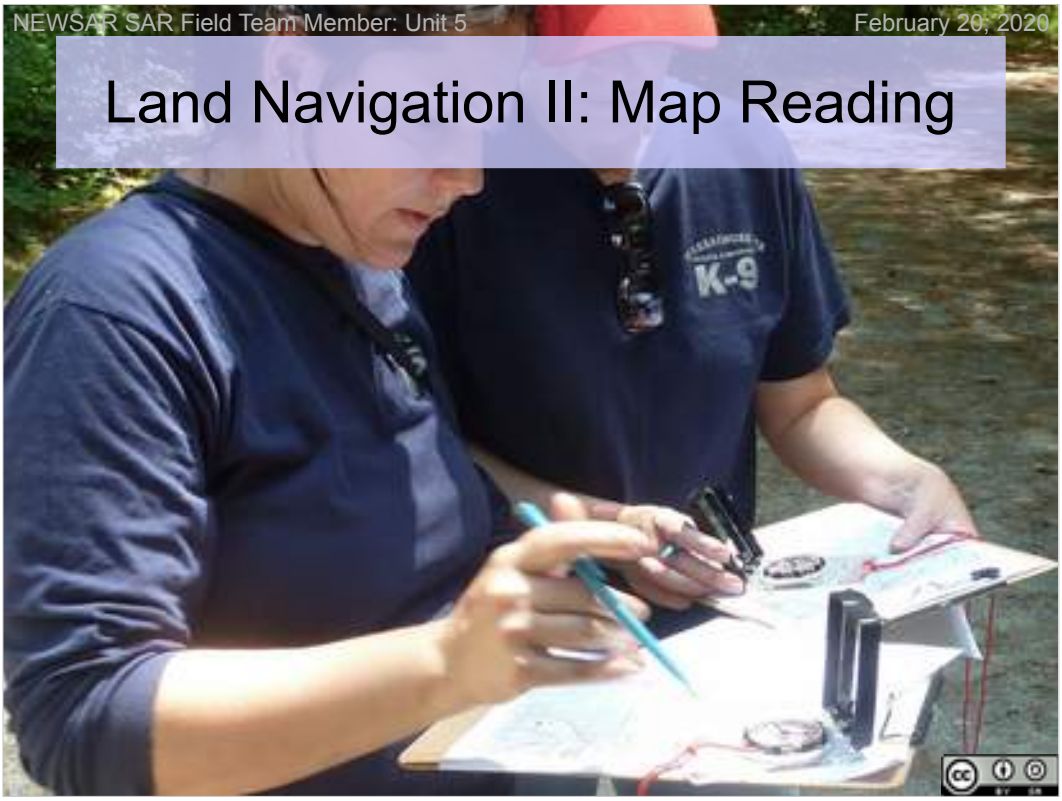

Unit 5: Land Navigation II, Map Reading
Date Last Updated February 20, 2020

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Map and Air Photo

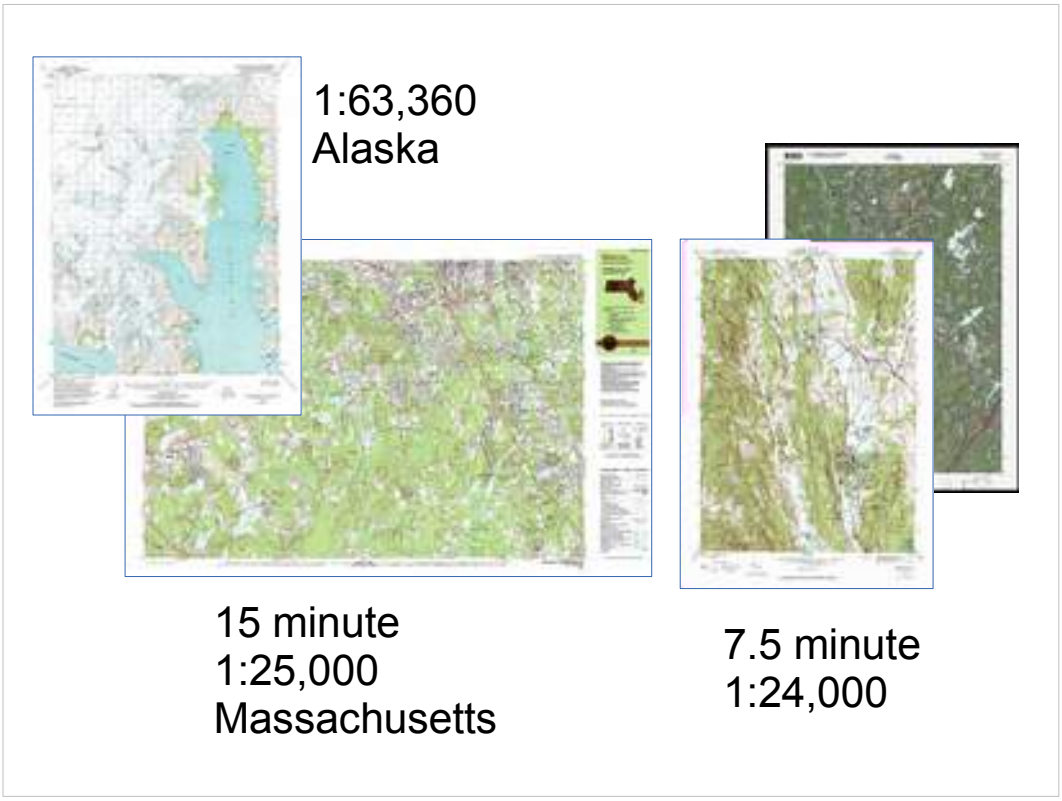
Teaching map reading used to be simple, all about learning to read topographic maps.

No longer true. There are all kinds of map and GIS products readily available in SAR – including air photos and satellite imagery.

Learning to work with all kinds of cartographic products is important, as is understanding what you can get from one sort that you can't get from another.

What can we see in the map?

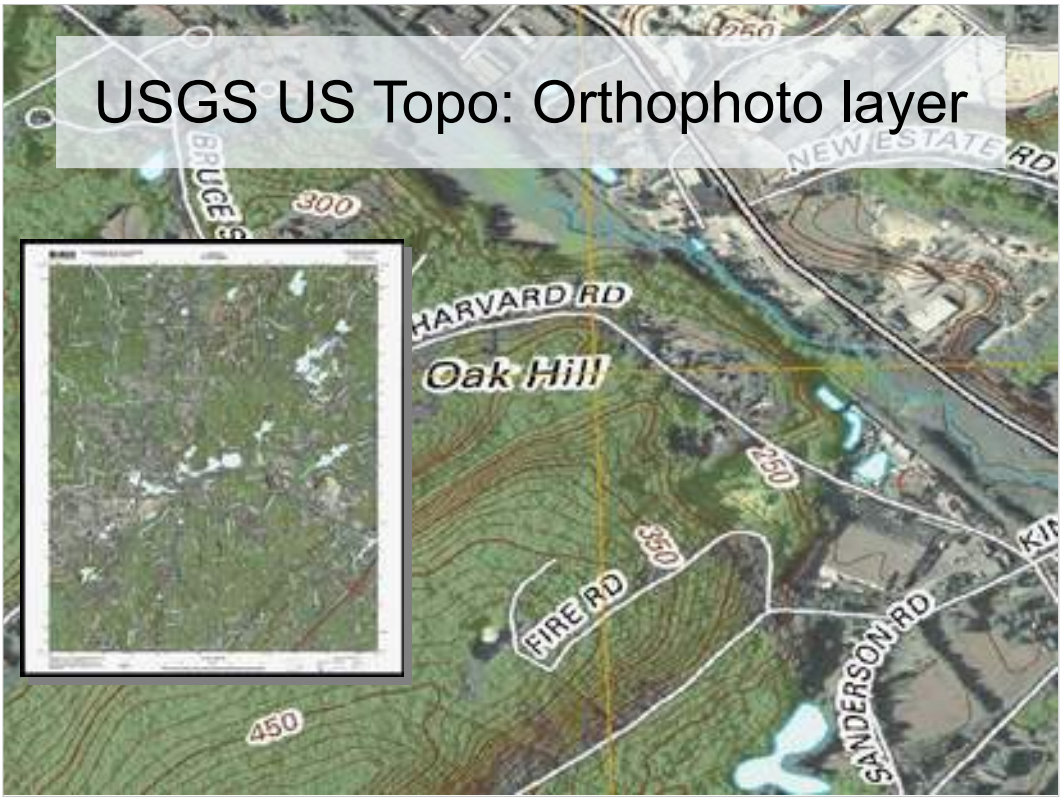
What can we see in the air photo?



Most of the US is covered by USGS 7.5 minute 1:24,000 scale maps: Topo quads.

Alaska is covered by a 1:63,000 series (big state, larger number, less detail).

In the 1980s and 1990s MA was covered by folded 15 minute 1:25,000 scale maps. Slightly different scale than the rest of the country.



The USGS has switched from producing topographic maps to producing 7.5 minute 1:24,000 scale US Topo products created automatically from GIS products without artistic input or ground truthing. These are distributed as GeoPDF files, and include an orthophoto layer – rectified to the map air photos, and have other layers with topographic contours, roads, and a few other map symbols printed on them. Lack some notable features of historical topographic maps including features that are very important for SAR such as boundaries, schools, churches, trails, occupied and unoccupied structures, etc.

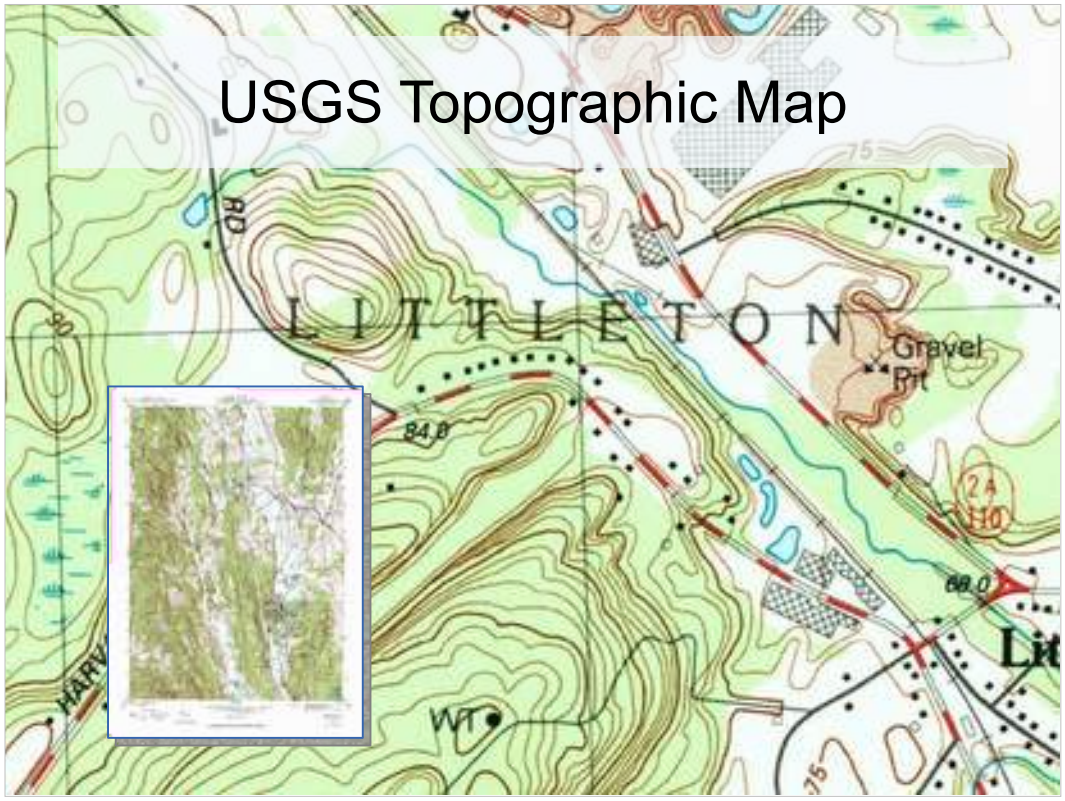
Much more current (updated on a 3 year cycle), and easier to keep current, than the topo quads, but not as abstract and require more photointerpretation.

So let's walk through some differences.

Here's part of an orthophoto quad of Littleton, MA

We can see oak hill, and in the center of the map, the long narrow valley cut into it (Tophet chasm, name isn't on the map).

We can identify built up areas, road,s open ground, wooded areas, a stream, some ponds, etc.



Here's the same area on a topographic map.

Abstraction, showing roads (of different types), railroad, structues (at the time the map was made), a gravel pit, streams, ponds, wetlands, wooded and open ground, etc.

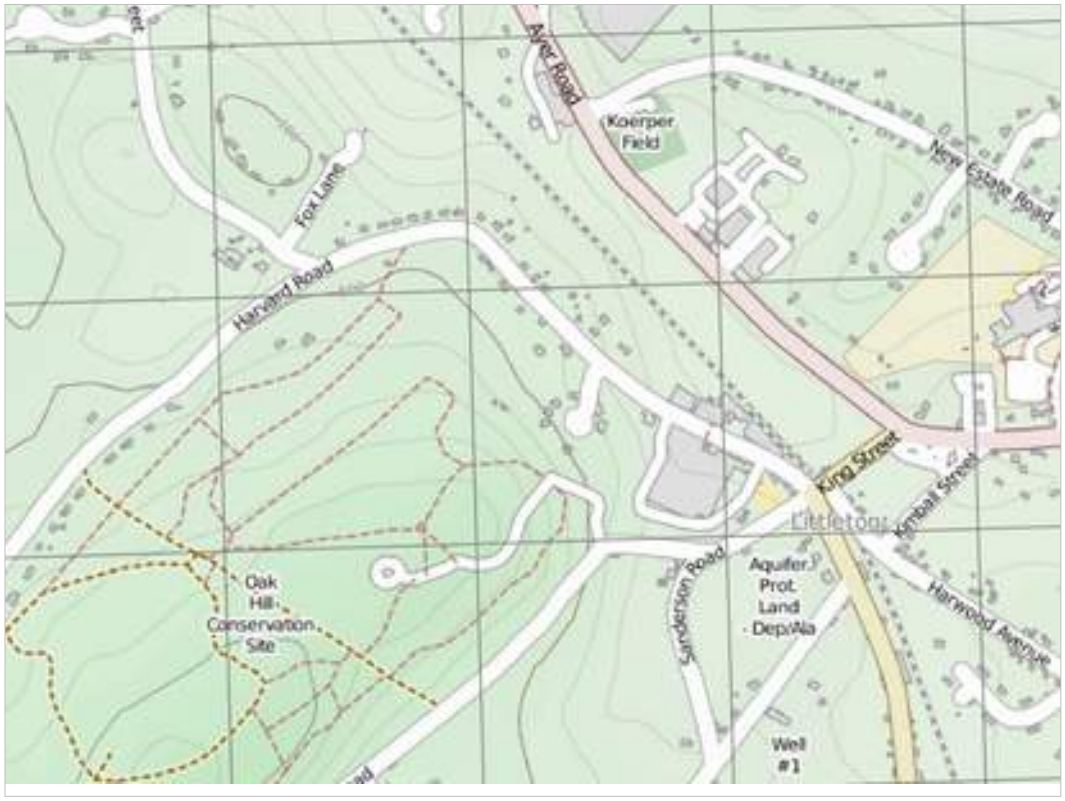
Tophet chasm is still evident.

Here's an Open Street Map rendering of the same area.

Open Street map is a global map that anyone can contribute to. Upload GPS traces, and then mark them up as roads, trails, railways, etc. Also draws in other public domain data sources (here MA GIS's structures and a global topography data set).

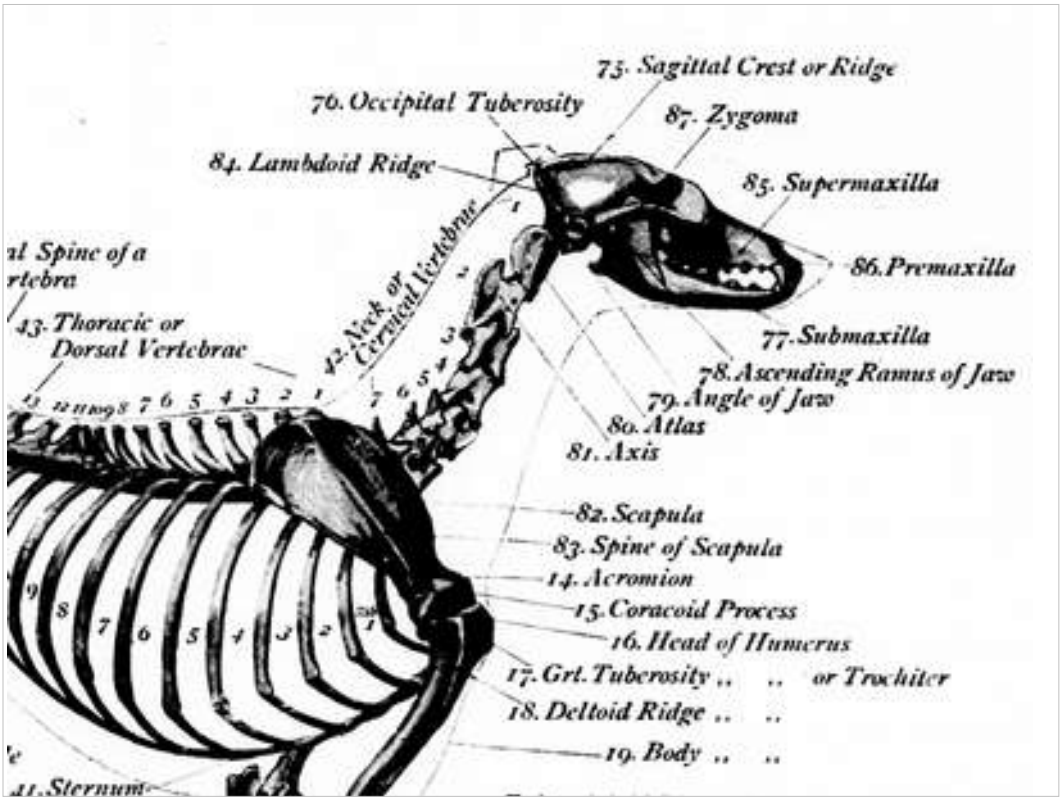
Oak hill is a conservation area – the trails have been mapped and contributed to Open Street Map.

Nice abstraction of roads, buildings, trails, railroads.



Where's Tophet chasm?

As of this rendering, the topography layer isn't good enough quality to see it (there's a bit on USGS maps – complies with national map accuracy standards that isn't necessarily met with Open Street Map, though information there can be very current and accurate and detailed, it may not be).



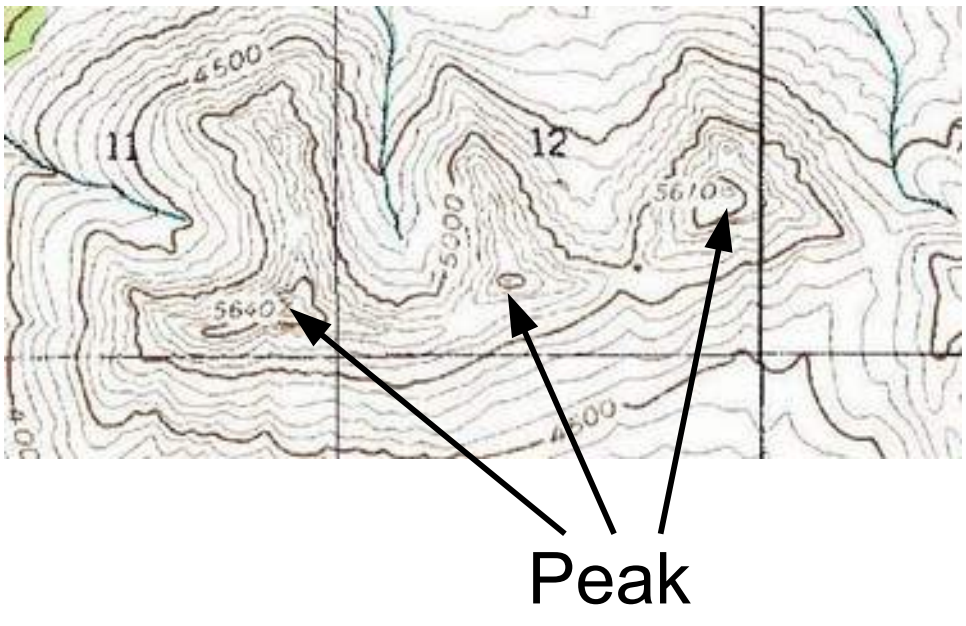
When we study anatomy, we put names on things to help us see, recognized, and observe them.

Terrain Features on Topographic Maps

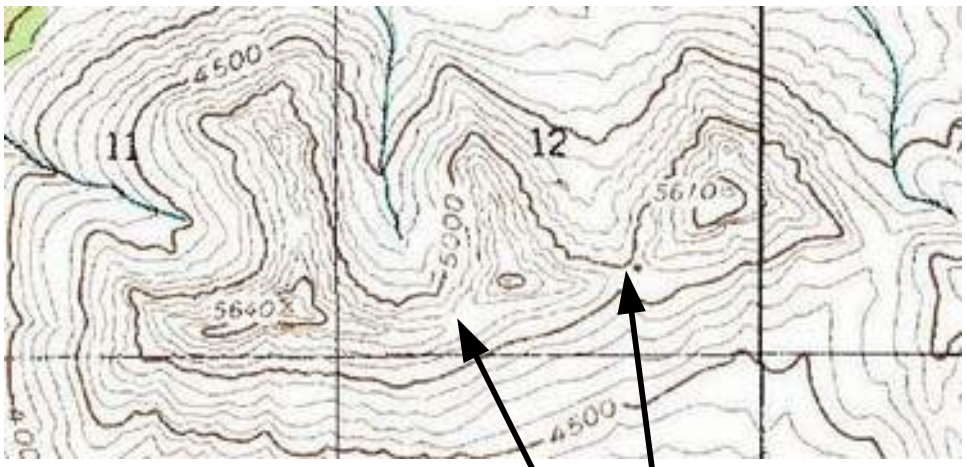
- Depression
- Cut
- Fill
- Hill
- Valley
- Ridge
- Saddle
- Draw
- Spur
- Cliff

Same thing with topography.

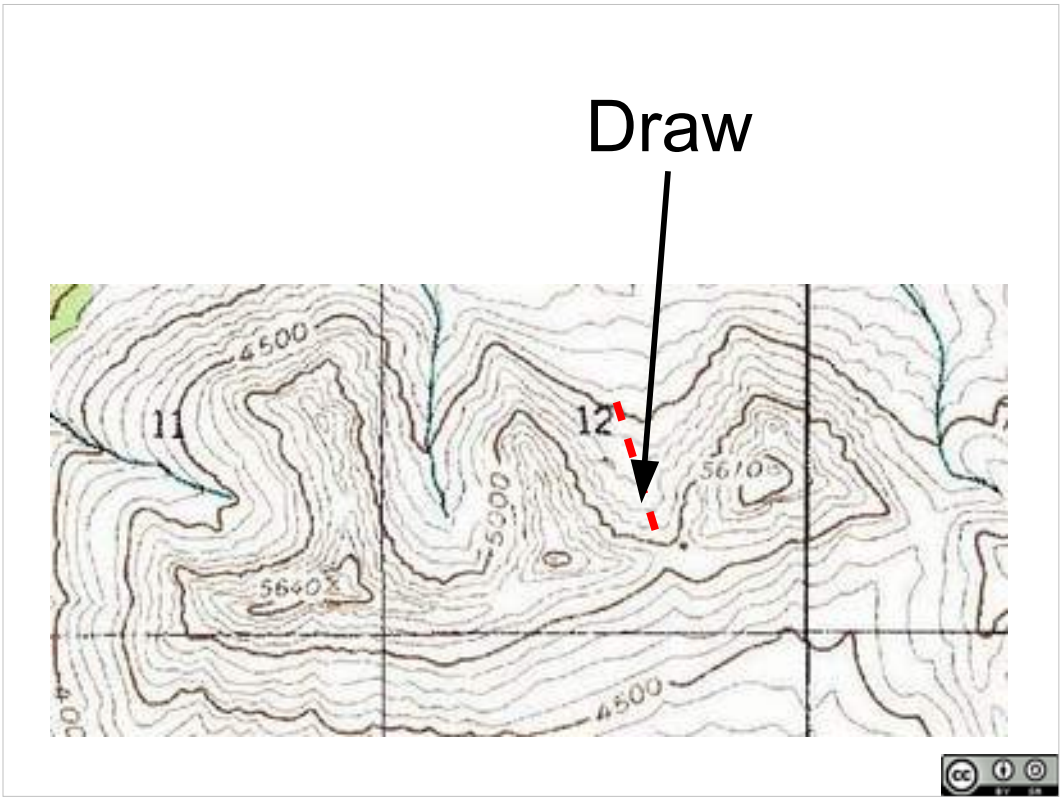
Putting names onto things can help us observe them. So, let's put some names to some terrain features.



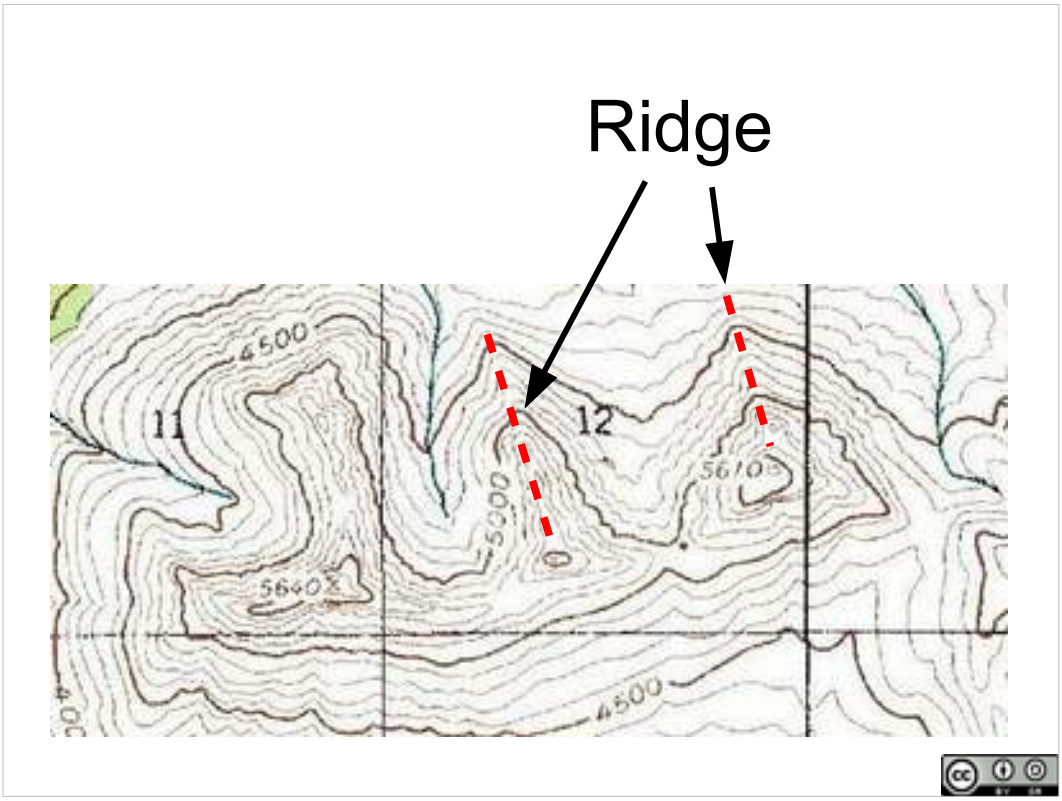
We've got peaks



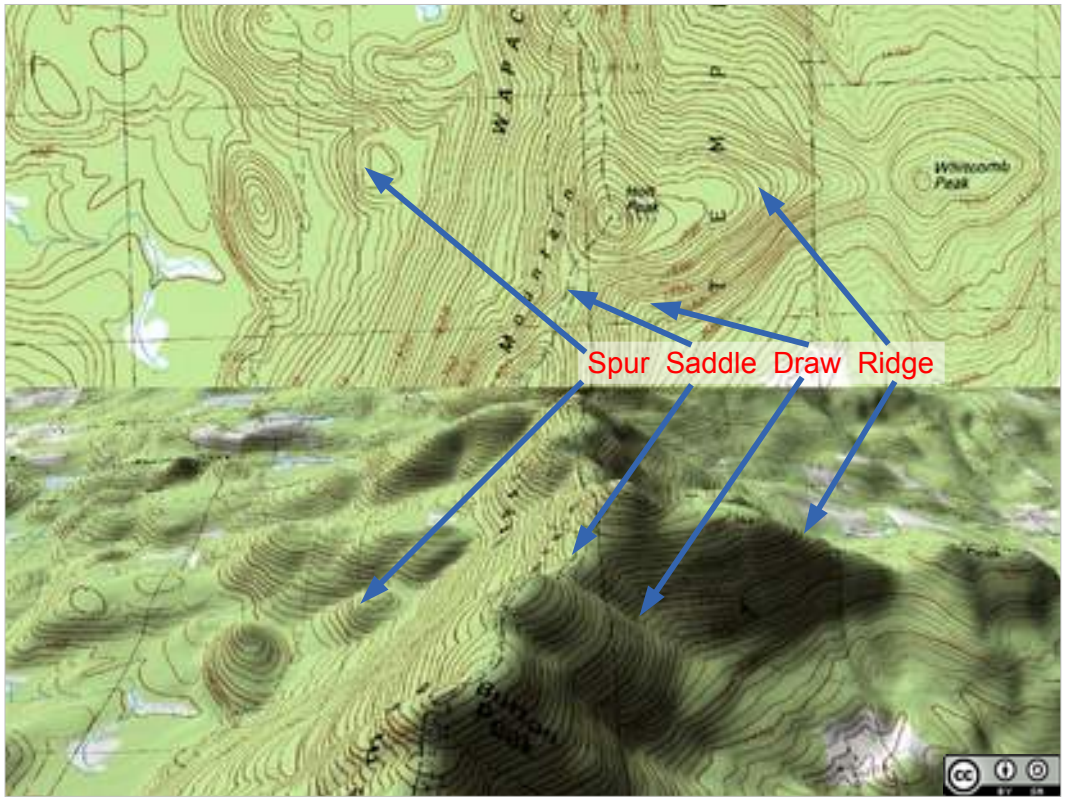
And saddles – things you could sit on with legs dangling down on each side and a high point infront and behind you.



Sitting in the saddle, your leg goes down a draw.



Between two ridges



Saddle, Draw, and Ridge on a topographic map, and a perspective view.

Also a spur – a side peak part way up a slope.

Now, let's start looking at some air photos.

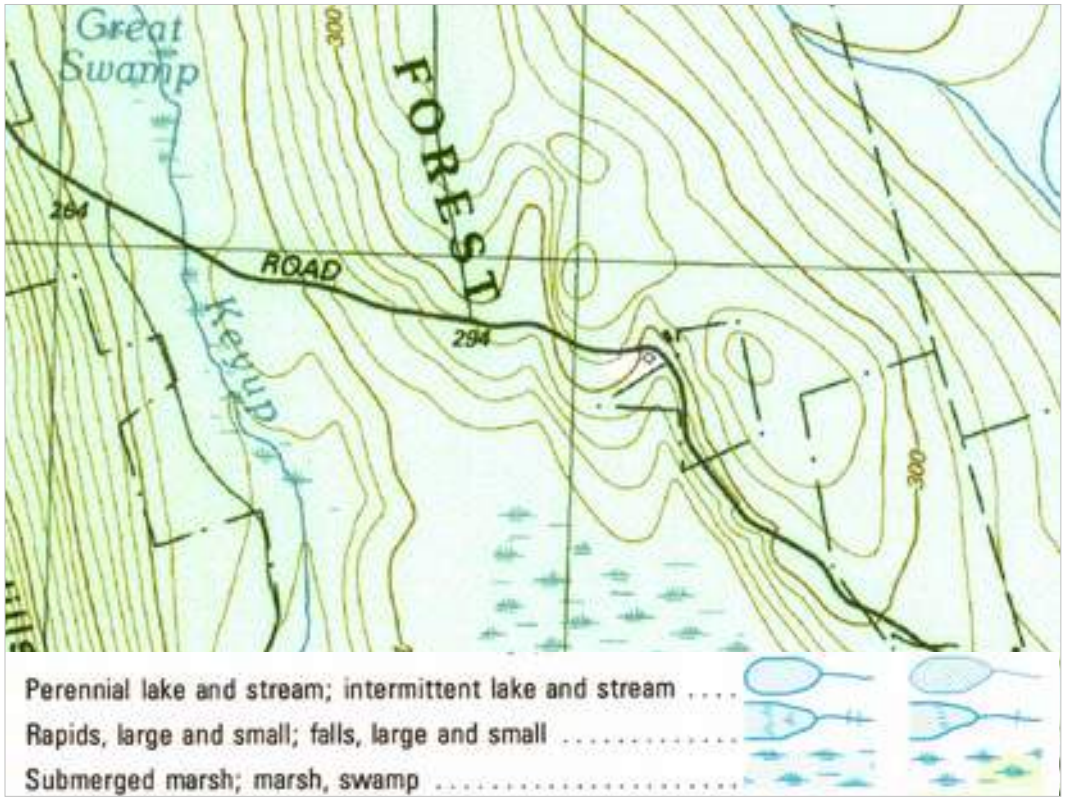
What do we see here?

Wetlands.

(and roads, parking lot, buildings, etc).

Here's an air photo of an area.

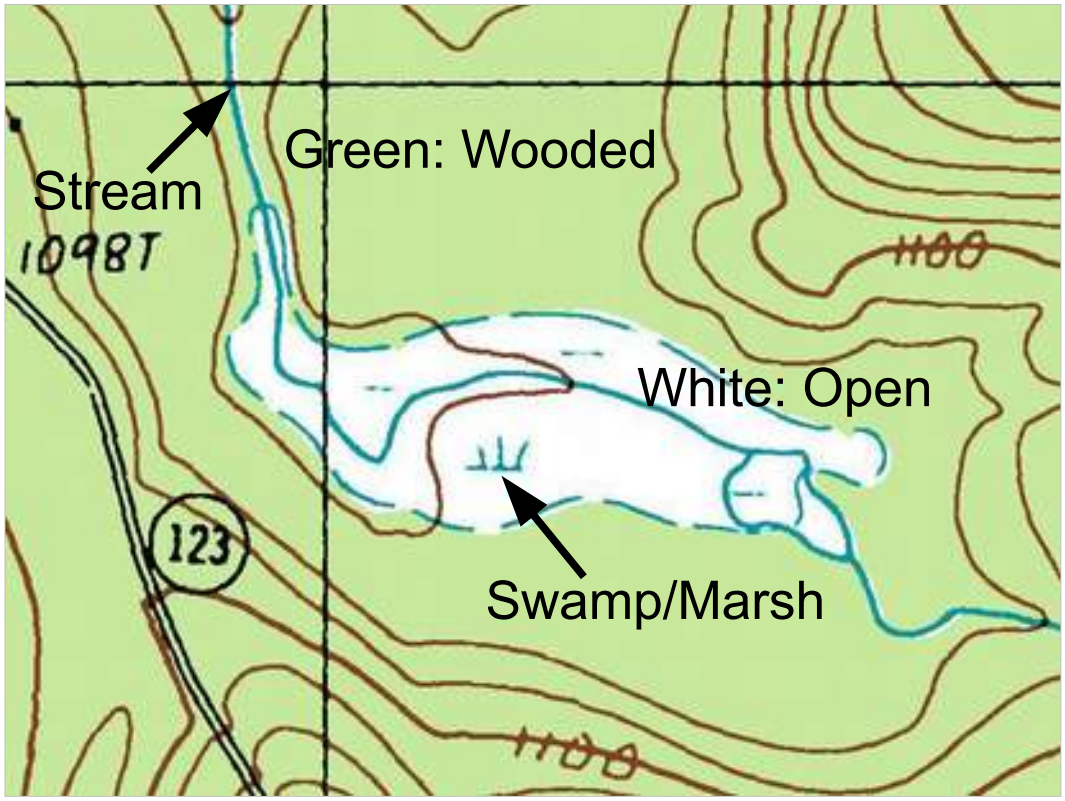
What jumps out at us?



Topographic map of the same area.

What can we see here?

What is evident here that wasn't evident on the air photo?



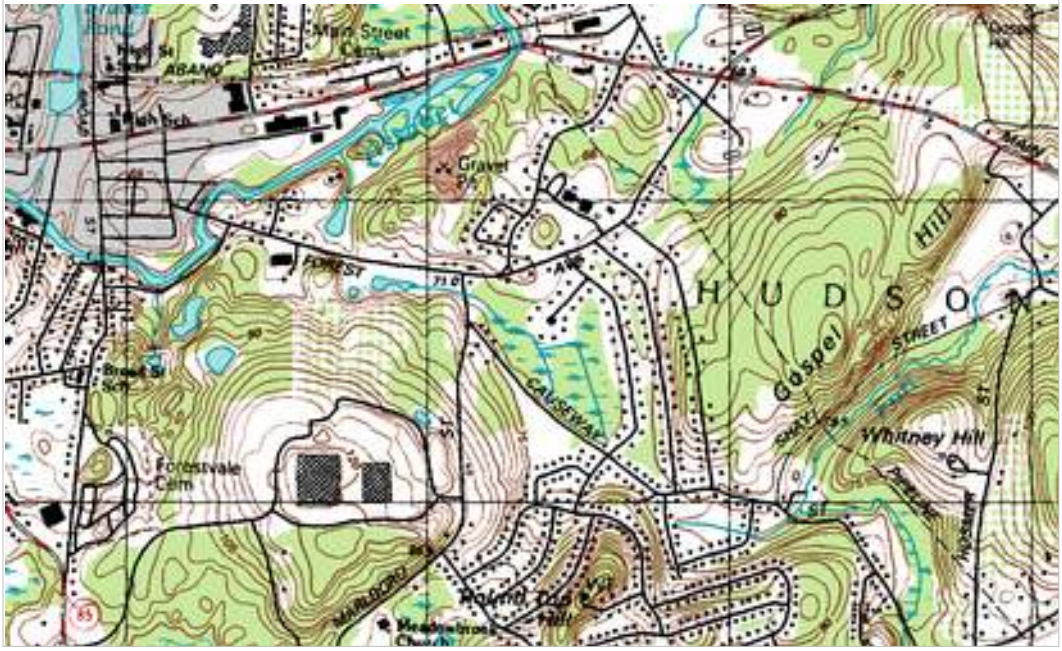
Wetlands indicated by blue horizontal line with three vertical strokes – wet ground with plants growing out of it.

Which way is the stream flowing?

Wetlands – partly wooded, partly open, and a photograph of the same area.

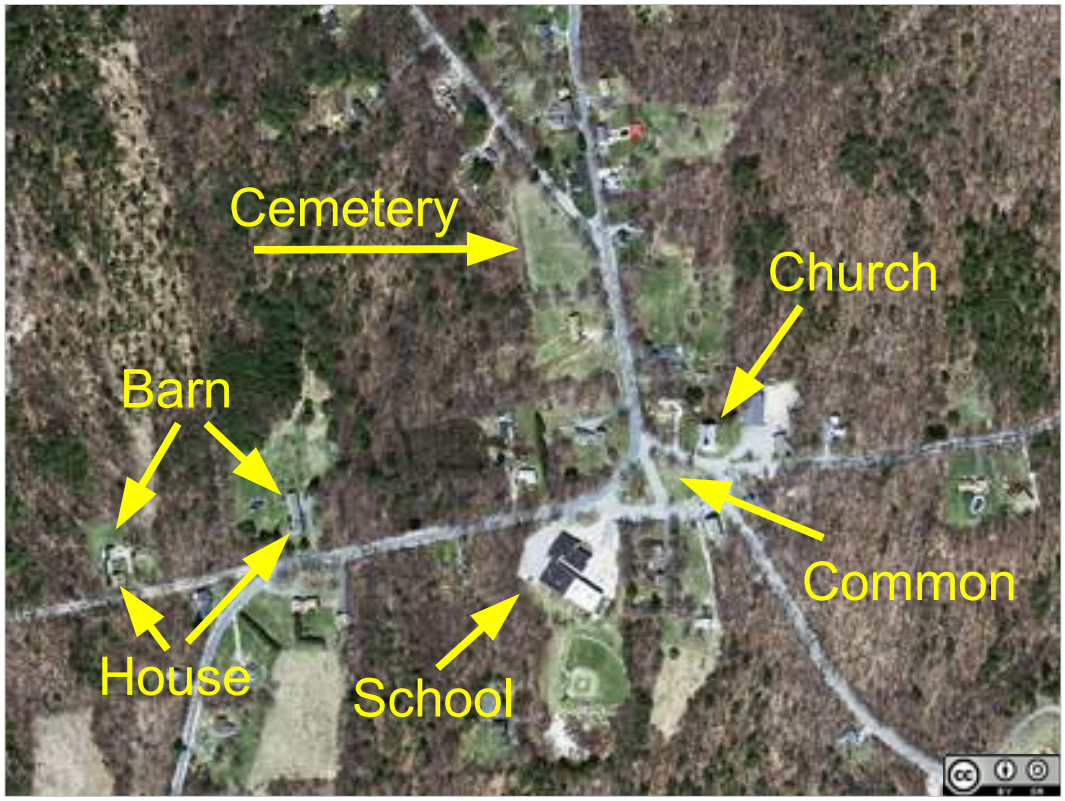
All marshy/swampy/wet ground, but partly green on the map and wooded, and partly white on the map and open.

Cultural Features on Topographic maps



Lots of human features also on topographic maps.

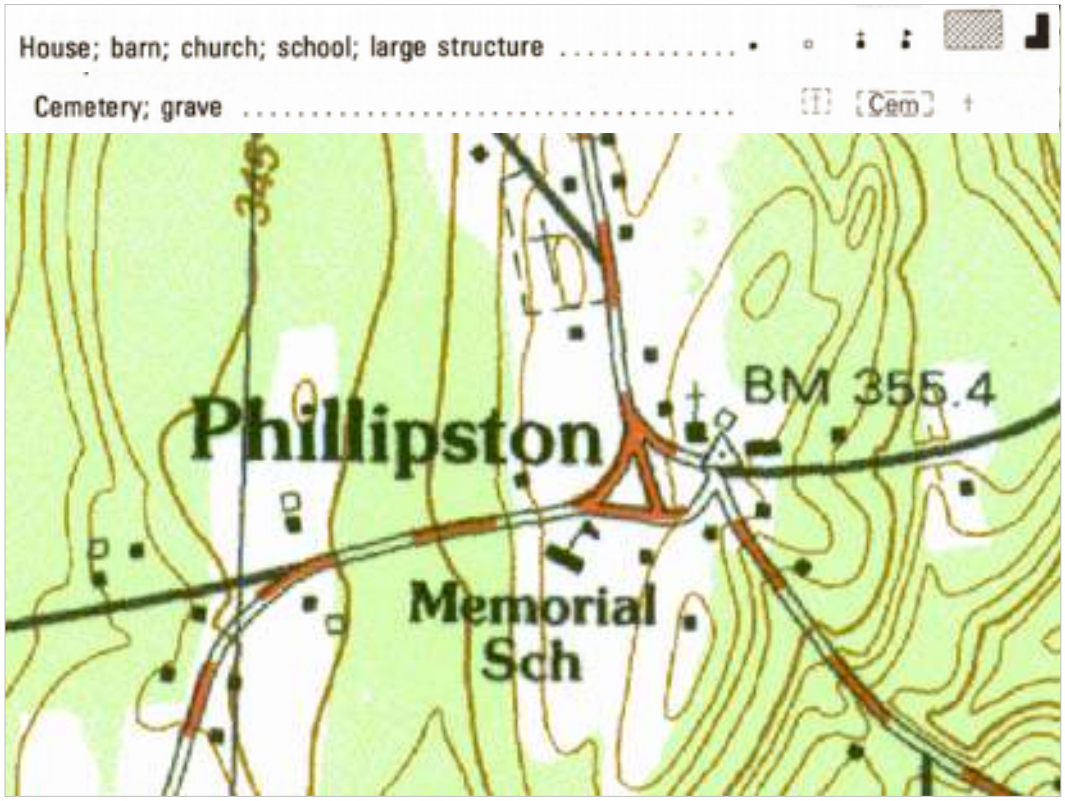
Let's look at a typical small New England town.



What can we identify?

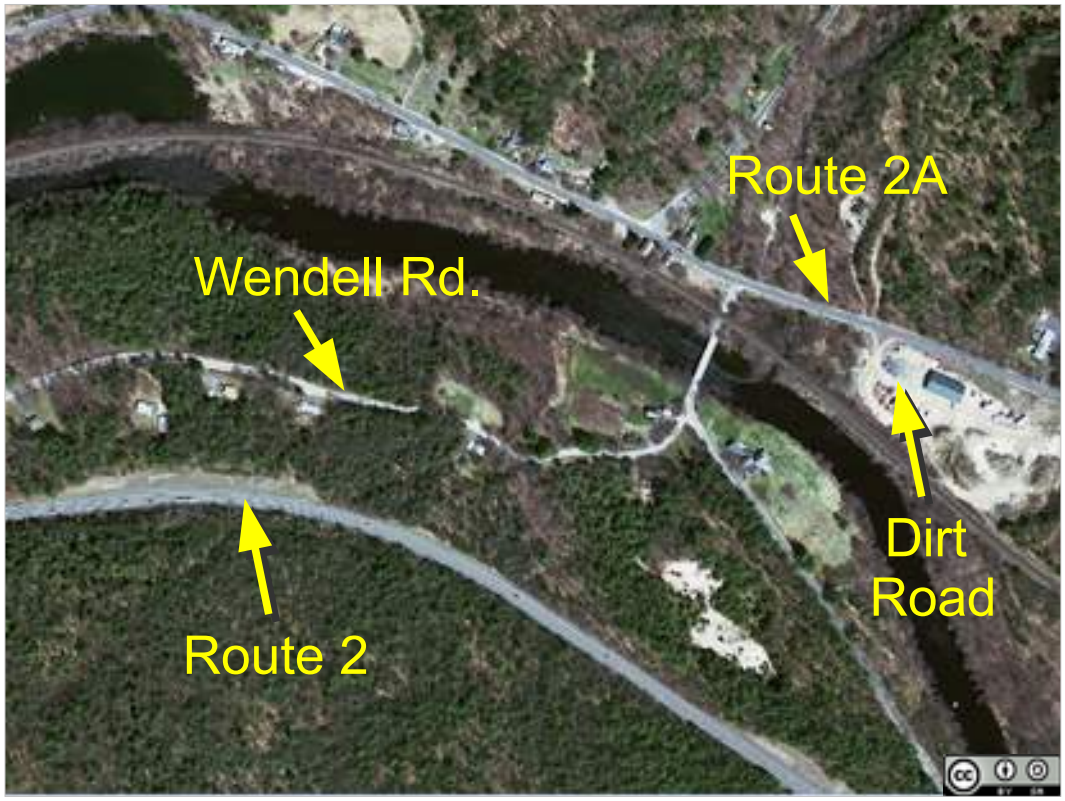
Knowing something about small New England towns, a lot.

We just saw the picture of the church off the common.



Here's the topographic map of the same area.

Things that we had to interpret are now mostly abstracted for us: The church, the school, cemetery, houses with barns behind them.

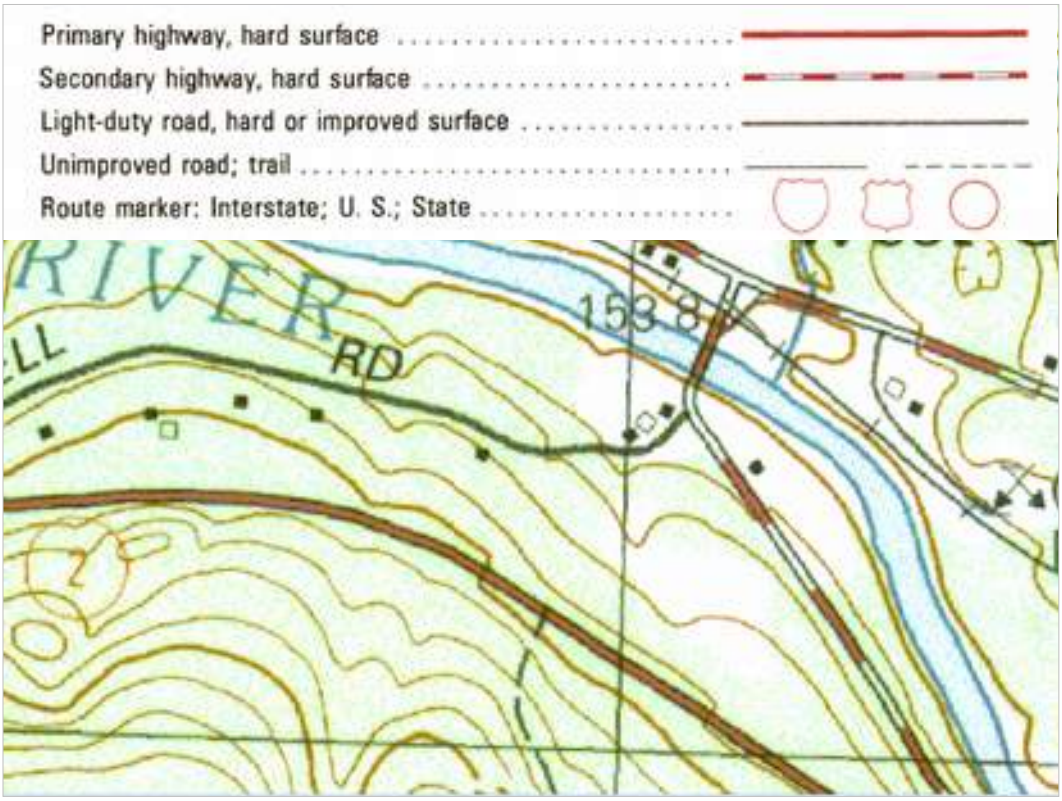


Here;s an air photo.

What do we see?

There are roads of different types.

What else do we see?

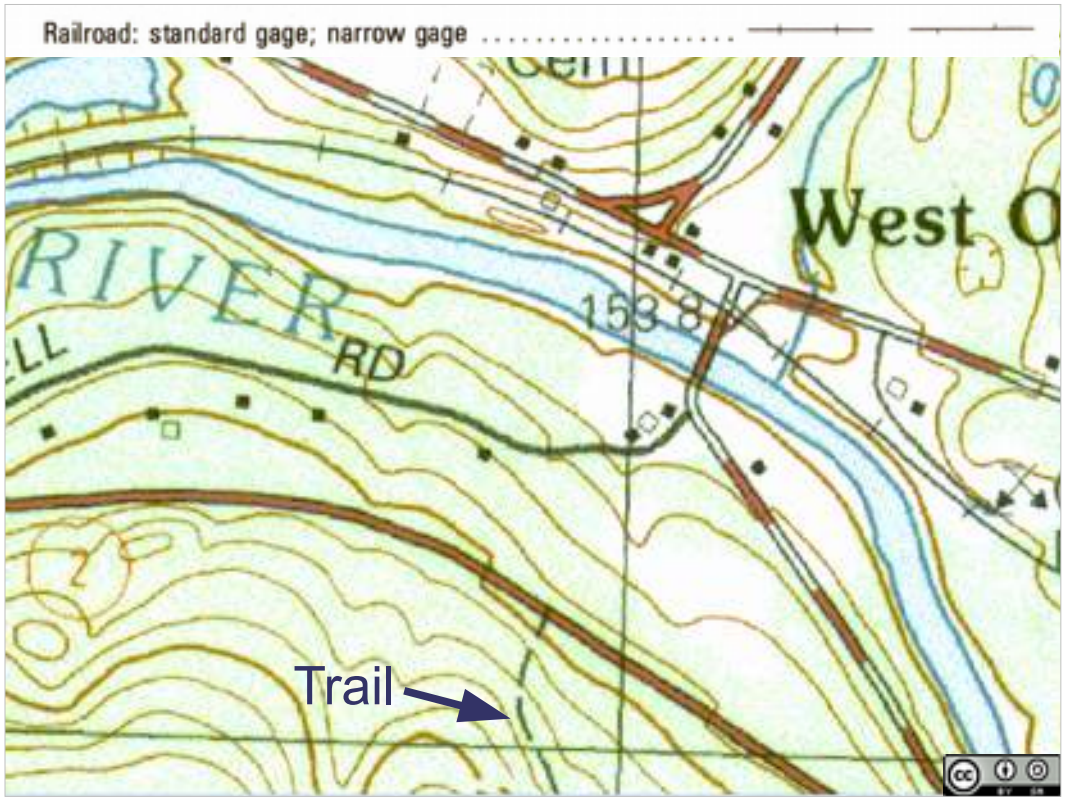


Roads of different types are evident on the map.

What else can we see on the map?

.

Here's the railroad – long gentle curves, sticks to the terrain, has fill in low spots.

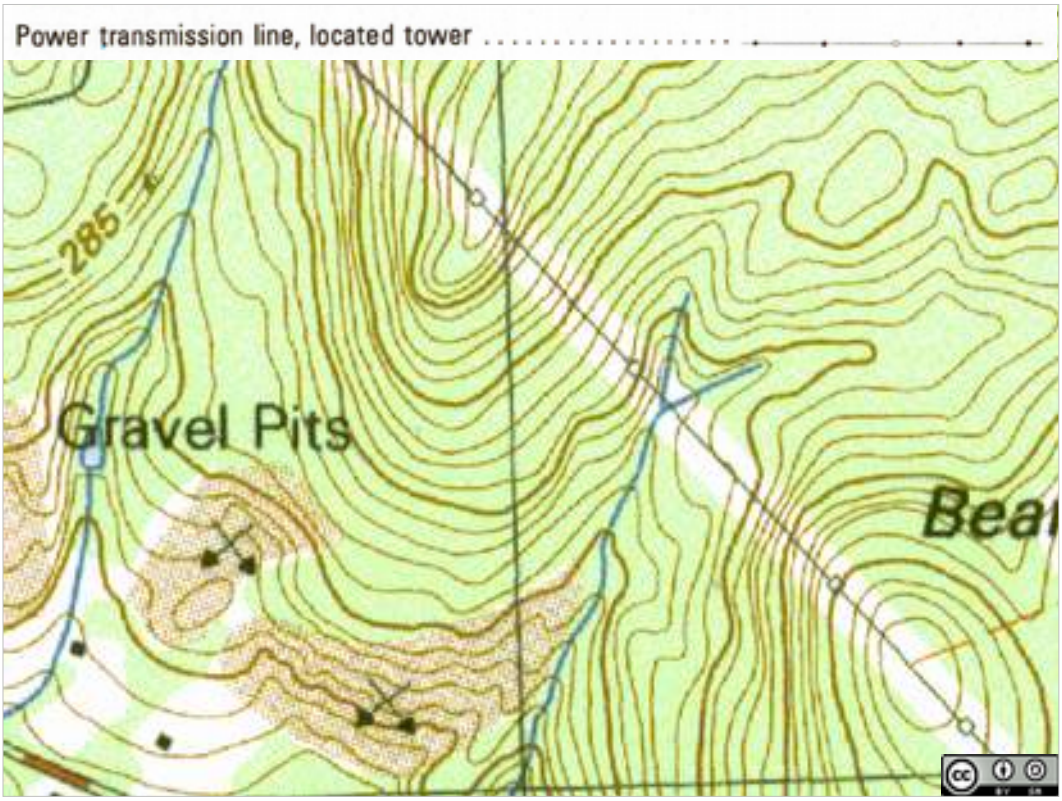


Railroad and fill evident on the map.

And there's a trail that we couldn't see on the air photo.

Another air photo.

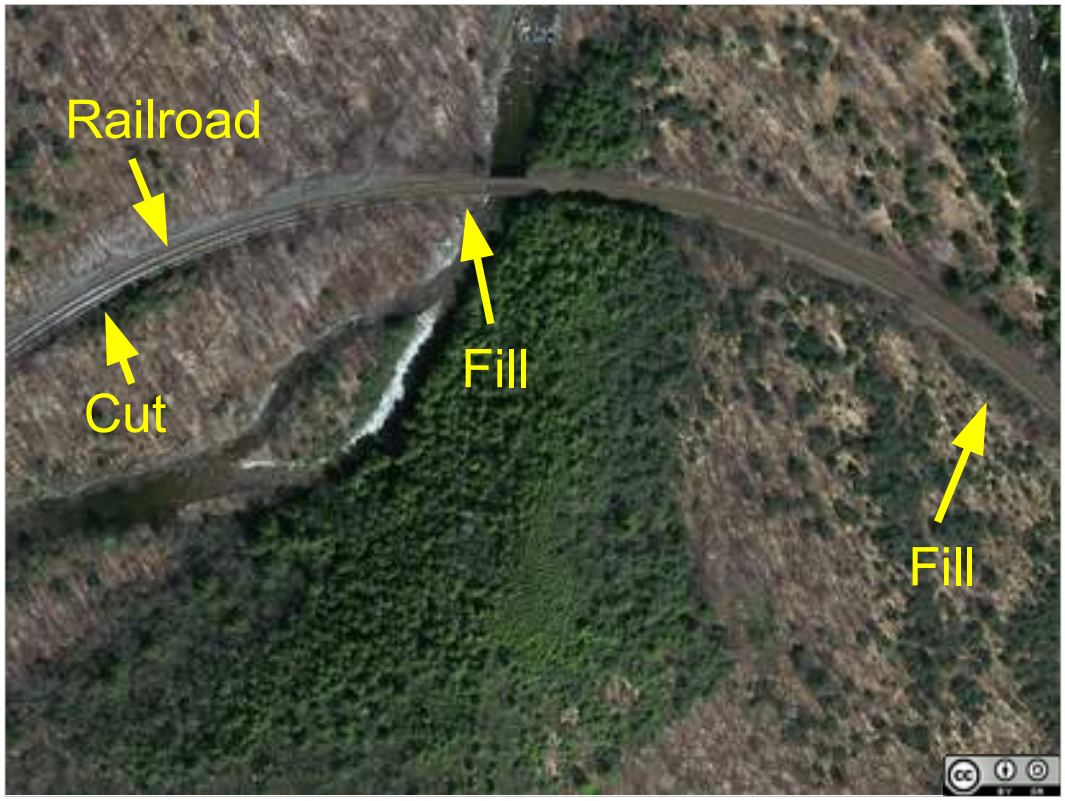
What do we see?



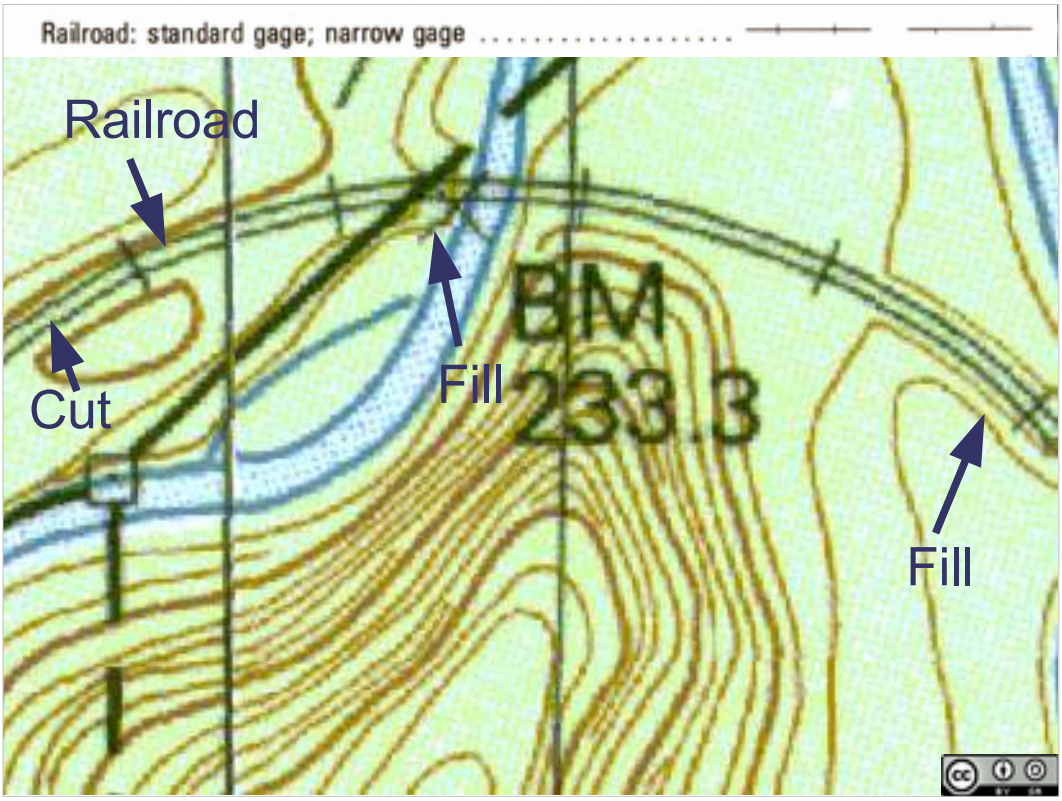
Where's the golf course?

What is the linear cleared feature?

Are the gravel pits still there?



What can we see here?



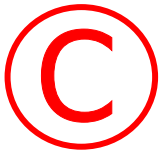
Same area on a topographic map

Air photo of largely forested area from April, with leaves off the deciduous trees, and only the conifers showing up in green. Same area in August, a couple of years later, with trees fully leafed out.

Note water tank in lower center – built between 2001 and 2003.

Some Search Related Symbols

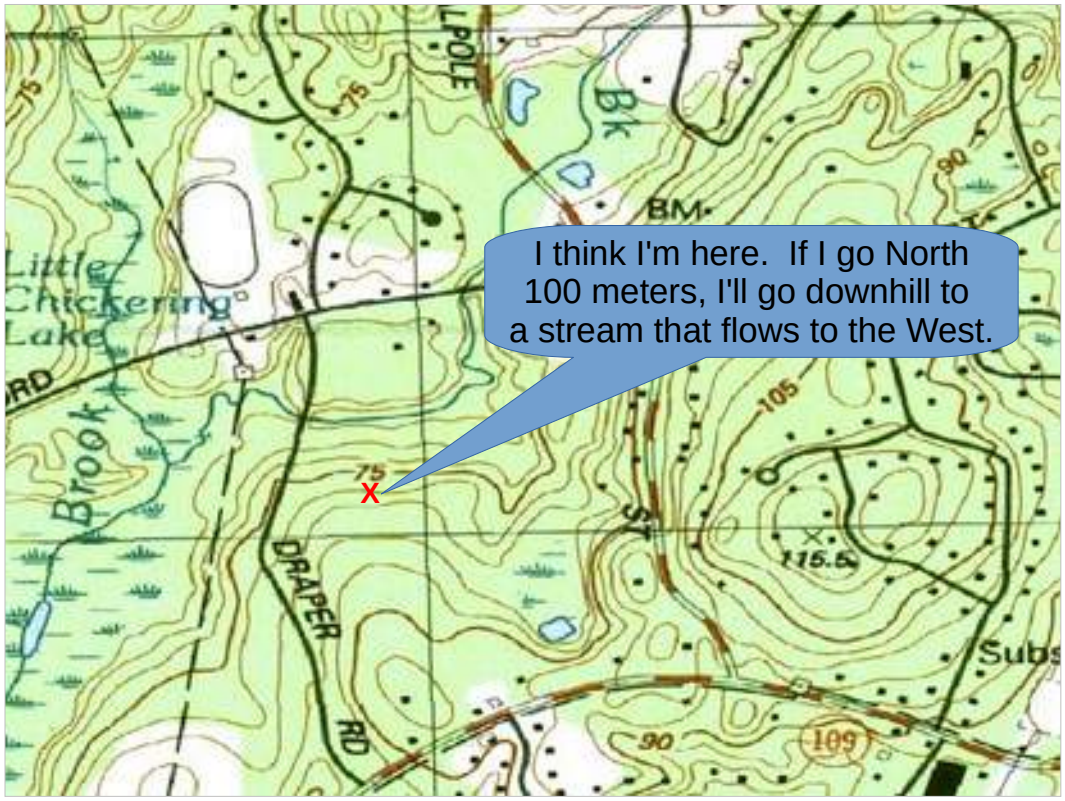
PLS/LKP/IPP



Clue

ELT hit
(SARSAT Location,
PLB hit)

Practical Evolution 1: Map and Air Photo Reading



When reading a map treat your location as a hypothesis.

Identify landmarks you can see. Identify landmarks on the map that you should be able to see.

Ask what the map say should happen if you move in some direction if you are in the place you think you are. Does the terrain on the map match the actual terrain?

If you move in that direction and you don't find what the map says you should find when you should find it, then either – you weren't where you thought you were, or you aren't traveling in the direction you thought you were traveling in, or both.

Behaviors on Terrain

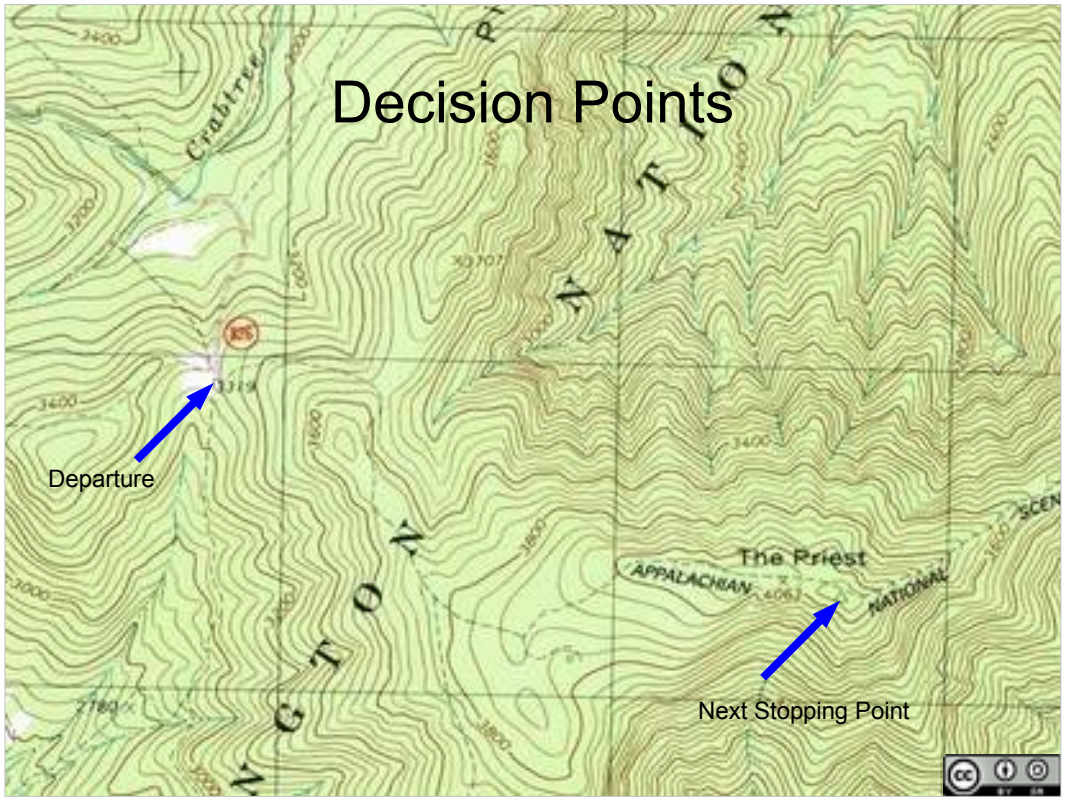
- Decision Points
- Paths of least resistance
  - Ridgelines
  - Remain in same watershed
- Goal directed behaviors
  - Route traveling to reorient (trails, roads, streams).
  - View enhancing: Going uphill in search of cell phone signal or view of landmarks.

People tend to be lazy...
People tend to behave in predictable ways on terrain.

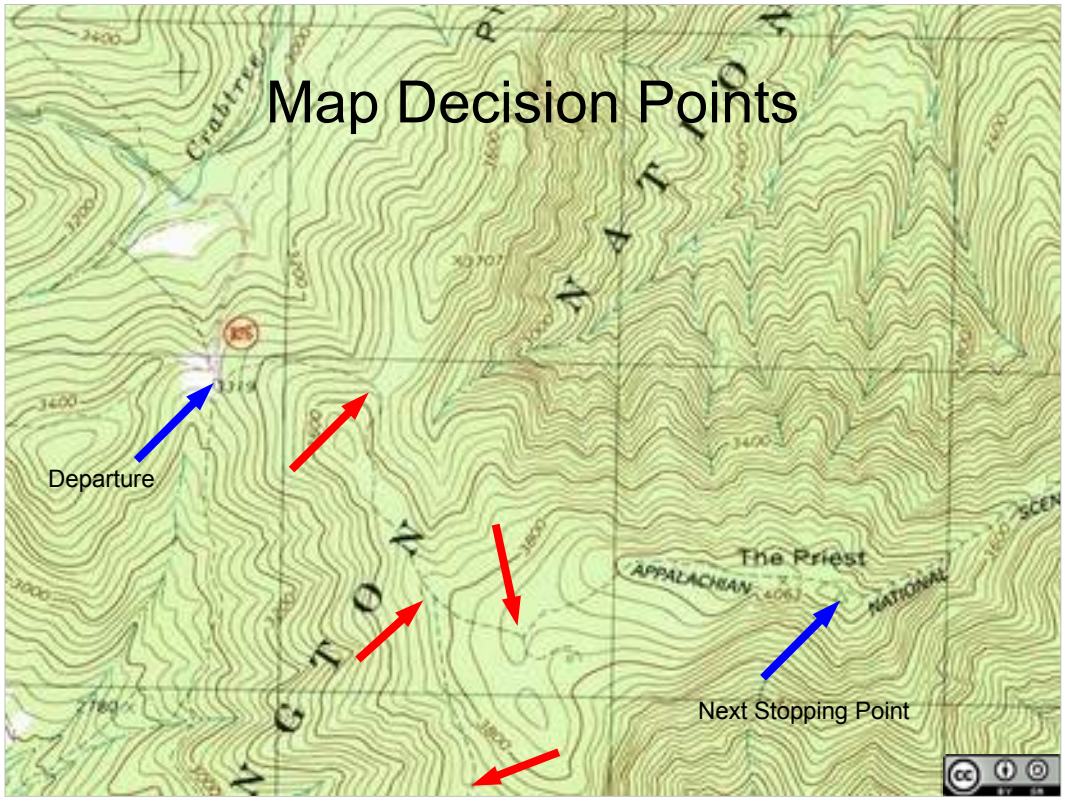
Key concept from Robert Koester and the study of lost person behavior is decision points – places on the terrain where a person may make a decision about navigation, and where they may make the wrong decision.

After making a wrong decision at a decision point people tend to (be lazy) follow paths of least resistance, and follow particular goal directed behaviors.

Understanding decision points, reading terrain, and understanding how people travel on terrain can help inform us where to look.



A party of hikers started off after a break from the marked departure point. They next stopped at a peak further down the trail, only to discover that one of the party was missing.



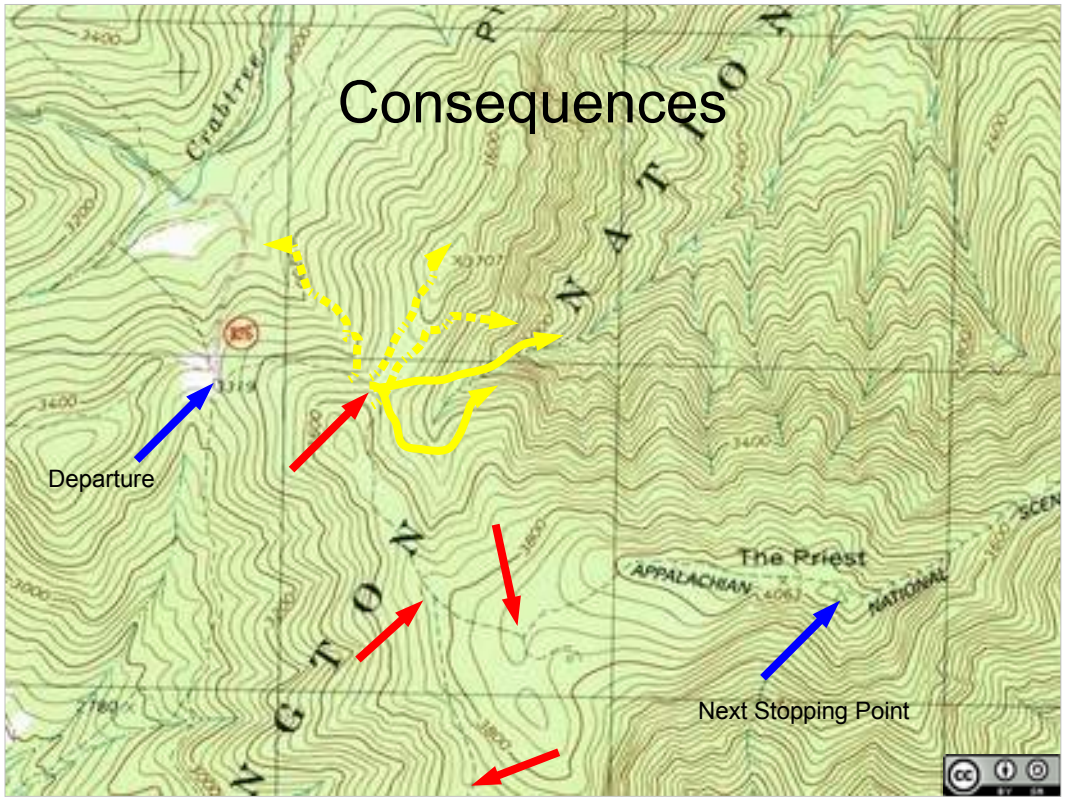
Where are places we can see on the map where this person may have made an incorrect navigation decision?

These are map decision points – we can see them on the map.

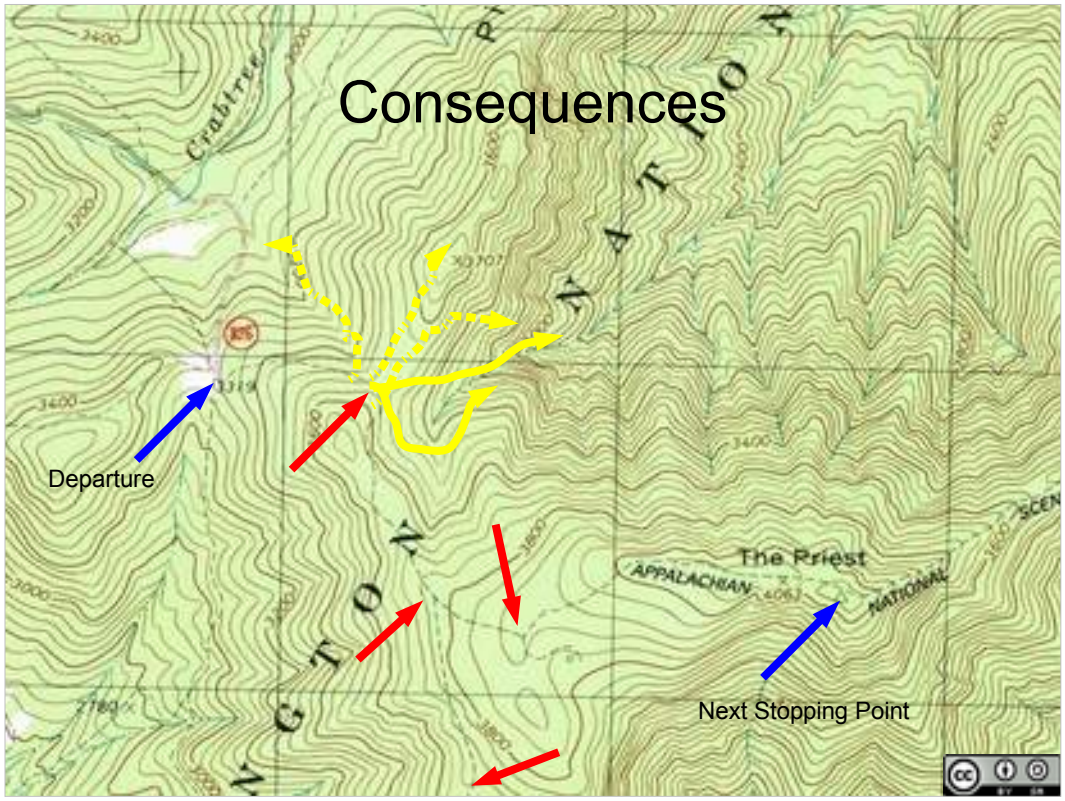
There are also field decision points – places on the ground where the route may not be evident – where a trail becomes faint, where it diverges into a set of herd paths, where it is cut by game trails, where it is overgrown, etc.

Here's a field decision point. In the rocks the trail makes a sharp right, but looks like it keeps going straight, and the next blaze isn't particularly evident at the turn.

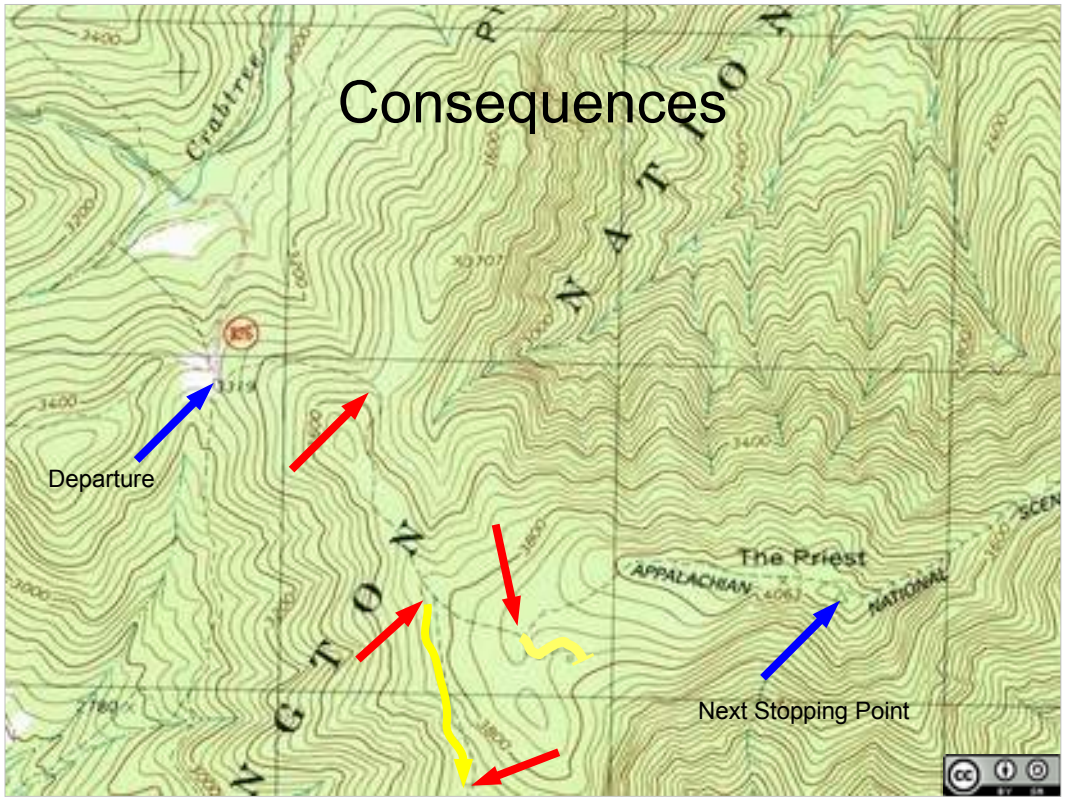
Very important to signcut field decision points, plot their location on the map, and report them in debriefing.



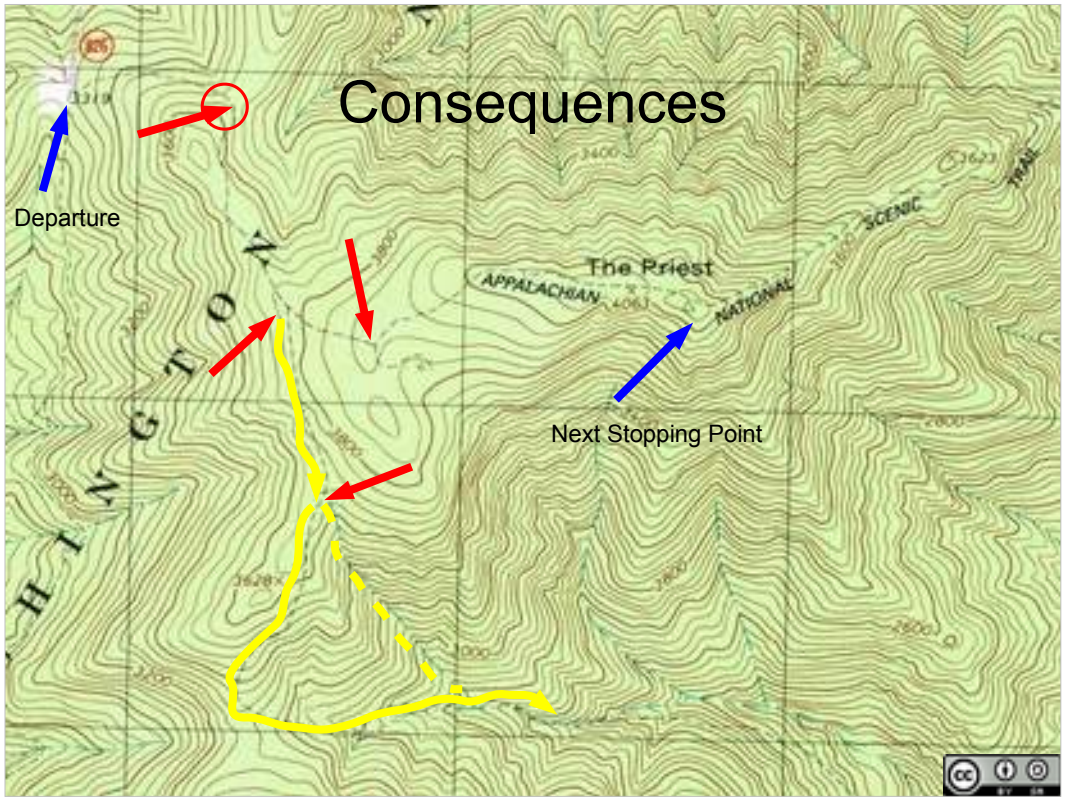
Now, what's the consequence of an incorrect decision at each decision point?



From the top point – most likely travel directions lead down into the steep valley toward the NE. Some lead back down NW towards civilization.

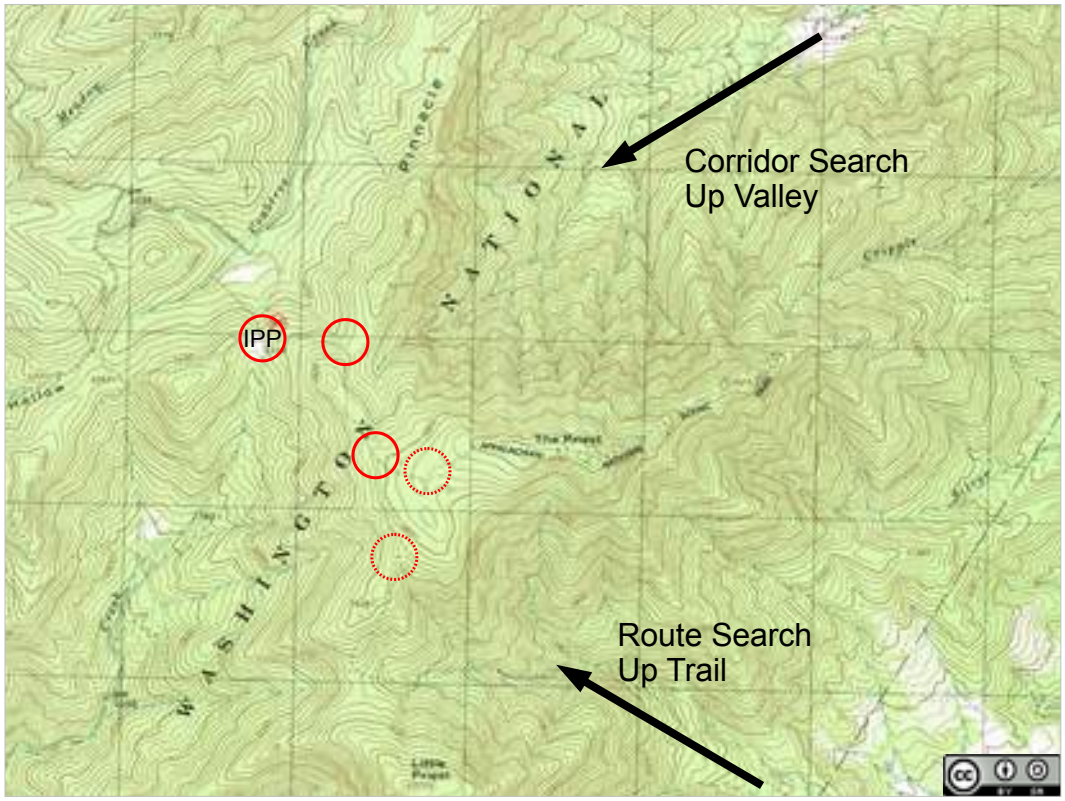


Points in the bottom center lead down into trails to the south. Point right center leads to a short spur trail. Consequence of taking a wrong turn there? Probably realizing it was a wrong turn and turning right around again.



Bit of the map just to the south – decision points lead into a trail down a valley to the east.

Where do you want to put resources?



Two key decision points are the turn at the top of the ridge, leading down the valley to the NE, and the trail junction leading down the trail to the SE.

Implication for some high priority assignments – put a corridor search up the valley to the NE and a route search up the trail from the SE.

Subject actually missed the turn at the top of the ridge, continued down into the valley and was found near the head of the upper arrow by a team searching up the valley.

Subject: 25 year old male day hiker.

PLS: Subject dropped off on the Bellows Pipe Trail trailhead on Thiel Road at about 10 AM by a friend.

Weather: Cool overcast morning, then cold rain and mist for remainder of the day. Temperatures in the 50s.

Subject did not return for pickup at the expected time (4 PM). Friend followed plan and called for help.

Identify Decision Points

Practical Evolution 2: Decision Points

Split into small groups, hand out map. Brief on scenario. Exersize: Identify Decision Points.

Additional details on scenario:
Subject wearing clothing appropriate for the weather, had a day pack usually containing water, trail snacks, extra clothing. Experienced trail hiker, good health. No known medical issues. No recent significant psyco-social events in his life. Cell phone is non-responsive.

Subject's plan was to hike up the Bellows Pipe Trail to the Mt Greylock Summit, then return on the same route to get picked up at about 4PM. Subject did not return at the expected time.

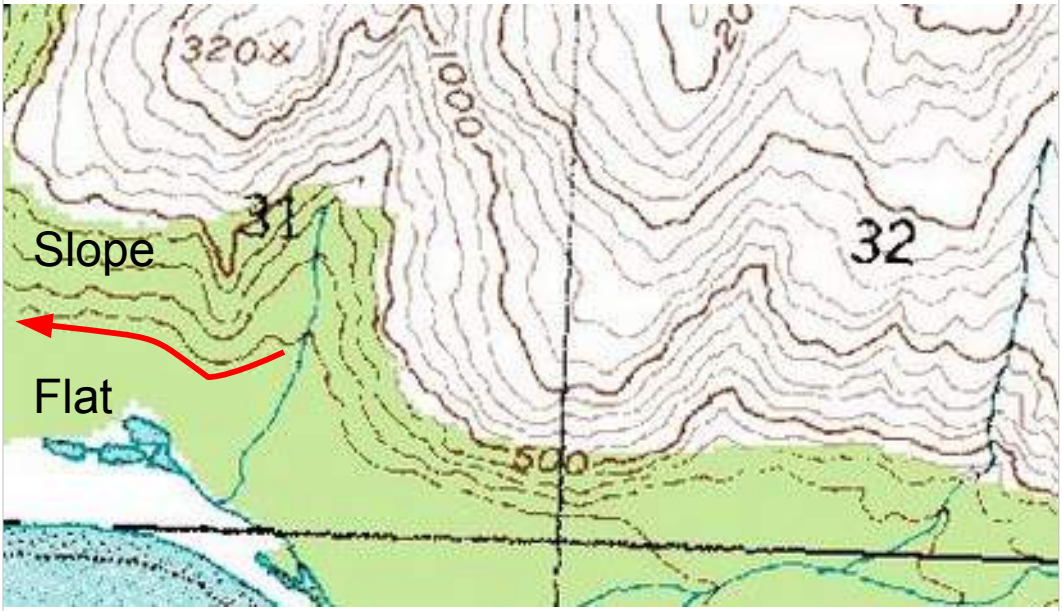
How do people travel on terrain?

Yosemite Watershed Data

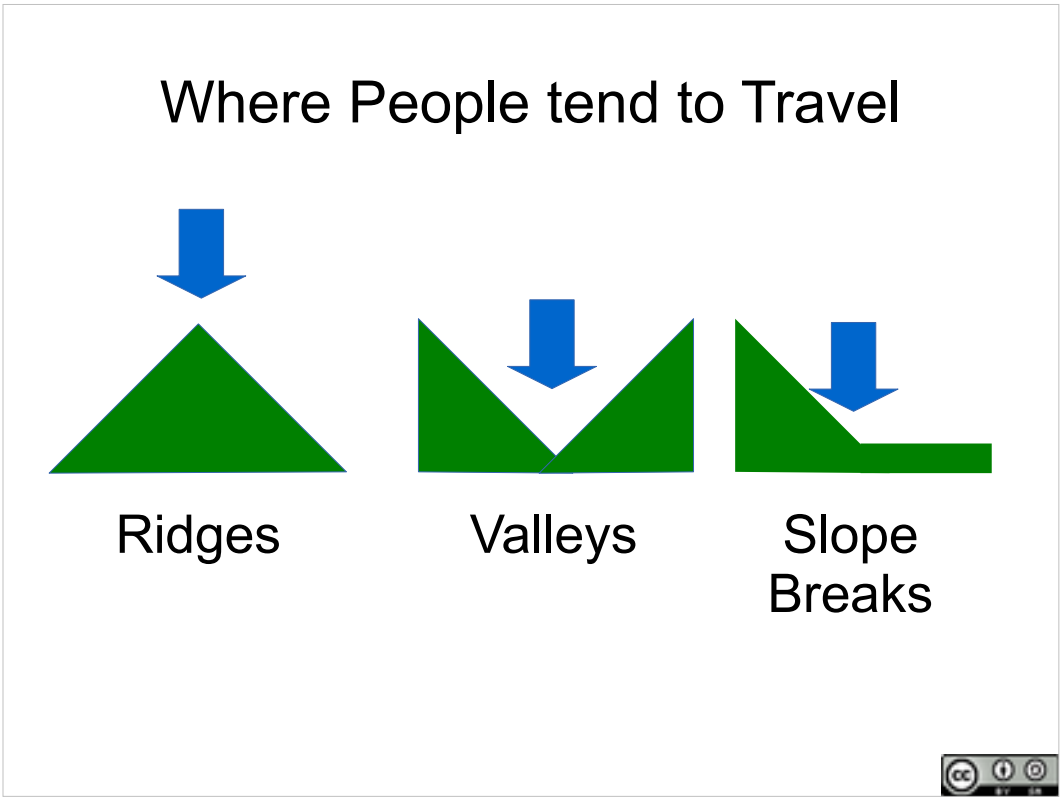
"129 hiker incidents (130 found locations), 63 people/groups (48%) were found within the same watershed in which they were reported last seen, and 15 of these were found at the IPP. Fifty (38%) people/groups were found in a watershed adjacent to the one in which they were reported last seen. Finally, 17 people/groups (13%) were found more than one watershed away."

Data from Yosemite (mostly hikers, more rugged terrain than New England) suggests that hikers tend to remain in the same watershed or cross over no more than one ridge into the next watershed.

Slope Break



People also tend to travel along slope breaks – between flat and steeper terrain.

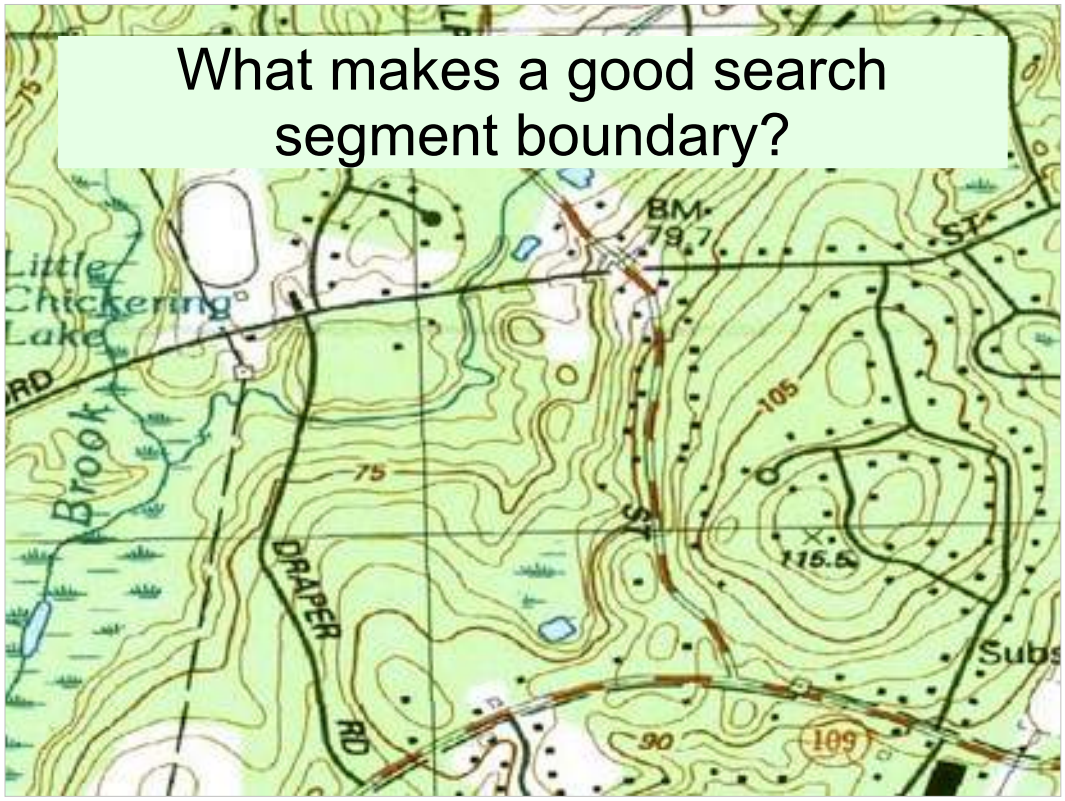


People tend to travel:

Along ridges.

Along valleys.

Along slope breaks.



What sort of map features make good segment boundaries? You've been assigned to search some area. How would you like that search segment to be marked on the map. Discuss.

Does it exist on the ground (grid lines don't (except PLSS sections))?

Does it exist on the map? Stone walls probably don't – but might line up with a property boundary overlay on a map produced by a GIS specialist.

Clearly identifiable baseline and a distance (e.g. baseline is Draper Rd, segment goes 300m to east) can work well.

Can have a resource put in a flagline on a bearing at on the ground to create a boundary.