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ON THE COVER

Shot hole in the bed of Pine Creek, Allegheny County, in the process of becoming a pothole (see article on page 2). This is the same hole as that shown in Figure 3 on page 6, but was photographed 5 years later. Most of the specific features of the weir are still recognizable, but the central bore hole and many of the radiating fractures have been deepened and widened. The scale is 1 meter in length. Photograph by J. A. Harper.

PENNSYLVANIA GEOLOGY

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Pennsylvania’s Geological Survey Becomes Part of New DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

With the passage of Act 18, the Department of Conservation and Natural Resources (DCNR) came into being on July 1, 1995. DCNR was created to provide a cabinet-level status for the Commonwealth’s natural (including geological) resources.

The Bureau of Topographic and Geologic Survey, one of the oldest state bureaus, was transferred by Act 18 to the new DCNR as one of five program bureaus. These include the Bureaus of State Parks, Forestry, Recreation and Conservation, and Facility Design and Construction.

The mission of DCNR is to maintain and preserve state parks; manage state forest lands to assure their long-term health, sustainability, and economic use; provide information on Pennsylvania’s ecological and geological resources; and administer grant and technical assistance programs that will benefit rivers conservation, trails and greenways, local recreation, regional heritage conservation, and environmental education programs across Pennsylvania.

The Bureau of Topographic and Geologic Survey, familiarly called the Pennsylvania Geological Survey, will continue to focus on providing basic geological and topographic data and assistance to all who need information about, and explanations of, Pennsylvania’s complex geology and varied topography. During the first year, we will also focus our Bureau resources on supporting DCNR initiatives to educate the public about our program and accomplishments. We also will assist our colleague program Bureaus in promoting community conservation partnerships and encouraging tourism and economic development opportunities.

At the same time, we will continue to provide new geologic and topographic maps, reports, and data, particularly in digital format, that result from basic data collection of groundwater, energy, and mineral resources, and from areal mapping. As an example, we are cooperating with the National Mapping Division of the U.S. Geological Survey in providing new topographic-map digital data for Pennsylvania. One of the principal products now being produced through this federal-state partnership is digital images (called digital raster graphics; see (continued on page 15)
An Explosive Case of Man-Induced Stream Potholes

by John A. Harper
Pennsylvania Geological Survey

POTHOLES, POTHOLES, AND MORE POTHOLES. As the citizens of Pennsylvania are well aware, potholes are an endemic feature of the Commonwealth. The annual freeze-thaw cycle of late winter and early spring, combined with the routine hammering of tires on some of the nation’s most heavily traveled roads, contributes to more than a few flat tires, front-end misalignments, and damaged suspension systems every year. But Pennsylvania’s roads are not the only locations of potholes. Some streambeds have developed potholes where the bed is formed of resistant, relatively homogeneous rock. Some excellent examples are potholes that have been carved into the thick Pennsylvanian sandstones that form the bed of the Youghiogheny River at Ohiopyle State Park in Fayette County. Sevon (1989) provided a good example of potholes formed in Mesozoic diabase in the bed of the Susquehanna River in Lancaster County. Numerous other examples could be cited as well.

Potholes formed in roads and those in streambeds are quite different features, however, both in terms of geometry and in how they were formed. Road-surface potholes form as a result of our climate and our heavy road use. Although asphalt and concrete road surfaces appear to be solid, they actually are quite porous. Water can seep rapidly into the road material if it is damaged or poorly constructed, collecting in the pore spaces between the aggregate grains. During winter, when the water freezes, the ice expands, pushing the aggregate grains apart and creating some excess space in the pores. When the ice melts, there is room for more water, which then freezes, pushes, and melts, allowing more water to enter. As the cycle continues, pushing the road surface apart from the inside out, the battering-ram action of vehicle tires destroys what is left of the cohesive strength of the road material. The asphalt or concrete falls apart and—voila—a pothole.

Streambed potholes, on the other hand, form primarily through the action of erosional forces in the stream. Freeze-thaw might have a part in the process by weakening the rock slightly, but the main formative agent, as Sevon (1989, p. 6) pointed out, is “hydraulic vor-
tices created by turbulence during high-velocity flow.” A hydraulic vortex is essentially an underwater tornado in which water rotates rapidly, drawing sediment in at the base and expelling it upward to the top of the vortex. Sediment grains suspended in the water act like sandpaper on the rock at the bottom of the vortex and begin scouring a depression. As the depression deepens through time, the sand scours the sides of the hole as well. The point of vortex formation, and therefore of pothole formation, occurs where the rock is weaker, such as at the intersection of joints or, in a sandstone, where the grains of the rock are not well cemented.

Some unusual potholes currently are forming in the bed of Pine Creek where the water flows over a sandstone shelf near the intersection of Pa. Route 8 and Saxonburg Boulevard in Shaler Township, Allegheny County, just north of Etna (Figure 1). The stream vortices are carving out the potholes at the intersections of numerous joints, just as they do in many other streams. What makes these potholes different is that, although they are being carved by natural hydraulic processes, they originated through human-generated explosions.

**PINE CREEK FLOOD CONTROL PROJECT.** Pine Creek flows in a large loop, an incised meander, that curls back and forth under Pa. Route 8 at Underhill (Figure 1). This loop outlines a spur of thick, resistant, well-developed Buffalo sandstone (Pennsylvanian, Conemaugh Group, Glenshaw Formation) that at one time projected northeastward as far as the word Undercliff on Figure 1. The railroad shown on the map runs along the hillside on the west side of the creek and through a tunnel cut into the sandstone at the spur. The spur had been partially breached on its southeastern side during construction of a large warehouse early in this century, and it was removed completely on the northeast side of Pa. Route 8 prior to construction of the Shaler Plaza shopping center (the large buildings at the word Underhill in Figure 1).

Pine Creek is prone to flooding in most of its drainage area during heavy rains, particularly at Undercliff, where the near-tortuous nature of the stream channel forced floodwaters out of the streambed and up over the surrounding flat lands. To remedy this situation, in 1986 the Commonwealth’s Bureau of Flood Protection Projects constructed a diversion channel across the near end of the loop in order to expedite the flow of water away from the most flood-prone areas, yet limit the amount of damage to aquatic life. They accomplished the first objective by demolishing the warehouse, breaching the rock spur (Figure 2), and constructing a 550-foot-long levee along the eastern bank of the diversion channel to contain the water. They accomplished
the second objective by leaving a weir (low dam) of sandstone partially blocking the diversion channel, thus maintaining the water level in the loop by allowing continuous water flow through a pipe arch beneath Pa. Route 8. The potholes occur on the surface of the weir.

**POTHOLE CITY (SUBAQUEOUS).** The diversion channel was constructed by blasting and digging through the rock spur. Explosive charges were set in holes bored into the rock and detonated to make rock removal easier. The detonations created radiating fractures (induced joints) that extend into the weir (Figure 3).

Potholes such as that shown in Figure 4A began forming where the induced joints in the rock created points at which water vortices formed during high-flow periods. In 1989, when I initially visited this site, most of the holes were relatively small, having a diameter not
Figure 2. Excavated diversion channel of Pine Creek showing the weir, riprap-covered levee upstream, and a grouted riprap wall to prevent erosion downstream. The approximate original surface on the former Buffalo sandstone spur has been drawn in for reference. The potholes occur in the upper surface of the weir.

much larger than 6 or 8 inches and commonly less than 4 inches deep. Additionally, many of the fractures radiating from the shot holes, although showing signs of scouring (Figure 4A), did not appear to be especially susceptible to stream erosion.

Five years later, in 1994, I revisited the site and was amazed at how much scouring had taken place. The cover photograph and Figure 4B illustrate the extent of scouring that has occurred in a very short time. Figure 4B, in particular, shows that the pothole in Figure 4A had been widened to about 24 inches and deepened significantly, to about 20 inches. The volume of a typical pothole had been enlarged a whopping 4,400 percent, from about 200 cubic inches to about 9,000 cubic inches (5.2 cubic feet) in just 5 years! That is an average erosion rate of approximately 3.2 inches per year (an 880 percent increase in volume per year). In addition, the surrounding rock has been scoured to the point where many of the formerly subdued surface features of the streambed now stand out in high relief. Erosion seems to have affected the rock associated with the radiating fractures most heavily. These probably are growing through the combined actions of being hammered
Figure 3. Shot hole in the bed of Pine Creek created during the Pine Creek flood-control project in 1986. The scale is 1 meter in length. The view is southeast across the diversion channel. Notice the radiating joint pattern typical of explosive fracturing. This photograph was taken in 1989; the photograph on the cover shows the same feature 5 years later.

by debris carried in the water column and having loose material plucked and carried away by the stream. Although the main erosional agent might be different, the relative smoothness of angles and surfaces attests to the effects of "sandpapering," the same type of scouring that creates potholes.

QUE SERA, SERA. All of this erosion might result eventually in the sort of exotically sculpted bedforms discussed by Sevon (1989). On the other hand, it might result simply in wide holes and smooth troughs in the sandstone. It will be interesting to return to the Pine Creek diversion channel in 5 or 10 years to review the progress of pothole development and erosive sculpturing in the weir. Will the potholes continue to grow deeper and wider during spring floods, or will the scouring completely change the sculpted form of the joints and their intersections? Will the joint planes widen, becoming smoother as they channel grit-laden water across the weir? Will Pine Creek become the home of exotically sculpted sandstone? Only time will tell, and Pine Creek has all the time in the world.
Figure 4. Close-up of a shot hole in the process of being sculpted into a pot-hole in the bed of the excavated channel of Pine Creek. Upstream is toward the lower right-hand corner. A. Scouring has begun to deepen and widen the shot hole, and the surrounding rock is relatively smooth. The photograph was taken in 1989. The scale is 4 inches (10 cm) long. B. The same hole 5 years later. Erosion of the streambed has increased significantly, and the hole has more than tripled in size in all dimensions. The scale is 6 inches (15 cm) long.

REFERENCE

NEW RELEASES

Open-File Report on Warren County Bedrock Geology Issued

A new open-file report on the bedrock geology of Warren County, northwestern Pennsylvania, has been released by the Pennsylvania Geological Survey. The report is a consequence of bedrock geologic mapping that was undertaken in support of a groundwater-resource investigation of Warren County by the Pennsylvania Geological Survey, in cooperation with the U.S. Geological Survey, Water Resources Division.

Open-File Report 95-02 consists of two plates. The first, entitled Bedrock Geologic Map of Warren County, Pennsylvania, was prepared by staff geologists Clifford H. Dodge and Albert D. Glover. The bedrock geology is subdivided into 12 units, including rocks of Devonian, Mississippian, and Pennsylvanian age, and is compiled on the Warren County topographic base map (1:50,000 scale). Lithologic descriptions of map units are given on the plate. The second plate, entitled Structure-Contour Map of Warren County, Pennsylvania, is by Clifford H. Dodge and also includes the same topographic base map. The structure contours are on two datums, which are excellent key horizons—the base of the Warren First sand for the northern third of the county and the top of the main bench of the Corry Sandstone or equivalent top of the Corry Sandstone and Knapp Formation, undivided, for the southern two thirds of the county. The structure-contour interval is 20 feet.

Recent geologic investigations and mapping in Warren County have resulted in much greater understanding of the regional lithostratigraphic framework, vertical and lateral variability of bedrock units, and regional structure, and have lead to recognition that the major buried valleys are deeper than previously believed.

See page 15 for information on ordering. The prepaid copying and shipping costs are $5.00 plus $0.30 state sales tax for Pennsylvania residents.
Freeburg Quadrangle
Open-File Report

The Pennsylvania Geological Survey announces the availability of Open-File Report 95–04, Bedrock Geology of the Freeburg 7½’ Quadrangle, Snyder County, Pennsylvania, by David B. MacLachlan, Donald M. Hoskins, and Dorothy F. Payne. Located in the heart of the Ridge and Valley province, the Freeburg quadrangle is underlain by Early Silurian to Late Devonian sedimentary rocks that are folded into one major anticline and one major syncline. The report consists of the following: (1) a one-color (black) photocopy of a 1:24,000-scale geologic map depicting the outcrop pattern of 23 stratigraphic units (Tuscarora Formation to Sherman Creek Member of the Catskill Formation) and showing selected structural attitudes, and (2) a separate text, which includes a description of the mapped formations and members. Considering that the geologic structure depicted on the map is not complex, but exhibits many largely unfaulted folds of differing amplitudes and wavelengths in easily traceable stratigraphic units, the report could serve as an excellent teaching tool in an introductory structural geology class.

See page 15 for information on ordering. The prepaid copying and shipping costs are $3.00 plus $0.18 state sales tax for Pennsylvania residents.

Sinkholes and Karst-Related Features of York and Adams Counties

Two new open-file reports, Sinkholes and Karst-Related Features of Adams County (Open-File Report 95–05) and Sinkholes and Karst-Related Features of York County (Open-File Report 95–06), have recently been released by the Pennsylvania Geological Survey. Compiled by staff geologist William E. Kochanov, they are part of a series of county-based
reports that relate to sinkhole occurrences in Pennsylvania. Each report includes a brief explanatory text and copies of 7.5-minute-quadrangle maps (1:24,000 scale). The methods used in compiling the report are described in the text, which also includes references, a listing of sinkholes and their coordinates, and a glossary. The maps show the locations of karst surface depressions, sinkholes, surface mines, cave entrances, and carbonate bedrock geology.

See page 15 for information on ordering. The prepaid copying and shipping costs are as follows: Adams County report, $15.00 plus $0.90 state sales tax for Pennsylvania residents; and York County report, $25.00 plus $1.50 state sales tax for Pennsylvania residents.

Edinboro North Quadrangle Open-File Report

The Pennsylvania Geological Survey announces the availability of Open-File Report 95-07, Bedrock Geology of the Edinboro North 7½' Quadrangle, Erie County, Pennsylvania, by Jeffrey J. Gryta, Dale Tshudy, and Joseph Lichtinger. Located near the edge of the Glaciated Pittsburgh Low Plateaus physiographic section in northwestern Pennsylvania, the Edinboro North quadrangle is underlain by nearly flat lying sedimentary rocks of Late Devonian age (Girard Shale to Venango Formation). The report consists of the following: (1) a 1:24,000-scale geologic map depicting the outcrop pattern of eight rock units (including two distinctive fossiliferous intervals) and indicating the locations of numerous local structural anomalies (i.e., "pop-up" structures and bedding-plane and low-angle thrust faults); (2) two plates depicting 17 stratigraphic sections measured along various stream courses in the quadrangle; (3) a plate showing a north-south geologic cross section of the quadrangle (vertical scale exaggerated); and (4) a separate text that includes a description of the mapped rock units and discussions of the fossils, sedimentary environments, and geologic structures characteristic of the area. All plates are one-color (black) photocopies. The report was prepared by Edinboro University professors and students, who investigated the area under a cooperative mapping contract with the Pennsylvania Geological Survey. Significant discoveries of skeletal remains of the giant Devonian fish Dunkleosteus that
were made during this mapping project will be described in a future issue of Pennsylvania Geology. See page 15 for information on ordering. The prepaid copying and shipping costs are $7.00 plus $0.42 state sales tax for Pennsylvania residents.

Military Geology Open-File Report

The Pennsylvania Geological Survey announces the availability of Open-File Report 95-08, Military Geology of the Richmond and Petersburg National Battlefield Parks, Virginia, by Jon D. Inners, Brant E. Inners, and David M. Sayre. The well-illustrated, 75-page report is a revised and expanded version of a guidebook prepared for a field trip held in conjunction with the 37th Annual Meeting of the Association of Engineering Geologists, Williamsburg, Va., October 2, 1994. Included with a detailed geologic and historic road log are stop descriptions and geologic maps at Chimborazo Hill, Drewry's Bluff, Petersburg Battlefield, The Crater, Forts Harrison and Johnson, and Cold Harbor. Particular attention is paid to the engineering contributions of Colonel Henry Pleasants of Pottsville, Pa., in the excavation of the Union mine detonated prior to the disastrous Union assault at The Crater in July 1864.

Copies of Open-File Report 95-08 can be obtained for $5.00 plus $0.30 sales tax for Pennsylvania residents. Please see page 15 for information on ordering.

Surficial Materials in Parts of York, Lancaster, and Chester Counties

The Pennsylvania Geological Survey has released as open-file reports eighteen 1:24,000-scale geologic quadrangle maps of the surficial materials in York, Lancaster, and Chester Counties. These maps are one-color (black) photocopies of original compilations and are accompanied by a common 22-page explanatory text.

OF 96-01 York quadrangle, York County
OF 96-02 Red Lion quadrangle, York County
OF 96-03 Safe Harbor quadrangle, York and Lancaster Counties
OF 96-04 Conestoga quadrangle, Lancaster County
OF 96-05 Quarryville quadrangle, Lancaster County
OF 96-06 Gap quadrangle, Lancaster County
OF 96-07 Glen Rock quadrangle, York County
OF 96-08 Stewartstown quadrangle, York County
OF 96-09 Airville quadrangle, York and Lancaster Counties
OF 96-10 Holtwood quadrangle, York and Lancaster Counties
OF 96-11 Wakefield quadrangle, Lancaster County
OF 96-12 Kirkwood quadrangle, Lancaster and Chester Counties
OF 96-13 New Freedom quadrangle, York County (Pennsylvania part only)
OF 96-14 Norrisville quadrangle, York County (Pennsylvania part only)
OF 96-15 Fawn Grove quadrangle, York County (Pennsylvania part only)
OF 96-16 Delta quadrangle, York and Lancaster Counties (Pennsylvania part only)
OF 96-17 Conowingo Dam quadrangle, Lancaster, York, and Chester Counties (Pennsylvania part only)
OF 96-18 Rising Sun quadrangle, Chester and Lancaster Counties (Pennsylvania part only)

The new open-file reports can be purchased individually (one map plus explanatory text) for $2.50, or in multiples (two or more maps plus one explanatory text) for $2.00 each, plus 6 percent state sales tax for Pennsylvania residents. Please see page 15 for information on ordering.

New Geologic Maps Are Open Filed by Pennsylvania Geological Survey

Five new multicolor geologic maps have been published by the Bureau of Topographic and Geological Survey and are available for purchase. These multicolor maps will eventually accompany texts that are currently in press. When printed, the texts will be joined with the maps and distributed through the Commonwealth's standard marketing outlet, the State Book Store. In the meantime, the maps are
available from the Bureau. In the list below, the costs include state sales tax and shipping. Please see page 15 for information on ordering.

**Atlas 144cd, Plate 1 and Plate 2**—Bedrock and Surficial Geologic Maps of the Allenwood and Milton Quadrangles, Union and Northumberland Counties, Pennsylvania (scale 1:24,000); **Plate 3**—Mineral Production Map (scale 1:48,000). **Cost $15.10** (multicolor plates and envelope). The two geologic maps include text descriptions of the mapped geologic units, plus a brief description of their groundwater-resource potential as aquifers, their mineral-resource potential, and their foundation stability. The mineral production map shows locations of quarries, borrow pits, and mine adits.

**Environmental Geology Report 9, Plate 1**—Landslide Susceptibility in the Williamsport 1- by 2-Degree Quadrangle (scale 1:250,000). **Cost $2.50** (two-color plate). The map shows areas of high, moderate, and low landslide susceptibility in the quadrangle by shades of blue on a two-color topographic base map.

**Water Resource Report 66, Plate 1**—Geologic Map of Delaware County, Pennsylvania, Showing the Locations of Selected Wells (scale 1:50,000). **Cost $9.75** (multicolor plate only). The plate includes very brief text descriptions of the mapped geologic units and their water-bearing properties.

**Water Resource Report 67, Plate 1**—Geologic Map of Cambria County, Pennsylvania, Showing the Locations of Selected Wells and Springs (scale 1:50,000). **Cost $8.20** (multicolor plate and envelope). This geologic map includes brief descriptions of the mapped geologic units, well yields, and water quality.

**Water Resource Report 68, Plates 1A and 1B**—Surficial Geologic Map of Major Glaciated Valleys of Bradford, Tioga, and Potter Counties, Pennsylvania, Showing Locations of Wells, Test Holes, and Data-Collection Sites (scale 1:100,000). **Cost $9.60** (two-color plate [on two sheets] and envelope). The plate includes descriptions of the mapped surficial materials and their water-bearing properties. Several enlarged area maps and numerous hydrogeologic cross sections are included as inset diagrams.

Upon request, tabular information concerning the wells located on the maps for Water Resource Reports 66, 67, and 68 (plus additional wells entered in the Bureau's water-well database after the maps were completed) is available as printouts or on disks. When photocopied, the tables require up to 100 pages. Please call 717–783–7256 for specific copying and digital media costs.
Coal Resources of Indiana County Now Available for Ordering on Open File

Coal Resources of Indiana County, Pennsylvania (Open-File Report 96-19), previously open filed in 1992 for inspection only (see Pennsylvania Geology, v. 23, no. 1), is now available for ordering on a quadrangle-by-quadrangle basis. Each of the compilation maps has been reduced to 1:48,000 scale (approximately 11 by 14 inches). Copies may be purchased for 25 cents per map, plus 6 percent sales tax for Pennsylvania residents. The following list shows the number and type of maps available for each quadrangle.

Maps Available in Open-File Report 96-19

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Total 146

¹SC, structure-contour map; CL, crop-line map of all major coal seams. Other abbreviations refer to separate maps showing crop lines and mined-out areas of the following coals: Sew, Sewickley; Red, Redstone; Pit, Pittsburgh; Duq, Duquesne; Mah, Mahoning; UFre, Upper Freeport; LFre, Lower Freeport; UKit, Upper Kittanning; MKit, Middle Kittanning; LKit, Lower Kittanning; Cln, Clarion; Brk, Brookville; Mer, Mercer.
How to Order Open-File Reports

The open-file reports described on pages 8 through 14 may be purchased by mail from the Pennsylvania Geological Survey, P. O. Box 8453, Harrisburg, PA 17105–8453. Please refer to the individual announcements for the cost of each report. Prepayment is required. Please make checks payable to Commonwealth of Pennsylvania, and be sure to include state sales tax where applicable. The reports may be examined in the library of the Pennsylvania Geological Survey, Evangelical Press Building, Second Floor, 1500 North Third Street, Harrisburg.

For further information on any of the open-file reports, please contact Jon Inners, Chief, Geologic Mapping Division, telephone 717–787–6029.

ANNOUNCEMENT

Internet Distribution List for Survey Announcements

The Pennsylvania Geological Survey is creating an Internet distribution list through which we will send you information concerning new or revised/reprinted publications and open-file reports, upcoming meetings and field trips, availability of surplus topographic maps, and so forth. If you wish to be included on this list, please send your Internet address to inners.jon@a1.dcnr.state.pa.us. It is anticipated that the first such announcements will be transmitted in April or May. The distribution list will be updated as new or revised addresses are received.

In addition, the Survey is developing a home page for access through the Internet's World Wide Web. If you have any suggestions on information you would like to see distributed through either of these media, please send your suggestions to hoskins.donald@a1.dcnr.state.pa.us.

State Geologist's Editorial (continued from page 1)

page 16) of each of the 881 7.5-minute topographic maps of Pennsylvania. These will be available to you in 1996 as a partnership-developed product of the “old” Survey in the “new” DCNR.

Donald M. Hoskins
State Geologist
NEW DIGITAL PRODUCTS

Digital Orthophoto Quarter-Quadrangles and Digital Raster Graphics

The U.S. Geological Survey recently announced the availability of the first black-and-white digital orthophoto quarter-quadrangles (DOQ's) and color digital raster graphics (DRG's) on CD-ROM for Pennsylvania. All of these digital products except the DOQ's for Lebanon and Clinton Counties were produced by the U.S. Geological Survey in cooperation with the Pennsylvania Geological Survey.

A DOQ is a digital raster image made by scanning an aerial photograph and removing the displacements caused by the terrain and the camera. The features on the rectified image are in their true geographic positions. The DOQ's produced for Pennsylvania are accurate at a scale of 1:12,000 and cover 3.75 minutes of latitude by 3.75 minutes of longitude (one quarter of the area covered by a standard 7.5-minute topographic quadrangle map). The file size of one DOQ can be up to 55 Mb. Each CD-ROM contains all of the individual DOQ's included in one county. The 10 counties currently available are shown on the location map on the back cover.

A DRG is a scanned color image of a paper copy of a U.S. Geological Survey 7.5-minute topographic quadrangle map (scale 1:24,000) that has been georeferenced (i.e., distortion has been removed) using the 2.5-minute ticks on the map for control. The scanned image has been converted to an 8-bit color TIFF (tagged image file format) file. The size of the files is typically between 5 and 15 Mb. DRG files are now available on CD-ROM for the five 1-degree by 1-degree areas (64-quadrangle blocks) shown on the back cover.

Because of the spatial accuracy of DOQ's and DRG's, they can be used as layers in geographic-information-system (GIS) applications and in other software applications that accept raster images. They may be used as foundation layers over which other digital data can be overlaid and manipulated, and also as reference layers for the revision and/or creation of other digital coverages.

The cost for each CD-ROM is $32.00, plus $3.50 for each order mailed, regardless of the quantity of discs in the order. Order from U.S. Geological Survey, Information Services, Box 25286, Denver, CO 80225, telephone 303-202-4700. Prepayment is required; please make checks payable to U.S. Geological Survey.
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IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC MAPPING
GROUNDWATER-RESOURCE MAPPING
EXPLANATION

Area (1° by 1° degree) for which digital raster graphics are available on CD-ROM (Scranton East area extends to 74°W longitude). Digital raster graphics for the remainder of the state are in progress.

County for which digital orthophotography is completed and available on CD-ROM

County for which digital orthophotography is currently in progress

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