as a scanning source, the separates must be combined into a single DRG file.

2.4 COVERAGE

The standard area of coverage of a DRG is the entire area printed on a USGS standard series topographic map including the map collar,

any overedge areas, and insets. These standard series maps include:

- 7.5-minute map series: Conterminous United States, Hawaii, and limited areas of Alaska at 1:24,000 and 1:25,000 scale.
- 7.5- by 15-minute map series: Covers limited areas of the conterminous United States at 1:25,000 scale.
- Pacific Island map series at 1:20,000, 1:24,000, and 1:25,000 scale.
- Puerto Rico and the Virgin Islands at 1:20,000 scale.
- Culebra, its adjacent islands, and the Island of Vieques at 1:30,000 scale.
- Alaska at 1:63,360 scale.
- 30- by 60-minute map series: Conterminous United States and Hawaii at 1:100,000 scale.
- 1- by 2-degree map series: United States at 1:250,000 scale.

2.5 DRG RESOLUTION

2.5.1 Scan resolution

DRG's will be collected on a high quality, multicolor scanner capable of resolutions of 250 dpi and finer. As a rule, the USGS will use a scanner resolution of 500 dpi to produce DRG's. Scanner limitations, large image file sizes, and processing times are considerations in the choice of a scanning resolution. The USGS has concluded that its production capabilities and requirements for digital revision and validation are adequately met by DRG's scanned at 500 dpi. However, other requirements may dictate finer scanning resolutions; for example, hard-copy needs and image extraction. The ground pixel resolution of a raster graphic derived from a 7.5-minute topographic map scanned at 1,000 dpi is equivalent to approximately 2 feet (500 dpi is approximately 4 feet; 250 dpi is

approximately 7.9 feet).

2.5.2 Output resolution

After resampling, the resolution of the final DRG will be 250 dpi.

2.6 PROJECTIONS AND GEOREFERENCING

The USGS DRG is cast on the UTM projection. This is consistent with other USGS digital data series cast on the UTM projection. However, this makes the image inconsistent with the projection statement on the source map collar because most 7.5-minute topographic maps were projected on either Lambert conformal conic or transverse mercator, using the appropriate state plane coordinate system. The horizontal datum of the DRG (either North American Datum of 1927 or 1983) is not changed by the UTM projection and will be the same as the published source map.

DRG's produced by the USGS are georeferenced to fit the computed UTM values of each latitude and longitude tick on an image. These ticks include the corners of the map neatline. UTM values are only significant to the nearest whole meter. Table 2-1 shows the number of ticks georeferenced for each map series.

Table 2-1
Georeferenced Ticks for Standard Series Maps

scale	area of coverage	tick spacing	ticks referenced
1:24,000 and 1:25,000	7.5- X 7.5-min	2.5 min	16
1:25,000	7.5- X 15-min	2.5 min	28
1:100,000	30- X 60-min	15 min	15
1:250,000	1 deg X 2 deg	15 min	45

Maps of Puerto Rico and the Virgin Islands at 1:20,000-scale and other Caribbean islands at 1:30,000-scale have tick spacing of 2.5

minute, but the number of ticks vary depending on the area of coverage. The number and spacing of ticks for the 1:63,360-scale Alaska series quadrangles vary depending on the position of the quadrangle along the longitudinal axis. Map inset areas will not undergo separate georeferencing procedures.

The USGS DRG's employ GeoTIFF specifications that define a set of TIFF tags to describe all "cartographic" information associated with TIFF images originating from the scanned source. Its purpose is to allow a means for tying a raster image to a known model space or map projection, and for describing those projections. The most recent revision of the GeoTIFF specification is available via World Wide Web at:

http://mcmcweb.er.usgs.gov/ (look under DRG Product Information)

For other GeoTIFF inquiries, e-mail:

esic@mcdgs01.er.usgs.gov

2.7 ACCURACY

DRG’s will retain the horizontal accuracy of the source maps. Most USGS printed maps contain the National Map Accuracy Standards (NMAS) note in the collar area. The NMAS states that for maps on publication scales of 1:20,000 or smaller, not more than 10 percent of the points tested shall be in error by more than 1/50 inch measured on the publication scale. Test points must be "well-defined", that is, easily visible or recoverable on the ground. For DRG's this accuracy statement applies only to that area of the DRG that falls within the neatline of the source map (excluding inset areas). Overedge areas falling outside the transformation boundary area (the map neatline), can exhibit anomalies or discrepancies. These anomalies also will appear in the map inset areas and in the map collar. For maps without the NMAS note, the horizontal accuracy is unknown. However, the DRG will retain the accuracy of the source map.

2.8 COLOR STANDARDIZATION

Although only six inks are employed on a USGS topographic map,

screen printing processes can create more than six defined colors. The USGS DRG's will employ a color palette, or look-up table, consisting of 13 colors depending on the map series and whether or not the scanned image is descreened. The digital number is defined in the palette by three numbers: one each for red, green, and blue and each separately defined as a value from 0 through 255. Table 2-2 describes the DRG color palette. The colors defined in the color look-up table are chosen to represent as closely as possible the colors of the printed map within a map series. However, it is likely that the DRG will not match precisely the colors of its printed counterpart. An example of a specific color variation on DRG's applies to the display of bathymetric depths, which are printed on some paper maps as different shades of blue--the deeper the depth, the bluer the color. The DRG will contain only two blues, dark blue for shorelines and light blue for open water bodies, to describe all open water on a given map.

Table 2-2
The USGS DRG Color Palette

Digital Number	Color	Red	Green	Blue
0	Black	0	0	0
1	White	255	255	255
2	Blue	0	151	164
3	Red	203	0	23
4	Brown	131	66	37
5	Green	201	234	157
6	Purple	137	51	128
7	Yellow	255	234	0
8	Light Blue	167	226	226
9	Light Red	255	184	184
10	Light Purple	218	179	214
11	Light Grey	209	209	209
12	Light Brown	207	164	142

2.9 DESCREENING, QUANTIZING, AND NOISE FILTERING

The USGS DRG is produced with the intention of replicating as close as possible the original source map. Users of the DRG will note, however, that a certain amount of "noise" can be discerned when small areas are blown up or viewed under zoomed-in conditions. This noise is in the form of random specks or pixels of color and halos due to any number of factors, such as, the quality of the source, the use of screens and patterns on the litho, and the unevenness of ink due to saturation and absorption. Discontinuities or breaks in linear features may also be present and are due to improper calibration or usage of the scanner, the condition of the source, and resampling. Descreening, quantizing, and noise filtering are methods used to reduce noise, which, besides creating a more aesthetically pleasing image, have the added benefit of reducing the size of the image file. Removal of lithographic screen patterns is preferred but not required.

2.10 IMAGE MOSAICKING

Edge matching or mosaicking a DRG to its neighboring DRG's is not a requirement.

2.11 DATA QUALITY

2.11.1 Color Consistency Verification

DRG's are examined to ensure color consistency within a series. Inspections are performed on selected DRG's to ensure that both the order of digital numbers (see table 2-2) and digital number values are correct. Colors will be checked for color compliance to map series and for major color differences between features on the DRG and similar features on the source map. Color consistency throughout each series is checked by comparing a DRG to its neighboring quadrangles whenever possible.

2.11.2 Image Completeness Verification

Image completeness is checked by visually inspecting a sampling of DRG's. Each selected DRG will be examined for gaps (missing data) in the main body of the map, the map collar, the overedge areas, and

any insets.

2.11.3 Positional Accuracy Verification

A random sampling of DRG's will be accuracy tested. The accuracy test will be performed by comparing the positions of UTM grid intersections on the source graphic against the corresponding location on the digital image. A visual inspection will determine whether those coordinates fall within the pixels that define a grid tick.

No accuracy value will be recorded and no separate georeferencing will be performed on areas within an inset. Insets, overedge areas, and the map collar will not be tested and no accuracy is assumed.

2.12 METADATA

Federal agencies are required by Executive Order 12906 (April 11, 1994) to include metadata with all digital geospatial data. Executive Order 12906 established the National Spatial Data Infrastructure and adopted the Federal Geographic Data Committee's (FGDC) "Content Standard for Digital Geospatial Metadata" to provide a consistent approach and format for the description of data characteristics. Each DRG will have an associated metadata file that will comply to these standards.

Metadata contain a wide range of information about the image data to assist users in determining the availability, quality, and usefulness of the data. Attribute information, spatial reference information, and distribution information are also available in the metadata.

The template shown in Appendix 2-A is an example of a metadata file that complies with the FGDC standard. Where applicable, an element value is shown. An element value is considered to be either generic or specific. Generic values are data that apply to an entire DRG series and are repeated in the metadata file of each DRG in that series. Specific values are associated with a particular DRG and

can change with each DRG.

Copies of the “Content Standards for Digital Geospatial Metadata” in PostScript, ASCII text, Portable Document, and WordPerfect formats (meta6894.ps, meta6894.txt, meta6894.pdf, and meta6894.wp5, respectively) are available via anonymous FTP at:
ftp://fgdc.er.usgs.gov/pub/metadata/

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APPENDIX 2-A

Digital Raster Graphics - Metadata Template

APPENDIX 2-A

Digital Raster Graphic - METADATA TEMPLATE

INFORMATION ABOUT THE TEMPLATE

1. Metadata elements are in uppercase followed by a value.

2. Numbers preceding data elements refer to section numbers in the "Content Standards for Digital Geospatial Metadata", June 8, 1994.

3. Section numbers preceded by an asterisk (*) indicate file specific elements. These are followed by the element description from the "Content Standards for Digital Geospatial Metadata" and bracketed comments where applicable.

4. Element values specified by the "Content Standards for Digital Geospatial Metadata" are prefaced and followed by double quotation marks.

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1 Identification Information

1.1 Citation

8.1 ORIGINATOR: The USGS [Some DRG's may originate from mapping agencies or programs other than the USGS. In such a case, the name of the organization or individual that developed the data set would be placed here.]

*8.2 PUBLICATION DATE: The date when the data set is published or otherwise made available for release. [A single date is used to populate three separate DRG metadata elements. They are:

1. The Identification Information/Publication Date (8.2). The FGDC definition for element Publication Date is the "date when the data set is published or otherwise made available." That date is the date the last DRG production step occurs, which is the completion of the metadata file.

2. The Publication Information/Process Date (2.5.2.3). The element Process Date is described as the "date when the event was completed" or, in the case of DRG's, the date when the last DRG production step, processing the metadata file, was completed.
3. The Metadata Reference Information/Metadata Date (7.1). The date the metadata were created is the same as the date of the last production step (Process Date), and when the data becomes available (Publication Date).]

*8.4 TITLE: The name by which the data set is known. [The map name as designated by the Geographic Cell Names Data Base. Note that the source map for the DRG can be an older, unrevised map and have a different name than the DRG.]

8.6 GEOSPATIAL DATA PRESENTATION FORM: "map"

8.8 Publication Information

8.8.1 PUBLICATION PLACE: Reston, VA

8.8.2 PUBLISHER: The USGS

1.2 Description

1.2.1 ABSTRACT: A DRG is a raster image of a scanned USGS topographic or planimetric map including the collar information, georeferenced to the UTM grid.

1.2.2 PURPOSE: A DRG is useful as a source or background layer in a GIS, as a means to perform quality assurance on other digital products, and as a source for the collection and revision of vector data. DRG's can also be merged with other digital data, for example, DEM's or DOQ's, to produce a hybrid digital file.

*1.2.3 SUPPLEMENTAL INFORMATION: Other descriptive information about the data set. [The USGS will place the UTM metric coordinates of pixel 1,1 in this element.]

1.3 Time period of content

9.1 Single Date/Time

*9.1.1 CALENDAR DATE: The year (and optionally month, or month and day). The latest date found beneath the map title on the lower right hand side of the source map populates the Calendar Date element.

1.3.1 CURRENTNESS REFERENCE: "Ground Condition"

1.4 Status

1.4.1 PROGRESS: "Complete"

1.4.2 MAINTENANCE AND UPDATE FREQUENCY: "Irregular"

1.5 Spatial Domain

1.5.1 Bounding Coordinates

*1.5.1.1 WEST BOUNDING COORDINATE: Western-most coordinate of the limit of coverage expressed in longitude [-].

*1.5.1.2 EAST BOUNDING COORDINATE: Eastern-most coordinate of the limit of coverage expressed in longitude [-].

*1.5.1.3 NORTH BOUNDING COORDINATE: Northern-most coordinate of the limit of coverage expressed in latitude.

*1.5.1.4 SOUTH BOUNDING COORDINATE: Southern-most coordinate of the limit of

coverage expressed in latitude.

1.6 Keywords

1.6.1 Theme

1.6.1.1 THEME KEYWORD THESAURUS: "None"

1.6.1.2 THEME KEYWORD: digital raster graphic

1.6.1.2 THEME KEYWORD: DRG

1.6.1.2 THEME KEYWORD: topographic map

1.6.2 Place

1.6.2.1 PLACE KEYWORD THESAURUS: Department of Commerce, 1977, Countries, Dependencies, Areas of Special Sovereignty, and their Principal Administrative Divisions (Federal Information Processing Standard 10-3): Washington, Department of Commerce, National Institute of Standards and Technology.

*1.6.2.2 PLACE KEYWORD: The geographic name of a location covered by a data set. [The United States (and Mexico or Canada).]

1.6.2.1 PLACE KEYWORD THESAURUS: Department of Commerce, 1987, Codes for the Identification of the States, The District of Columbia and the Outlying Areas Of The United States, and Associated Areas (Federal Information Processing Standard 5-2): Washington, Department of Commerce, National Institute of Standards and Technology.

*1.6.2.2 PLACE KEYWORD: The geographic name of a location covered by a data set. [STATE1]

*1.6.2.2 PLACE KEYWORD: The geographic name of a location covered by a data set. [STATE2]

1.7 ACCESS CONSTRAINTS: "None"

1.8 USE CONSTRAINTS: Acknowledgment of the USGS would be appreciated in products derived from these data.

*1.11 DATA SET CREDIT: Recognition of those who contributed to the data set. [States or agencies that contribute to the production of DRG's can receive a credit here.]

2 Data Quality Information

2.1 Attribute Accuracy

2.1.1 ATTRIBUTE ACCURACY REPORT: The DRG is an 8-bit color image that employs a color palette to ensure uniform colors throughout a particular DRG series. All DRG's within a series must have the same RGB value.

2.2 LOGICAL CONSISTENCY REPORT: Not Applicable

2.3 COMPLETENESS REPORT: The DRG is a faithfully reproduced digital image of the original source map. Some differences may be detected between the source graphic used for scanning and the DRG due to the RGB values assigned that particular color. The intent is to recreate those colors as near as possible. Data completeness for DRG files reflect content of the source graphic.

2.4 Positional Accuracy

2.4.1 Horizontal Positional Accuracy

2.4.1.1 HORIZONTAL POSITIONAL ACCURACY REPORT: Refer to the DRG collar for information on horizontal accuracy (National Map Accuracy Standards Note). The DRG retains the accuracy of the source map.

2.4.2 Vertical Positional Accuracy

2.4.2.1 VERTICAL POSITIONAL ACCURACY REPORT: Refer to the DRG collar for information about vertical accuracy.

2.5 Lineage

2.5.1 Source Information

2.5.1.1 Source Citation

2.5.1.5 SOURCE CITATION ABBREVIATION: map1

8.1 ORIGINATOR: The USGS

*8.2 PUBLICATION DATE: The date when the data set is published or otherwise made available for release. [The latest date beneath the map title.]

*8.4 TITLE: The name by which the data set is known. [Source map name.]

8.6 GEOSPATIAL DATA PRESENTATION FORM: "map"

8.8 Publication Information

8.8.1 PUBLICATION PLACE: Reston, VA

8.8.2 PUBLISHER: USGS

*2.5.1.2 SOURCE SCALE DENOMINATOR: 24,000 (The denominator of the representative fraction on a map as in this example for a 1:24,000-scale map).

2.5.1.3 TYPE OF SOURCE MEDIA: "paper"

2.5.1.4 Source Time Period of Content

9.1 Single Date/Time

*9.1.1 CALENDAR_DATE: The year (and optionally month, or month and day). [The date found beneath the map title on the lower right hand side of the source map if only a single date is present. If two or more dates exist beneath the map title then multiple dates are listed (see following text in double brackets).

[[If multiple dates are shown beneath the map title of the source map the following dates are required:

*9.1.1 CALENDAR_DATE: The year (and optionally month, or month and day). [The black map date.]

2.5.1.4.1 SOURCE CURRENTNESS REFERENCE: "ground condition"

*9.1.1 CALENDAR_DATE: The year (and optionally month, or month and day). [The latest revision date.]

2.5.1.4.1 SOURCE CURRENTNESS REFERENCE: "ground condition"

*9.1.1 CALENDAR_DATE: The year (and optionally month, or month and day). [The photoinspection date if minor revision or reprint.]

2.5.1.4.1 SOURCE CURRENTNESS REFERENCE: "ground condition"]]

2.5.1.4.1 SOURCE CURRENTNESS REFERENCE: "ground condition"

2.5.1.6 SOURCE CONTRIBUTION: The source map is scanned to produce the DRG.

2.5.2 Process Step

2.5.2.1 PROCESS DESCRIPTION: The production procedures, instrumentation, hardware, and software used in the collection of standard DRG products vary depending on systems used at the contract, cooperator, or the USGS production sites. The majority of DRG data sets are acquired through government partnership and contract. The process step describes, in general, the process used in the production of DRG's from 1:24,000-scale maps.

1. Production of a DRG begins with the scanning of a paper 7.5-minute topographic map (map1) on a high-resolution scanner. Scanning resolutions range from 500-1,000 dpi with an output file of 160-300 Mb in size.

2. Removal of screens (descreening) and color quantization to reduce the number of colors also takes place during the scanning phase.

3. The raw scan file is then transformed and georeferenced using UTM coordinates of the sixteen 2.5-minute grid ticks, which are obtained using the in-house produced program COORDAT and stored in a ground control file. Those sixteen 2.5-minute ticks are interactively visited and assigned their respective UTM coordinates. The USGS program XSHAPES4 then performs a piecewise linear rubber sheet transformation.

4. An output resolution of 2.4 meters (8.2 feet) is chosen to resample the file to 250 dpi.

5. The image file is converted to a TIFF 6.0 image and further reduced by converting the file to a run length encoded PackBits compression (type 32773).

6. The color palette of the compressed DRG is then standardized by replacing the original RGB values assigned during the scanning process with standard RGB value combinations using the in-house produced TIFFREMAP program.

7. The DRG metadata file is completed.

8. Prior to archiving the DRG undergoes the following quality assurance procedures:

   a. The color index values of each DRG are checked to ensure the RGB combinations are consistent with the standardized color palette.

b. All DRG files are inspected to ensure that they are geometrically consistent with normal map presentation.

c. Selected DRG's are checked to ensure that data elements in the DRG metadata file correspond to the map collar information and to the information in the associated image file.

d. Selected DRG's are checked for georeferencing accuracy by comparing the General Cartographic Transformation Package (GCTP) calculated value of latitude and longitude tick marks with corresponding tick intersections in the DRG image.

e. Transformations are checked on selected DRG's by comparing the positions of well defined points, such as UTM grid intersections in the graphic product, with the corresponding image points in the DRG.

USGS DRG production specifications are available on request from the National Mapping Division and Mid-Continent Mapping Center by contacting:

Rolla-ESIC
U.S. Geological Survey
1400 Independence Rd., MS231
Rolla, MO 65401-2602
Phone 573-308-3577
Facsimile 573-308-3652
E-mail to esic@mcdgs01.er.usgs.gov
World Wide Web: http://mcmcweb.er.usgs.gov/drg/

2.5.2.2 SOURCE USED CITATION ABBREVIATION: The Source Citation Abbreviation of a data set used in the processing step. [map1]

*2.5.2.3 PROCESS DATE: The date when the event was completed. [Production date.]

3 Spatial Data Organization Information

3.2 DIRECT SPATIAL REFERENCE METHOD: "Raster"

3.4 Raster Object Information

3.4.1 RASTER OBJECT TYPE: "Pixel"

*3.4.2 ROW COUNT: The maximum number of raster objects along the ordinate (y) axis.

*3.4.3 COLUMN COUNT: The maximum number of raster objects along the abscissa (x) axis.

4 Spatial Reference Information

4.1 Horizontal Coordinate System Definition

4.1.2 Planar

4.1.2.1.2 Transverse Mercator

*4.1.2.1.2.2 LONGITUDE AT CENTRAL MERIDIAN: The line of longitude at the center of a map projection generally used as the basis for constructing the projection. [-]

4.1.2.1.2.3 LATITUDE OF PROJECTION ORIGIN: 0.0

4.1.2.1.2.4 FALSE EASTING: 500000.

4.1.2.1.2.5 FALSE NORTHING: 0.0

4.1.2.1.2.17 SCALE FACTOR AT CENTRAL MERIDIAN: 0.9996

4.1.2.2.1 GRID COORDINATE SYSTEM NAME: "Universal Transverse Mercator"
Universal Transverse Mercator (UTM)

*4.1.2.2.2.1 UTM ZONE NUMBER: The identifier for the UTM zone.

4.1.2.4 Planar Coordinate Information

4.1.2.4.1 PLANAR COORDINATE ENCODING METHOD: "row and column"

4.1.2.4.2 Coordinate Representation

*4.1.2.4.2.1 ABSCISSA RESOLUTION: The (nominal) minimum distance between the "x" or column values of two adjacent points expressed in Planar Distance Units of measure.

*4.1.2.4.2.2 ORDINATE RESOLUTION: The (nominal) minimum distance between the "y" or row values of two adjacent points, expressed in Planar Distance Units of measure.

4.1.2.4.4 PLANAR DISTANCE UNITS: "meters"

4.1.4 Geodetic Model

*4.1.4.1 HORIZONTAL DATUM NAME: The identification given to the reference system used for defining the coordinates of points. [The datum used is the datum of the DRG source.]

*4.1.4.2 ELLIPSOID NAME: The identification given to established representations of the Earth's shape. [The ellipsoid of the DRG source; for example, GRS 1980, Clarke 1866.]

*4.1.4.3 SEMI-MAJOR AXIS: Radius of the equatorial axis of the ellipsoid.[GRS 1980 = 6378137, Clarke 1866 = 6378206.4]

*4.1.4.4 DENOMINATOR OF FLATTENING RATIO: The denominator of the ratio of

the difference between the equatorial and polar radii of the ellipsoid when the numerator is set to 1. [GRS 1980 = 298.257, Clarke 1866 = 294.98]

5 Entity and Attribute Information

5.2 Overview Description

5.2.1 ENTITY AND ATTRIBUTE OVERVIEW: Each raster entity or pixel contains a digital number from 0 through 12 referencing a color palette of RGB values from 0 through 255 in which the standard colors used in the DRG are defined.

The USGS DRG Color Palette

Digital Number	Color	Red	Green	Blue
0	Black	0	0	0
1	White	255	255	255
2	Blue	0	151	164
3	Red	203	0	23
4	Brown	131	66	37
5	Green	201	234	157
6	Purple	137	51	128
7	Yellow	255	234	0
8	Light Blue	167	226	226
9	Light Red	255	184	184
10	Light Purple	218	179	214
11	Light Grey	209	209	209
12	Light Brown	207	164	142

5.2.2 ENTITY AND ATTRIBUTE DETAIL CITATION: Standards for Digital Raster Graphic.

6 Distribution Information

6.1 Distributor

10.2 Contact Organization Primary

10.1.2 CONTACT ORGANIZATION: Earth Science Information Center, U.S. Geological Survey Contact Address

10.4.1 ADDRESS TYPE: "mailing address"

10.4.2 ADDRESS: 507 National Center

10.4.3 CITY: Reston

10.4.4 STATE OR PROVINCE: Virginia

10.4.5 POSTAL CODE: 22092

10.5 CONTACT VOICE TELEPHONE: 1 800 USA MAPS

10.5 CONTACT VOICE TELEPHONE: 1 703 648 6045

6.3 DISTRIBUTION LIABILITY: Although these data have been processed successfully on a computer system at the USGS, no warranty expressed or implied is made by the USGS regarding the use of the data on any other system, nor does the act of distribution constitute any such warranty. The USGS will warrant the delivery of this product in computer-readable format and will offer appropriate adjustment of credit when the product is determined unreadable by correctly adjusted computer input peripherals, or when the physical medium is delivered in damaged condition. Requests for adjustment of credit must be made within 90 days from the date of this shipment from the ordering site.

6.4 Standard Order Process

6.4.2 Digital Form

6.4.2.1 Digital Transfer Information

6.4.2.1.1 FORMAT NAME: TIFF

6.4.2.1.2 FORMAT VERSION NUMBER: 6.0

6.4.2.1.6 FILE DECOMPRESSION TECHNIQUE: PackBits

6.4.2.2 Digital Transfer Option

6.4.2.2.2 Offline Options

6.4.2.2.2.1 OFFLINE MEDIA: "CD-ROM"

6.4.2.2.2.3 RECORDING FORMAT: "ISO 9660"; DRG image files with corresponding metadata files.

6.4.3 FEES: For delivery on compact disc, the charge is $32 per CD-ROM plus a handling fee of $3.50 per order. The charge for multidisc sets is $32 for the first disc, $10 for each additional disc in a set, plus the $3.50 handling fee. Prices are subject to annual revision.

7 Metadata Reference Information

*7.1 METADATA DATE: The date that the metadata were created or last updated.

7.4 Metadata Contact

10.2 Contact Organization Primary

10.1.2 CONTACT ORGANIZATION: U.S. Geological Survey

10.4 Contact Address

10.4.1 ADDRESS TYPE: "mailing address"

10.4.2 ADDRESS: 590 National Center

10.4.3 CITY: Reston

10.4.4 STATE OR PROVINCE: Virginia

10.4.5 POSTAL CODE: 22092

10.5 CONTACT VOICE TELEPHONE: 1 703 648 4533

10.8 CONTACT ELECTRONIC MAIL ADDRESS: Copies of this publication are available from anonymous File Transfer Protocol (anonymous FTP); ftp://fgdc.er.usgs.gov/pub/metadata/

7.5 METADATA STANDARD NAME: "Content Standards for Digital Geospatial Metadata"

7.6 METADATA STANDARD VERSION: 19940608