



# REFERENCE MAPS

## TOPOGRAPHIC

Reference maps present a wide range of themes together on a map without strong emphasis on one over another. The goal of reference maps is to provide locational details for both casual map users and professionals. The largest scale reference maps often include details of topography, usually represented with contour lines. Topographic maps are produced as series at a variety of scales covering entire countries across the globe. In the United States, topographic series created by the U.S. Geological Survey (USGS) are available at 1:24,000, 1:100,000, and 1:250,000 scales (these may be downloaded from USGS at [www.store.usgs.gov/locator/](http://www.store.usgs.gov/locator/) or other Web services). Topographic maps from other countries have quite different designs. The Netherlands and Switzerland, for example, have distinctively different terrains, so their topographic maps emphasize different landforms. Land cover and water features are more prominent on the Dutch map, and mountain detail dominates the Swiss map.

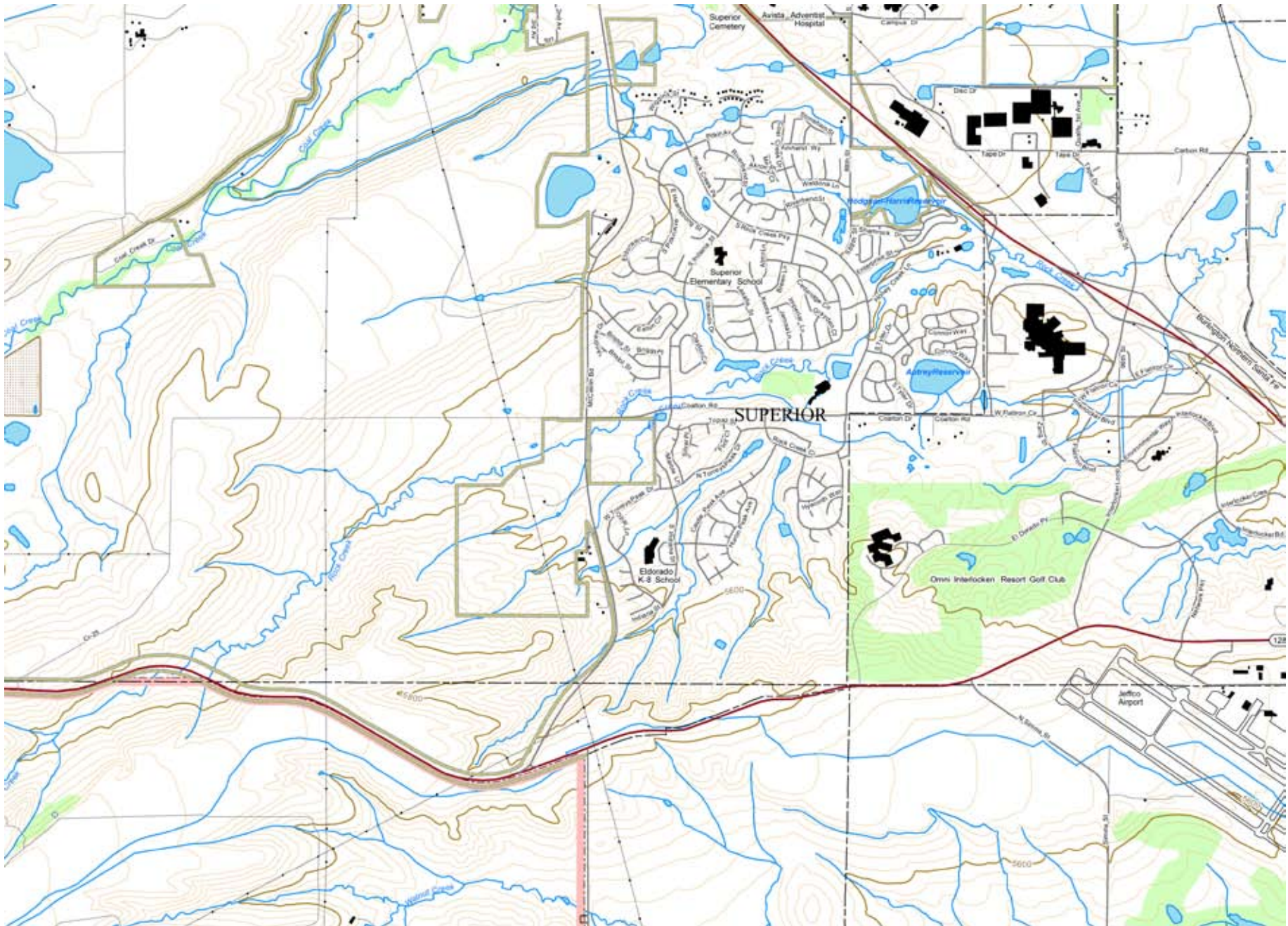
Many contemporary reference maps combine hillshading and elevation tints, rather than relying on contour lines to symbolize landforms. Hillshading techniques model the surface by rendering the hypothetical reflection of sunlight (often coming from the northwest) that illuminates a homogeneous surface (no rock colors or vegetation textures are displayed). Hillshading may be calculated using a digital elevation model (DEM), or hand drawn by interpreting contour lines. It produces a portrait that emphasizes the shape of the landforms. The effect has a variety of names with very similar meanings,

such as relief shading, analytical shaded relief, and terrain shading. Elevation tints, also called hypsometric tints, are often added to hillshading. They may be presented as continuous gradation through a series of colors or split into specific elevation ranges with each class bordered by contours and assigned a color. The combination of land shape and elevation gives a complete sense of the landscape. Flat landforms in a hillshade layer may be colored as a lowland or high plateau by the elevation tints, providing additional information to map readers. The general depth of a gorge and height of a mountain range are communicated through elevation tints.



















Terrain and physical features are a key element of some of the maps highlighted in this chapter, with complete labeling for hydrography, glaciers, valleys, ranges, and peaks. On others, physical features function more as supporting information to the political and cultural elements in the foreground, such as boundaries, transportation, cities, and points of interest. Features are generally categorized with serif fonts for physical features and sans serif fonts for human features in most of the maps presented in this chapter.

The chapter progresses from large-scale topographic maps, through country reference maps, to small-scale continent representations, and contains a wide variety of reference map styles that emphasize topography. Together these maps offer design ideas for a common map genre.

1.0 USGS DIGITAL TOPOGRAPHIC MAP





Legend			
	Buildings		Lakes
	Mines		Rivers and Streams
	County Boundary		Wells
	City Boundary		Contour Line, Index
	Small Parks		Contour Line
	Enhanced Reservation		Railroads
	Interstates		Local Roads
	U.S. and State Highways		Trails
	Pipeline		Transmission Line

Topographic map data at a scale of 1:24,000 for an area near Superior, Colorado, is shown with different visual emphases in four designs on the following pages. The original and black-and-white designs balance emphasis among features, and the other two designs place more emphasis on human boundaries or natural features.

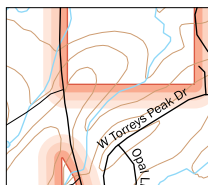
Courtesy of Parallel Incorporated and U.S. Geological Survey.



**ORIGINAL DESIGN (Pages 2 and 4)**

This map shows a prototype design by US Geological Survey (USGS) for *The National Map* using a limited set of digital data for contours, hydrography, transportation, boundaries, structures, and geographic names (prepared using data from local, state, and federal agencies). Index contours, streams, and pond outlines are bold elements in this design. Different dashed black line patterns distinguish line symbols for county, park, and enhanced reservation boundaries and for trails and pipelines. The gray band under the yellow dashed line of the city boundaries provides contrast for easy visibility and preserves a clean dash pattern when the line overlaps another dashed boundary. Gray local road lines are frequently broken by white halos on black labels, ensuring that labels are readable.

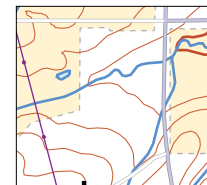
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**EMPHASIS ON BOUNDARIES (Page 4)**

A wider variety of boundary styles is shown with this design. Green dashes for county lines separate them from other boundaries. A fine red line details city boundaries and reddish tint bands distinguish city from noncity sides, adding clarity to an irregular boundary. A band of progressively finer diamond textures outline the interior side of the Rocky Flats Environmental Technology Site boundary at the lower left (in the enhanced reservation category). Road symbols are simplified to a hierarchy of widths of black lines and are broken less often by using tighter label halos. Water features are pushed into the background with lighter colors and thinner lines.

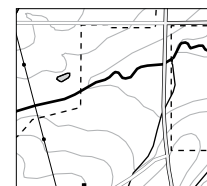
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**EMPHASIS ON NATURAL FEATURES (Page 5)**

In this design, contours are wider, more saturated brown lines that are labeled with greater frequency, and bold hydrography from the original design is repeated. This combination emphasizes natural features. The road network becomes a background element with a progression of purple to white cased lines for major roads to small rural lanes. These light roads allow labels to be placed on roads, but the trade-off is that the reader needs to look closely at the map to extract information about roads. The city boundary is a fine gray dash that would be barely visible, but it is assisted by a light fill outside urban areas to establish city limits behind the landscape information.

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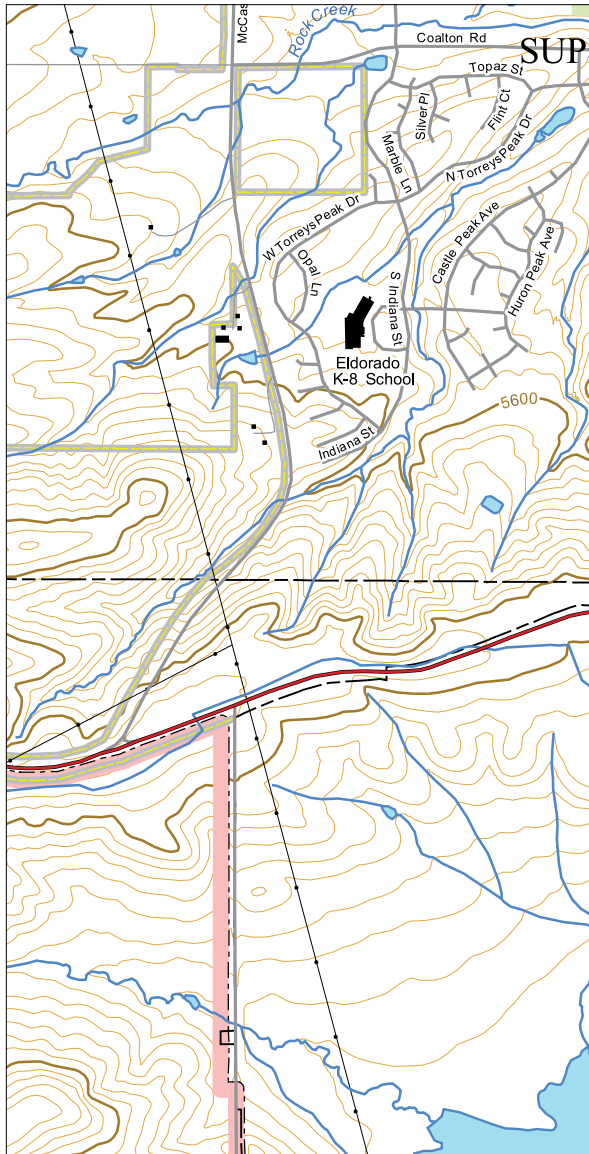
**BLACK-AND-WHITE DESIGN (Page 5)**





Road, contour, and boundary line weights are balanced in this design so one does not dominate the map. The streams fit better into the landscape because they are tapered; in other words, small tributaries are indicated by the thinnest lines, slightly thicker lines are used after tributaries join, and this progression continues, building wider lines with increases in stream flow. Gray is used for water body areas; gray inside cased roads distinguishes them from other fine black lines; large buildings are black; and contours lines are gray with wider index contours. Patterns are used for line dashes, but notice there are no patterned area fills, thereby preserving the readability of contour lines.

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REDESIGNS

IA ORIGINAL DESIGN

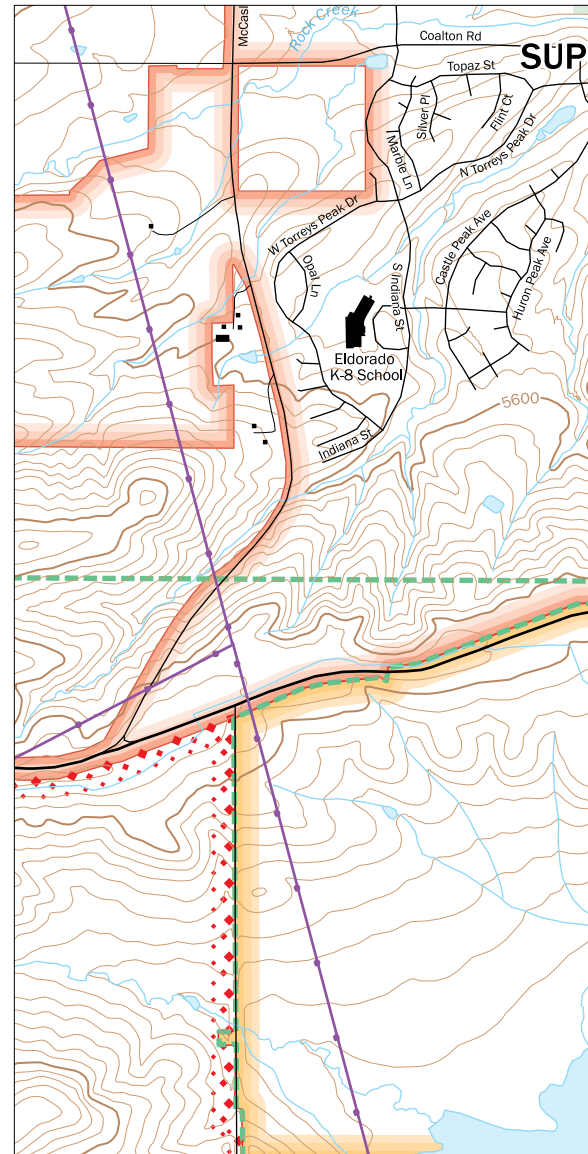






-  **CONTOURS**  
 Index: 1 pt, 33C 48M 100Y  
 12K, round join  
 Intermediate: 0.25 pt,  
 12C 34M 88Y, round join  
 Label: 6 pt, Arial,  
 33C 48M 100Y 12K  
 Halo: 1 pt, white
-  **ROADS**  
**Highways**  
 Line: 1 pt, 15C 100M 100Y  
 Casing: 1.5 pt, 100K  
**Major**  
 Line: 1.2 pt, 50K  
 Label: 5 pt, Arial, 100K  
 Halo: 1 pt, white  
**Minor**  
 Line: 0.5 pt, 50K
-  **BOUNDARIES**  
**Enhanced Reservation**  
 Line: 0.5 pt, 100K, dash  
 pattern 6/2/2/2 (dash/gap  
 in pts)  
 Offset band: 6 pt, 31M 15Y,  
 offset -3 pt  
**County**  
 Line: 0.75 pt, 100K, dash  
 pattern 17/2/5/2  
**City**  
 Line: 0.5 pt, 6C 96Y, dash  
 pattern 6/1/3/1  
 Casing: 3 pt, 30K  
 Label: 14 pt, Times Roman,  
 100K
-  **OTHER**  
**Water**  
 Fill: 34C 4Y  
 Line: 1 pt, 70C 40M, round  
 join  
 Label: 6 pt, Arial Italic,  
 80C 57M  
**Transmission line**  
 Line: 0.25 pt, 100K, circle  
 marker line pattern 1.5/28  
 (symbol size/spacing in pts)  
**Buildings**  
 Fill: 100K  
 Label: 6 pt, Arial, 100K

ArcMap Tips (see pages 161 to 167)

2 Multilayer line	5 Marker line
6 Offset line	40 Layer order

IB EMPHASIS ON BOUNDARIES

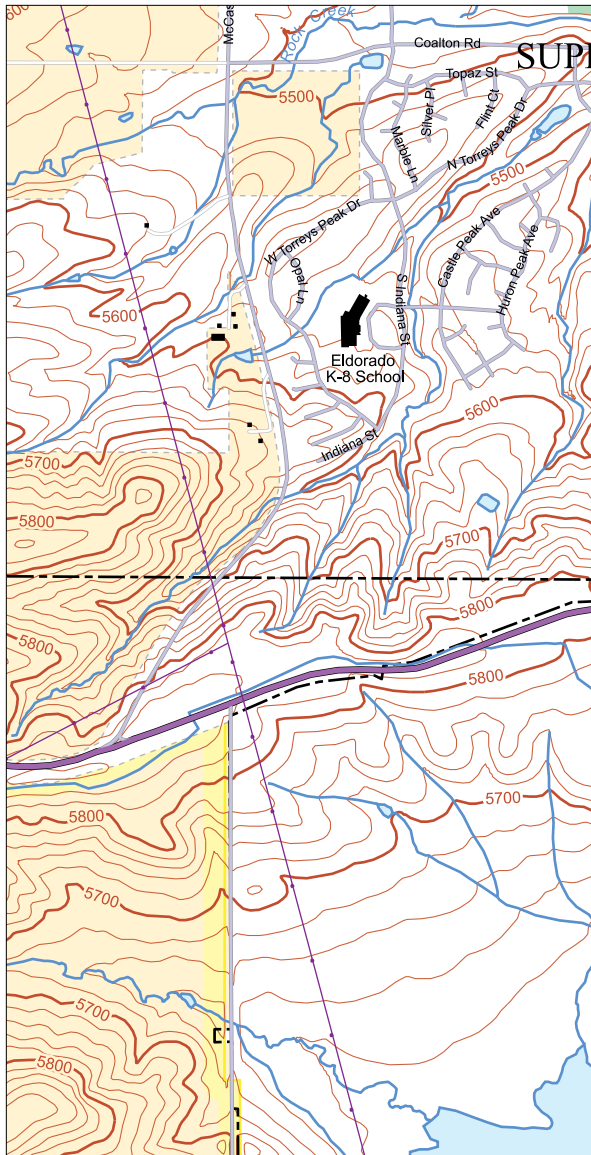


-  **CONTOURS**  
 Index: 0.75 pt, 30C 50M  
 70Y, round join  
 Intermediate: 0.25 pt,  
 20C 40M 60Y, round join  
 Label: 6 pt, Arial,  
 30C 50M 70Y  
 Halo: 1 pt, white
-  **ROADS**  
 All lines: round cap/join  
**Highways**  
 Line: 1 pt, 100K  
**Major**  
 Line: 0.5 pt, 100K  
 Label: 5 pt, Franklin Gothic  
 Book, 100K  
 Halo: 0.5 pt, white  
**Minor**  
 Line: 0.25 pt, 100K
-  **BOUNDARIES**  
**Enhanced Reservation**  
 Line: 1 pt, 100M 100Y,  
 three diamond marker line  
 patterns: 3/14; 2/14 offset  
 2.5 pt; 1.5/7 offset 6.5 pt  
**County**  
 Line: 2 pt, 60C 60Y, dash  
 pattern 5/2  
**City**  
 Line: 0.5 pt, 10C 80M 80Y,  
 round join  
 Offset bands: 3 pt,  
 40M 40Y; 6 pt, 20M 20Y;  
 9 pt, 10M 10Y  
 Offset bands: 3 pt,  
 20M 55Y; 6 pt, 15M 40Y;  
 9 pt, 10M 25Y  
 Label: 14 pt, Franklin  
 Gothic Medium, 100K  
 Halo: 1 pt, white
-  **OTHER**  
**Water**  
 Fill: 15C  
 Line: 0.5 pt, 40C, round  
 join  
 Label: 6 pt, Franklin Gothic  
 Book Italic, 60C 10M  
**Transmission line**  
 Line: 1 pt, 50C 80M, circle  
 marker line pattern 2.5/28  
**Buildings**  
 Fill: 100K  
 Label: 6 pt, Franklin Gothic  
 Book, 100K

ArcMap Tips

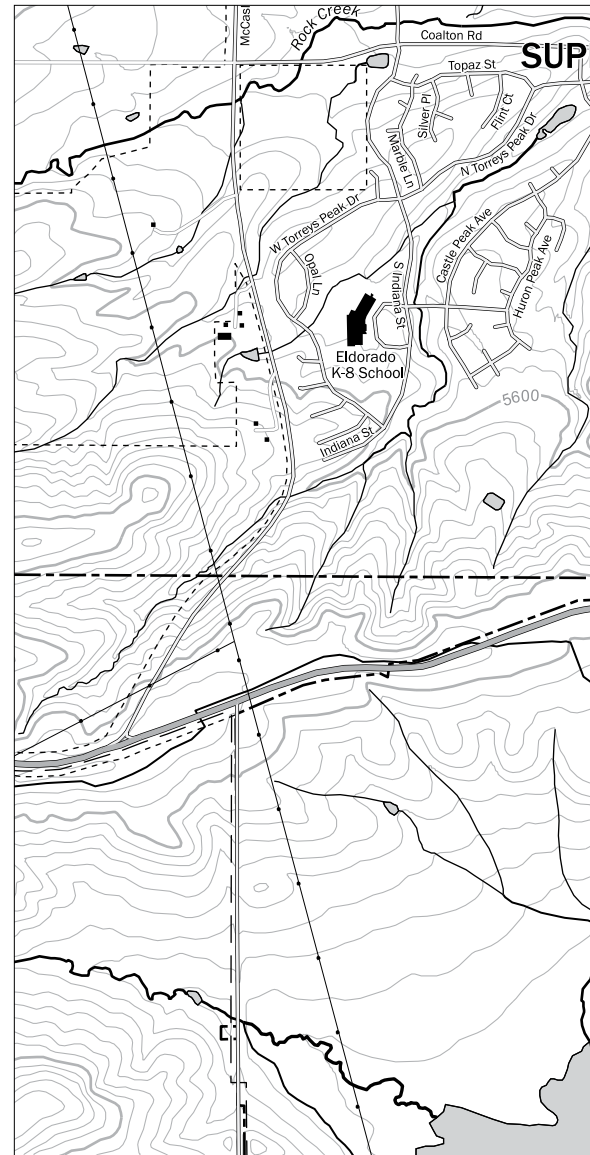
6 Offset line	10 Tint bands
12 Index contours	34 Maplex settings

IC EMPHASIS ON NATURAL FEATURES



- CONTOURS**  
 Index: 1 pt, 25C 85M 100Y, round join  
 Intermediate: 0.4 pt, 20C 75M 90Y, round join  
 Label: 6 pt, Arial, 25C 85M 100Y  
 Halo: 1 pt
- ROADS**  
 All lines: round cap/join  
**Highways**  
 Line: 2 pt, 40C 70M  
 Casing: 2.5 pt, 100K  
**Major**  
 Line: 1 pt, 20C 20M  
 Casing: 1.5 pt, 50K  
 Label: 5 pt, Arial, 100K  
**Minor**  
 Line: 1 pt, white  
 Casing: 1.5 pt, 30K
- BOUNDARIES**  
**Enhanced Reservation**  
 Line: 1 pt, 4C 90Y  
 Offset band: 8 pt, 40Y, offset -4 pt  
**County**  
 Line: 1 pt, 100K, dash pattern 10/2/3/2  
**City**  
 Fill: 3M 20Y (outside city)  
 Line: 0.5 pt, 35K, dash pattern 2/2  
 Label: 14 pt, Times Roman, 100K
- OTHER**  
**Water**  
 Fill: 15C  
 Line: 0.5 pt, 65C 35M, round join  
 Label: 6 pt, Arial Italic, 65C 35M  
**Transmission line**  
 Line: 0.5 pt, 60C 100M, circle marker line pattern 1/28  
**Buildings**  
 Fill: 100K  
 Label: 6 pt, Arial, 100K

ID BLACK-AND-WHITE DESIGN



- CONTOURS**  
 Index: 1 pt, 35K, round join  
 Intermediate: 0.4 pt, 35K, round join  
 Label: 6 pt, Arial, 50K  
 Halo: 1 pt, white
- ROADS**  
 All lines: round cap/join  
**Highways**  
 Line: 2 pt, 35K  
 Casing: 2.5 pt, 100K  
**Major**  
 Line: 1 pt, 5K, round cap/join  
 Casing: 1.5 pt, 100K, round cap/join  
 Label: 5 pt, Franklin Gothic Book, 100K  
 Halo: 0.5 pt, white  
**Minor**  
 Line: 1 pt, white, round cap/join  
 Casing: 1.5 pt, 50K
- BOUNDARIES**  
**Enhanced Reservation**  
 Line: 0.5 pt, 100K, dash pattern 10/5  
**County**  
 Line: 1 pt, 100K, dash pattern 10/2/3/2  
**City**  
 Line: 0.5 pt, 100K, dash pattern 2/2  
 Label: 14 pt, Franklin Gothic Medium, 100K
- OTHER**  
**Water**  
 Fill: 20K  
 Lines (four classes): 0.5 pt, 0.75 pt, 1 pt, 1.25 pt, 100K  
 Label: 6 pt, Franklin Gothic Book Italic, 100K  
**Transmission line**  
 Line: 0.25 pt, 100K, circle marker line pattern 2/28  
**Buildings**  
 Fill: 100K  
 Label: 6 pt, Franklin Gothic Book, 100K

ArcMap Tips

1 Dashed line	3 Cased line
10 Tint bands	28 Variable-depth masking

ArcMap Tips

4 Merge/overpass	14 Tapered lines
34 Maplex settings	37 Curved labels

1.1 USGS TOPOGRAPHIC MAPS, 1980 AND 1990

USGS topographic maps have varied in design over the years. This example shows most of Dayton, Tennessee, with the southeast corner of the Morgan Springs quadrangle positioned above the northeast corner of the Graysville quadrangle. The maps show content field checked in 1972, with a 1980 photorevision for the upper half and 1990 limited updating on the lower half. These are the most current printed topo sheets at 1:24,000 for this area. Printed USGS topo quads are on average over twenty years old, and data currency efforts now focus on digital products. The fonts USGS uses for newer topographic print products (lower half) are bolder with a large x-height to aid reproduction. Other symbols are also more simply designed. For example, roads rely less on cased lines and cross-hatch patterns are not used in large buildings. U.S. topographic maps may be printed with five spot colors (green, blue, red, black, brown inks) plus purple for the photorevisions. This simplicity of production maintains the detail of fine contours, for example (because brown is not produced by registering cyan, magenta, and yellow inks during the press run), but it requires a five- or six-color press, which may increase costs.

Courtesy of U.S. Geological Survey.

BOUNDARIES	
National	
State or territorial	
County or equivalent	
Civil township or equivalent	
Incorporated city or equivalent	
Federally administered park, reservation, or monument (external)	
Federally administered park, reservation, or monument (internal)	
State forest, park, reservation, or monument and large county park	
Forest Service administrative area*	
Forest Service ranger district*	
National Forest System land status, Forest Service lands*	
National Forest System land status, non-Forest Service lands*	
Small park (county or city)	
BUILDINGS AND RELATED FEATURES	
Building	
School; house of worship	
Athletic field	
Built-up area	
Forest headquarters*	

CONTOURS	
Topographic	
Index	
Approximate or indefinite	
Intermediate	
Approximate or indefinite	
Supplementary	
Depression	
Cut	
Fill	
Continental divide	
Bathymetric	
Index***	
Intermediate***	
Index primary***	
Primary***	
Supplementary***	
RAILROADS AND RELATED FEATURES	
Standard gauge railroad, single track	
Standard gauge railroad, multiple track	
Narrow gauge railroad, single track	

RIVERS, LAKES, AND CANALS	
Perennial stream	
Perennial river	
Intermittent stream	
Intermittent river	
Disappearing stream	
Falls, small	
Falls, large	
Rapids, small	
Perennial lake/pond	
Intermittent lake/pond	
Dry lake/pond	
Narrow wash	
Wide wash	
Canal, flume, or aqueduct with lock	
Elevated aqueduct, flume, or conduit	
Aqueduct tunnel	
Water well, geyser, fumarole, or mud pot	
Spring or seep	

ROADS AND RELATED FEATURES	
Please note: Roads on Provisional-edition maps are not classified as primary, secondary, or light duty. These roads are all classified as improved roads and are symbolized the same as light duty roads.	
Primary highway	
Secondary highway	
Light duty road	
Light duty road, paved*	
Light duty road, gravel*	
Light duty road, dirt*	
Light duty road, unspecified*	
Unimproved road	
Unimproved road*	
4WD road	
4WD road*	
Trail	
Highway or road with median strip	
Highway or road under construction	
Highway or road underpass; overpass	
Highway or road bridge; drawbridge	
Highway or road tunnel	
Road block, berm, or barrier*	
Gate on road*	

SUBMERGED AREAS AND BOGS	
Marsh or swamp	
Submerged marsh or swamp	
Wooded marsh or swamp	
Submerged wooded marsh or swamp	
Land subject to inundation	

SURFACE FEATURES	
Levee	
Sand or mud	
Disturbed surface	
Gravel beach or glacial moraine	
Tailings pond	

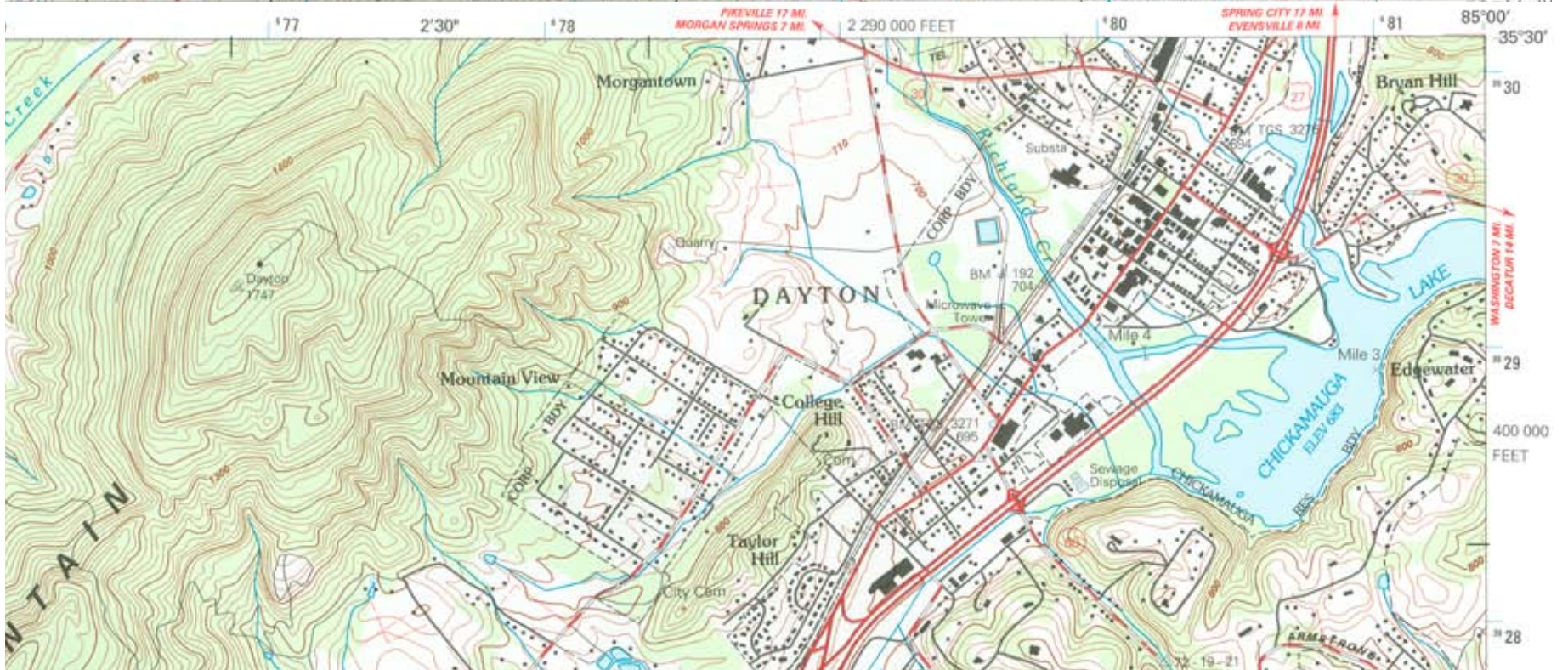
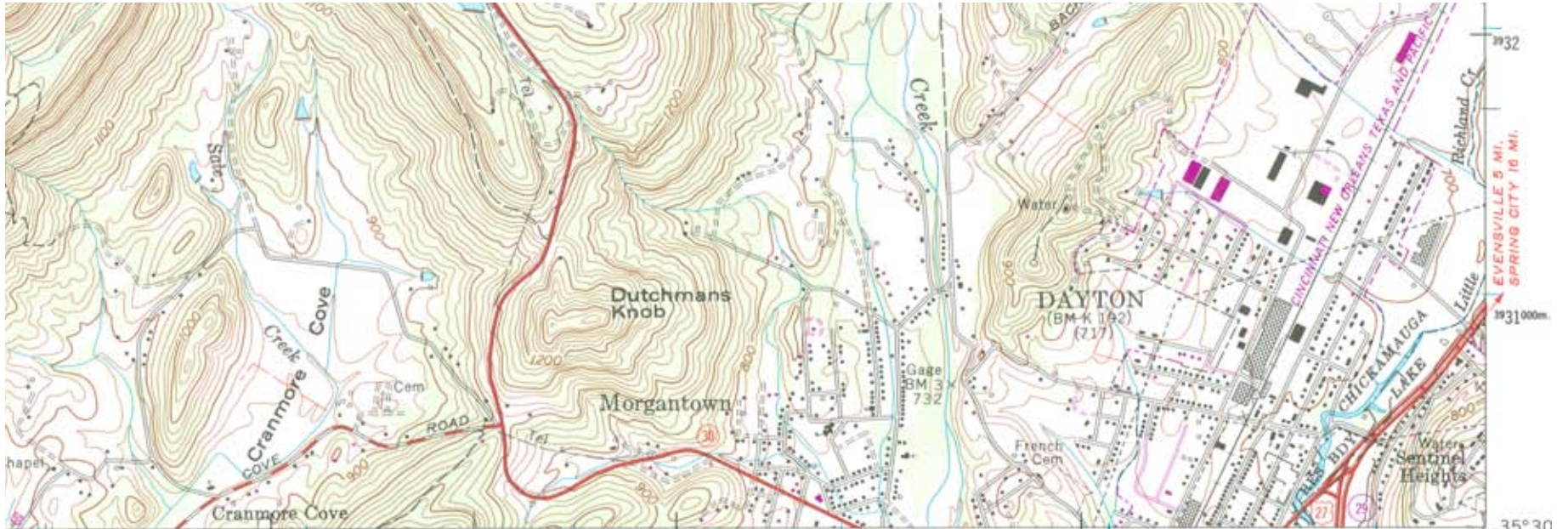
TRANSMISSION LINES AND PIPELINES	
Power transmission line; pole; tower	
Telephone line	
Aboveground pipeline	
Underground pipeline	

VEGETATION	
Woodland	
Shrubland	
Orchard	
Vineyard	
Mangrove	

\* USGS-USDA Forest Service Single-Edition Quadrangle maps only. In August 1993, the U.S. Geological Survey and the U.S. Department of Agriculture's Forest Service signed an Interagency Agreement to begin a single-edition joint mapping program. This agreement established the coordination for producing and maintaining single-edition primary series topographic maps for quadrangles containing National Forest System lands. The joint mapping program eliminates duplication of effort by the agencies and results in a more frequent revision cycle for quadrangles containing

See the full legend at [erg.usgs.gov/isb/pubs/booklets/symbols/topomapsymbols.pdf](http://erg.usgs.gov/isb/pubs/booklets/symbols/topomapsymbols.pdf).







### 1.3 SWISS TOPOGRAPHIC MAP

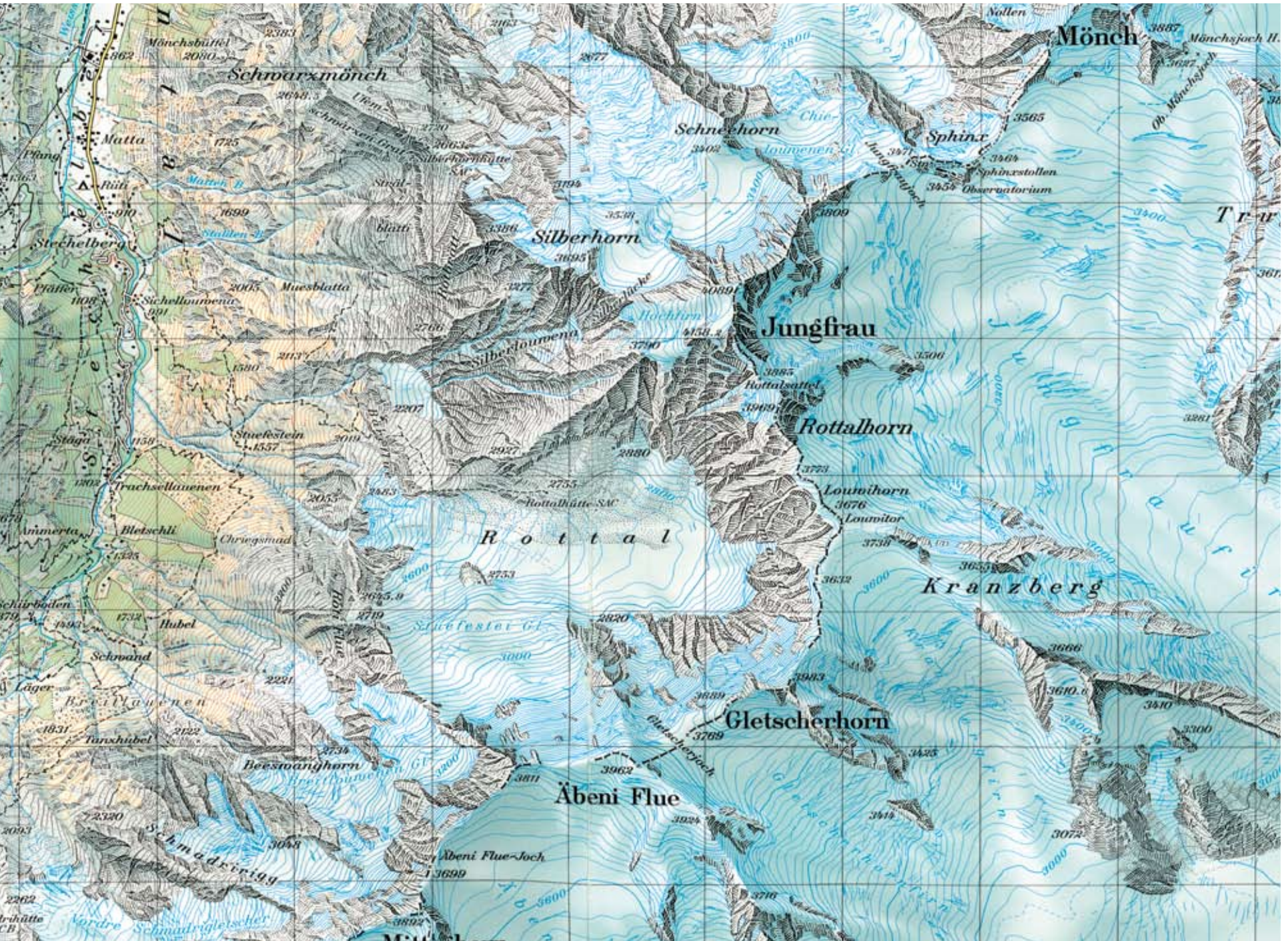
Swiss topographic maps present the country's high-relief landscape with beautifully rendered detail. Hand-drawn cliffs and rocks are placed where slopes are too rugged to describe with contours. Light hillshading is augmented with nuanced use of blue hues on shadowed slopes and warm yellow and peach hues highlighting sunlit slopes. The forms of glaciated surfaces are represented with blue contours and crevasse drawings, striking against a cold white background. Fine, mostly italic labels lie on the surface, elegantly spaced across features. Similarly, buildings, roads, and trails are characterized by thin or small black symbols that do not compete with the topography details, which are the main message of the map. Labels are carefully fit to the terrain with attention to the placement of each letter. For example, the letters of the Stechelberg label running vertically up the valley are each placed between building clusters and labels for towns and spot height.

Reproduced by permission of swisstopo (BA071473).

Roads, tracks		1:50 000		Railways		1:50 000		Individual symbols		1:50 000	
Highway (divided lanes)				Railway station, tracks				House			
Junction	under construction			Platform roof				Ruin			
Rest area				Stop with separate track				Remote inn			
Parking				Stop without separate track				Greenhouse			
2nd cl. highway (undivided lanes)	under construction			Normal gauge railway: multiple tracks	Bridge			Allotment (garden)			
Exit / Access				Normal gauge railway: single track	Bridge			Church			
Trunk road	Main connecting road			Narrow gauge railway: multiple tracks	Bridge			Cemetery			
1st cl. road (at least 6 m wide)	conspicuous bridge			Narrow gauge, rack, cable railway: single track	Bridge			Cooling tower			
2nd cl. road (at least 4 m wide)	conspicuous bridge			Freight or nostalgic railway	Bridge			Chimney-stack			
Suburban road (at least 4 m wide)	conspicuous bridge			Railway out of service	Bridge			Lookout tower			
3rd cl. road (at least 2.8 m wide)	covered bridge			Intercommunal tramway with stop	Bridge			Radio transmitter			
4th cl., narrow road (at least 1.8 m)	Bridge			Industrial track	Bridge			large antenna			
5th cl., path, trail, bicycle path	Footbridge, catwalk			Tunnels				small antenna			
6th cl., footpath	Passenger ferry, attached free			Galleries				Camp site			
Traces, mountain passage	on glacier			Aerial cable way, chairlift with intermediate station	Pylon			Sports ground			
Barrier, traffic ban				Goods lift	Pylon			Rifle range			
conspicuous roundabout	Parking lot			Ski lift				Race course (horses)			
Level crossings								Border of an area			
Underpasses								Ski jump			
Overpasses								Wall			
Tunnels	Ventilation shaft							Avalanche barricade			
Gallerie								erratic bloc			
Parklane	Tank road										
Traces of historic road											
Airport, hard surface runway											
Airfield, grass strip											
<b>Boundaries</b>											
National boundary with numbered markers				<b>Topography</b>				<b>Trigonometric points, spot heights</b>			
Cantonal boundary with markers				Contour lines	earth, scree / shingle, ice / lake		20 m	Trigonometric points 1st to 3rd order and LV95			2022.6
District boundary with markers				Index contours	earth, scree / shingle, ice / lake		200 m	Spot height			1587 713
Municipal boundary with markers				Intermediate contours	earth, scree / shingle, ice / lake		10 m	Index contour			800
Boundary for National Park or protected area				Small depression	Doline			Lake level			419 387
				Escarpment, earth	Escarpment, stone						
				Cutting	Embankment			<b>Vegetation</b>			
				Earth slip	Gravel pit			Forest, defined outline	undefined outline		
				Clay pit	Quarry			Scattered forest	isolated tree / group of trees		
				Rock	Scree			Scrub	Hedge		
				Glacier	Moraine			Orchard	Tree nursery		
								Vineyard			









### 1.9 ARCTIC CONSERVATION AREA MAP

This map emphasizes the lack of land at the Arctic Pole by showing the form of the ocean floor in the region rather than the ice cap. A thin two-tone shadow line along the coasts pulls the land above the water, and green-brown hypsometric tints provide a strong hue contrast with the blue progression for bathymetric tints. The landform colors provide a dark background to contrast with white areas representing permanent ice on land. International boundaries in white also contrast with the landform colors. Shaded relief combines with the elevation and depth colors for a fuller representation of form both above and below sea level. The map provides a small-scale reference to physical features within the area of concern for the Conservation of Arctic Flora and Fauna (CAFF) working group of the Arctic Council. The boundary of this area is represented with a bold green outline and a wide gradient from white to transparent inward from the boundary line. This gradient lightens areas at the inner edge of the area CAFF addresses, producing an appearance of illumination.





Courtesy of Hugo Ahlenius, UNEP/GRID-Arendal.








# ArcMap TIPS

These tips are suited for people who are experienced ArcGIS users and are comfortable navigating the ArcMap application in particular. They do not offer full instructions but rather pointers and keywords that help users discover parts of the software that can be used to accomplish cartographic goals. The instructions are for versions 9.2 or higher.

LINES				
1 Dashed line	<ul style="list-style-type: none"> <li>Symbol Selector &gt; Properties &gt; Symbol Property Editor &gt; Type: Cartographic Line Symbol &gt; Template tab &gt; drag and click template to create dash pattern</li> <li>Use Representations* to better control dashed lines: Stroke tab &gt; Endings to constrain dash behavior at line ends.</li> <li>Representations &gt; Geometric effect (+) &gt; Cut Curve to control dashes at line corners and ends. Use control points to ensure dashes are placed over corners for clarity where line changes direction</li> <li>ArcToolbox &gt; Data management Tools &gt; Generalization &gt; Dissolve to combine line segments to avoid unnecessary stops and restarts in a continuing dash pattern (dissolve on the field being symbolized)</li> </ul>			
	1C	5A	6A	6B
				
* Right-click the layer name in the table of contents and choose Convert Symbolology to Representation. Only available with ArcEditor and ArcInfo license levels.				

2 Multilayer line	<ul style="list-style-type: none"> <li>Symbol Property Editor &gt; Type: Cartographic Line Symbol &gt; add layers for multilayer line effect (+ at bottom left) &gt; adjust layer order using arrow buttons and set properties for each layer</li> <li>A multilayer line that includes a solid line below a dash line protects two dashed lines from combining with each other to create an inconsistent pattern (such as overlaid dashes from the boundaries of two adjacent cities)</li> </ul>			
	1A	2B	2D	
				
	Two layers: dash and solid thicker line	Two layers: hash and wider line	Three layers: center line, fill line, and wider case	
3 Cased line	<p>A cased line combines a thinner “fill” line overlaying a thicker line in a contrasting color that forms the case (an “outline” around the fill line)</p> <ul style="list-style-type: none"> <li>Symbol Property Editor &gt; Type: Cartographic Line Symbol &gt; create two layers &gt; adjust order, width, and color</li> <li>Lock the case line layer to allow quicker changes to just the fill line color</li> </ul>			
	1C	5D		
	