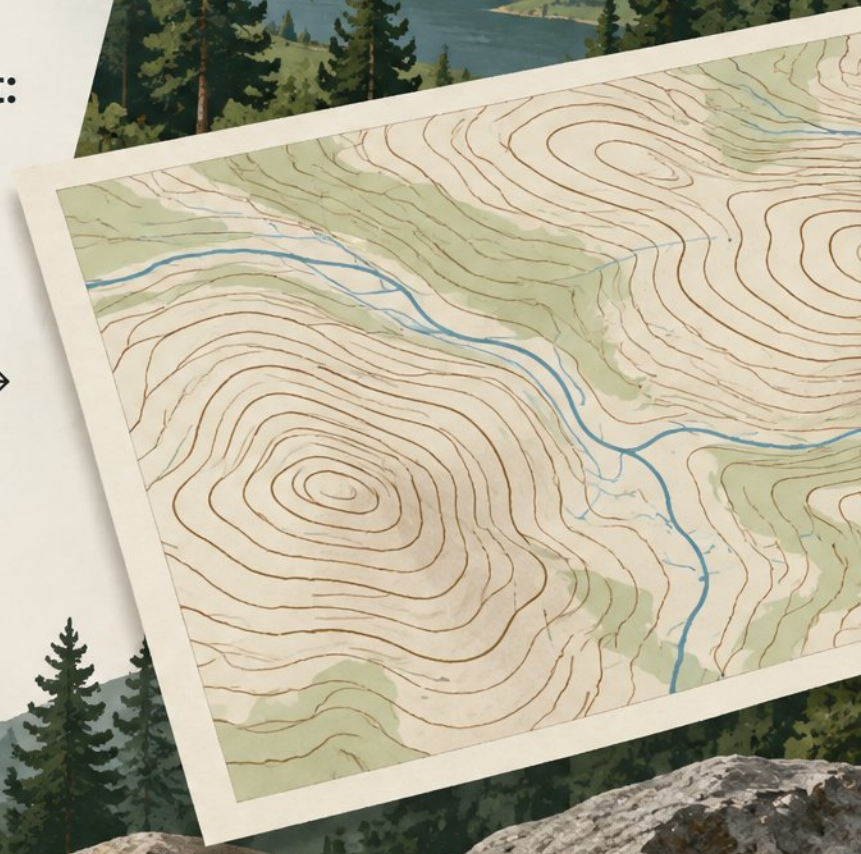
Reading Topographic Maps: Contours and Landforms

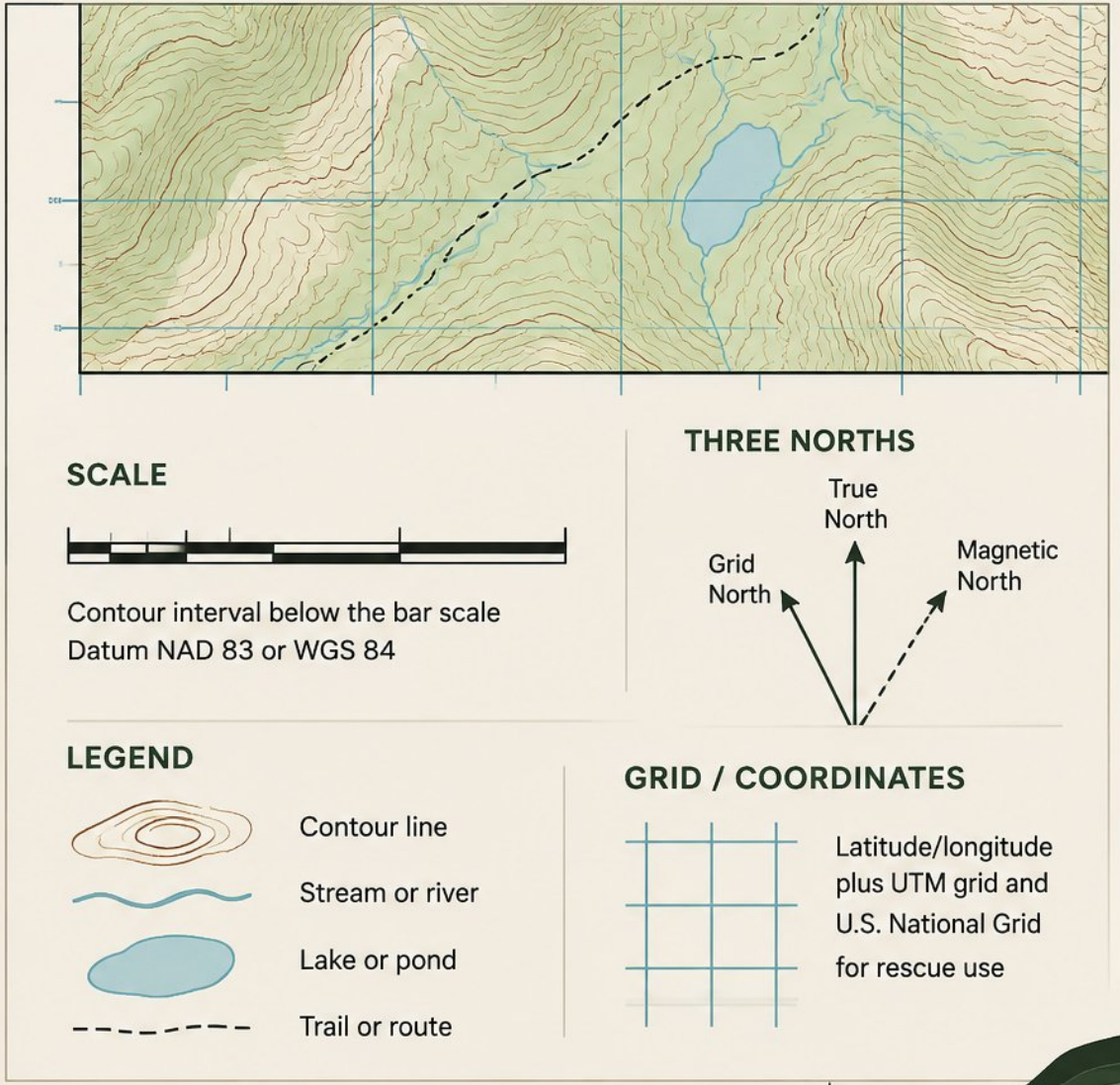
- **Purpose:** translate contour lines into a clear three-dimensional picture of the ground
- **Topo maps show what road maps omit:** elevation, slope, landform shape, drainage, and vegetation
- **Roadmap:** map anatomy → contour rules → 3D visualization → landforms → steep terrain → route planning
- **Outcome:** given any contour patch, describe steepness, slope direction, landform, and a sensible route





Map Anatomy: Scale, Legend, Grid, and North

- **Scale:** US Topo 1:24,000 means 1 cm on the map equals 240 m on the ground
- **Marginalia:** contour interval below the bar scale; datum NAD 83 or WGS 84
- **Coordinates:** latitude/longitude plus UTM grid and U.S. National Grid for rescue use
- **Three norths:** true, grid, and magnetic; magnetic declination shifts over time
- Use a current NOAA or BGS calculator, not a declination value printed on an old map



Contour Lines: The Rules That Never Change

- A contour joins points of equal elevation above a datum such as mean sea level
- Contours are brown; heavier index contours are labeled with their elevation
- Contour interval varies: about 10 feet in flat terrain, 100 feet or more in mountains
- Cardinal rules: contours never cross, they close or run off the map edge
- Elevation steps one interval between adjacent lines; spacing shows steepness
- Tightly packed contours mean steep ground; wide spacing means gentle slope
- Hachured depression contours point inward to lower ground; cut and fill marks show artificial change

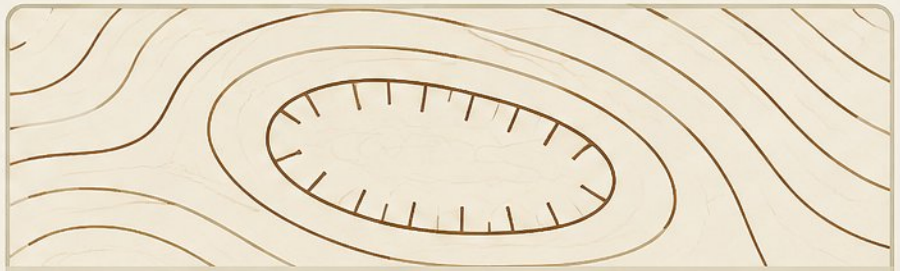


Tightly packed contours mean steep ground

Wide spacing means gentle slope



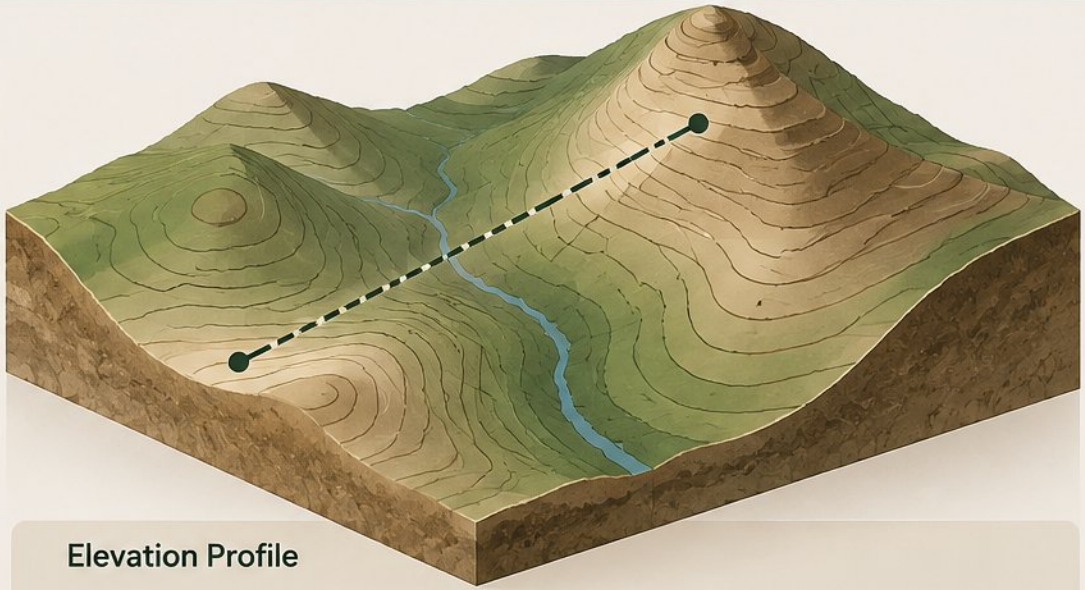
Heavier index contours are labeled with their elevation

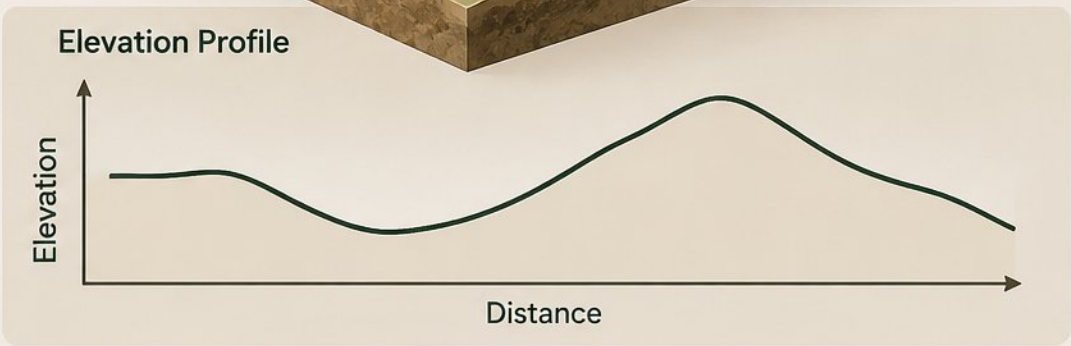


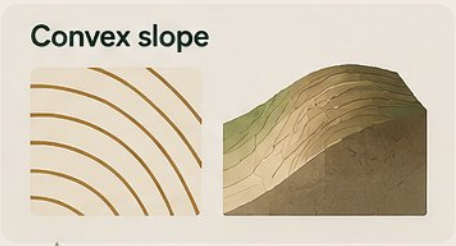
Hachured depression contours point inward to lower ground

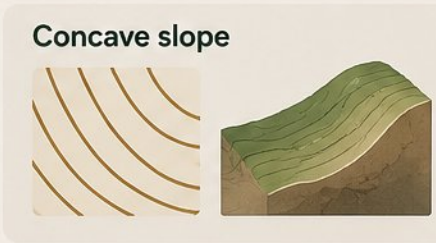
From 2D Lines to 3D Ground: Mental Visualization

- Convex slope: contours get closer downhill
- Concave slope: contours get closer uphill
- Planar slope: contours are evenly spaced
- Ridges and valleys form the terrain's skeleton—trace them first
- Elevation profile: plot distance against elevation along a line
- Trap: a V pointing toward you is a valley, not a ridge





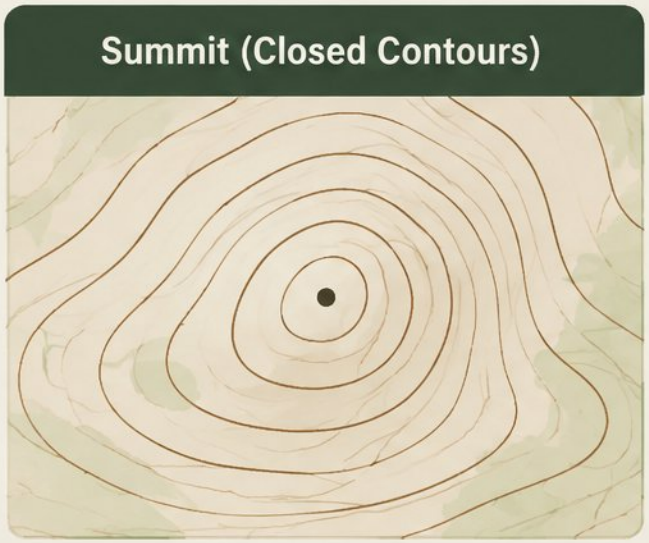




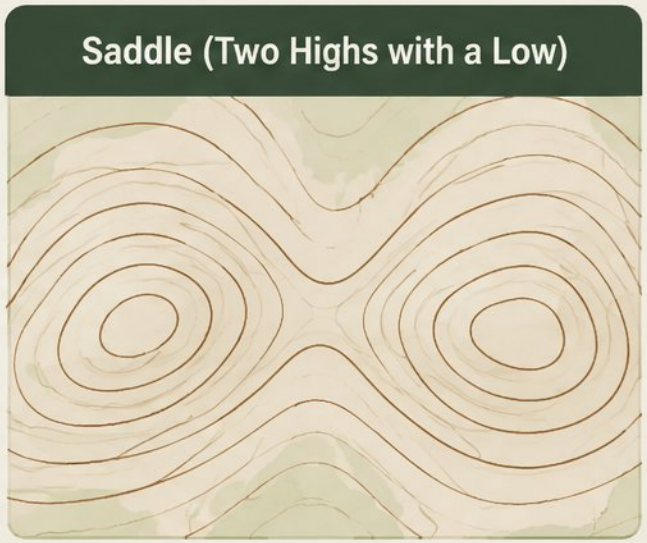




Landform Signatures: Summits, Basins, and Saddles







- Summits and knobs: closed contours rising inward, often marked with spot elevation
- Basins and depressions: closed contours falling inward, hachures point to lower ground
- Saddles and passes: two highs with a low between — natural crossings and campsites
- Read a saddle on the ground: higher points both sides, gentle gradients through the pass
- Contours remain brown; index contours are heavier and labeled with elevation

Ridges, Spurs, Valleys, and Gullies

- Ridges and spurs: V- or U-shaped contours point downhill; the crest runs through the V's tip
- Valleys and gullies: V shapes point uphill, often aligned with a blue stream
- Water crosses contours perpendicularly and flows toward the V's point—so valley Vs point upslope
- To tell a spur from a gully, check where the V attaches and whether contours rise or fall inward





Cliffs, Canyons, and Special Terrain

- Cliffs and escarpments: contours merge or coincide; hachures mark the break of slope
- Canyons: tightly packed contours plus drainage lines — the interval can't capture near-vertical ground
- Glacial and karst: moraines, cirques, and hachured sinkholes
- Overlays that reshape reading: cuts and embankments, shaded relief, woodland tint, land-cover polygons
- Contours never cross except at overhanging cliffs; check the legend for rock-face symbols



Cliffs and escarpments



Canyons



Glacial and karst



Hachured sinkhole (karst)



Cuts and embankments



Shaded relief



Woodland tint and land-cover polygons

Terrain Reasoning for Route Planning

Ridge travel: visibility and navigation handrails, but exposed to weather

Valley travel: sheltered, but wet, brushy, and flood-prone

Naismith's Rule: 1 hour per 5 km flat, plus 1 hour per 600 m ascent — a minimum baseline

Rough ground, off-track navigation, and heavy packs add 5–20% or more to moving time

Contour-read hazards: steep drop-offs, avalanche runouts, flood-prone bottoms, pinch points



Handrails, Catching Features, and Attack Points

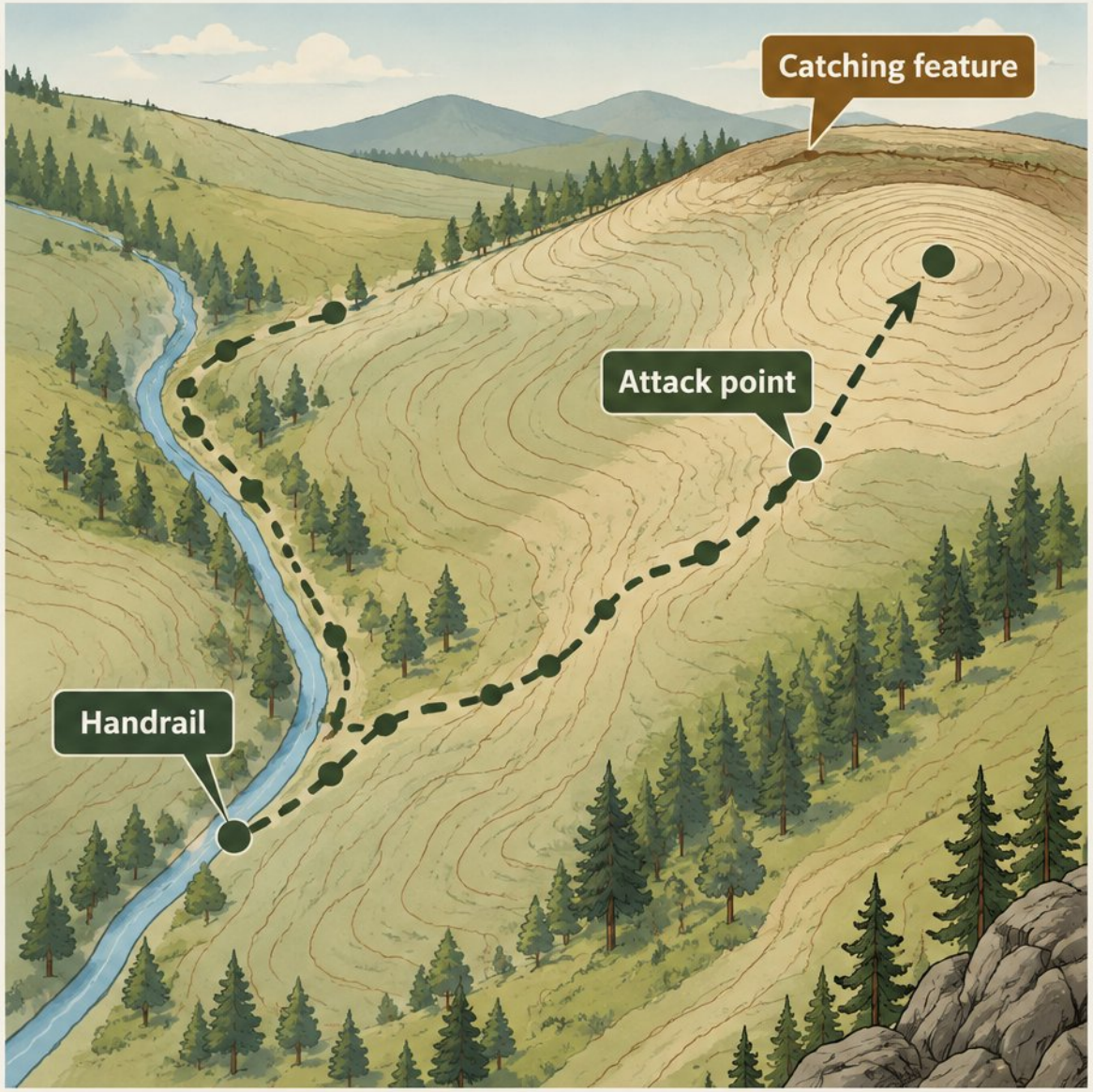
Handrail: a linear feature (ridge, stream, trail) that guides direction

Catching feature: a backstop behind the target that signals overshoot

Attack point: an easy-to-reach spot for a short, deliberate final bearing

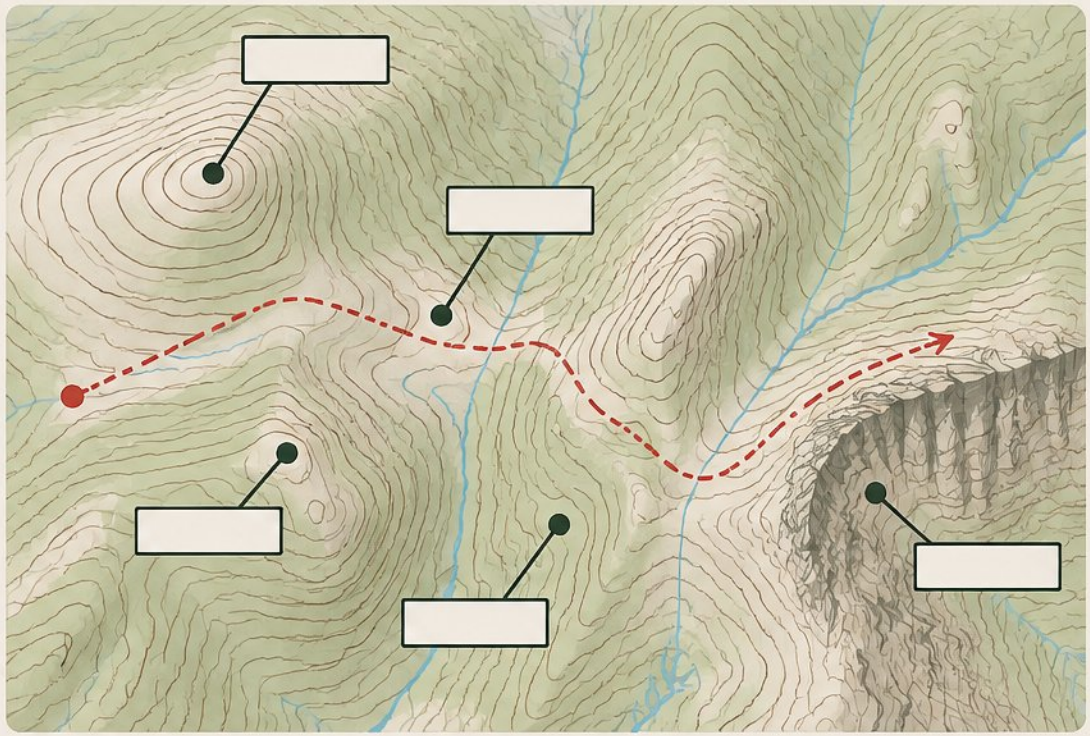
Combine with contours: choose a walkable line, not a map-straight line

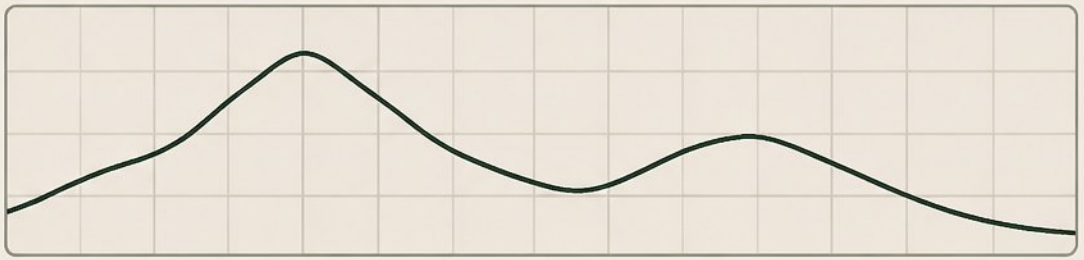
Contours confirm slope, so the handrail matches real terrain



Practice Lab: Read the Terrain, Tell the Story

- Guided exercise: name summit, saddle, spur, valley, and cliff features; describe steepness
- Sketch an elevation profile along a marked line; check each contour crossing
- Draw a route with rationale: handrails, catching features, and steep pitches to avoid
- Peer review of common misreadings, then a pre-trip self-check checklist





Reading the Terrain Under Pressure: A Scenario Walkthrough



- Scenario: visibility drops on a ridge with spur and valley contours
- Compass corrected for declination establishes direction
- Ridge crest becomes a handrail; saddle and stream are catching features
- Compare direct descent with longer contour-following route
- Estimate time with Naismith plus terrain multiplier, then debrief
- Contour interpretation, not GPS alone, drives the decision

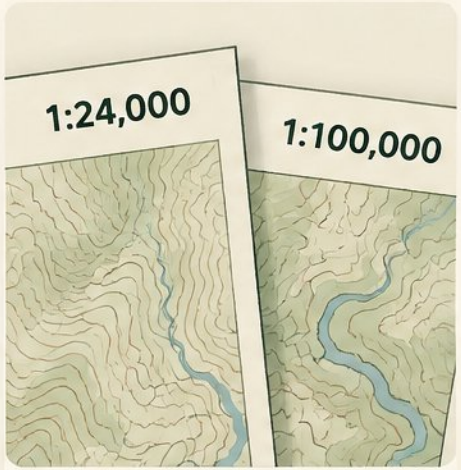
Common Pitfalls and How to Avoid Them



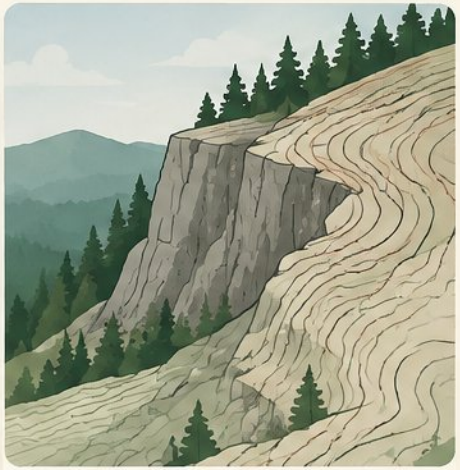
Out-of-date maps: US Topo revised on a three-year cycle; check the generation date



Stale declination: use current WMM2025 (valid through 2029), not old map values



Don't mix scales or contour intervals between 1:24,000 and 1:100,000 maps



Contours don't show everything: cliffs, dense vegetation, and new construction may be missing

Quick Reference: Contour Rules and Landform Signatures

Key Contour Rules

- Contour rules: equal elevation, never cross, spacing = steepness



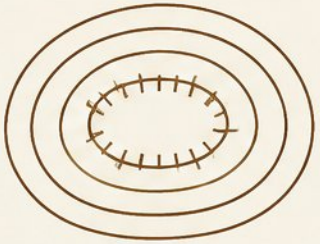
- Vs point uphill; hachures mark depressions



Landform Signatures



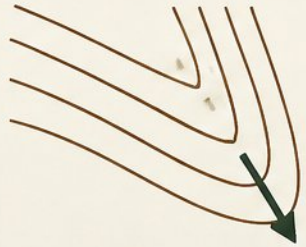
Summit rings rise inward



Basin rings fall inward



Saddle = two highs with a low between



Spur points downhill

Terrain Planning Checklist

- Check scale, interval, declination, handrails, catching features, escape route

Free Maps

- Free maps: topoView, National Map Downloader, USGS Store, topoBuilder

Before You Go

- Verify the map's publish or revision date before you go

Next Steps: Practice Resources and Further Learning



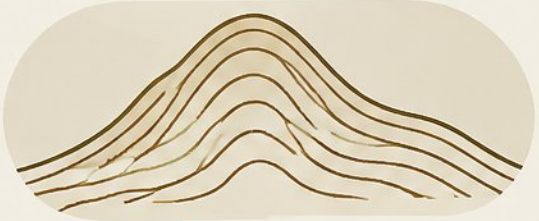
- Free practice sources: topoView, The National Map Downloader, USGS Store Map Locator



- topoBuilder creates free custom OnDemand Topos centered on your local hills



- Habit: read a familiar hill's contours, then compare map to ground



- Slope from spacing, landform from signature, route from reasoning



- Always confirm with a current map and current declination

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