# Task Assignment Form

## TASK ASSIGNMENT

| Team Number / Call Sign | Mission Number | Operational Period | Date |
|---|---|---|---|
| | | | |

| Type of Team | Name *(Team Leader First)* | Resource Name *(TL, Comm, Navigator)* | Skill / Equipment |
|---|---|---|---|
| ☐ Area<br>☐ ATV<br>☐ Communications<br>☐ Confinement<br>☐ Dog<br>☐ Fixed Wing<br>☐ Grid/Line<br>☐ Hasty<br>☐ Helicopter<br>☐ Horse<br>☐ Litter<br>☐ Snowmobile<br>☐ Technical Rope<br>☐ Tracking<br>☐ Vehicle | 1 | | |
| | 2 | | |
| | 3 | | |
| | 4 | | |
| | 5 | | |
| | 6 | | |
| | 7 | | |
| | 8 | | |

| Assignment Date | Estimated Departure Time | Actual Departure Time | Estimated Time in Segment |
|---|---|---|---|
| | | | |

| Radio Frequency | Briefed by | Reviewed by |
|---|---|---|
| | | |

**Sketch Map of Assignment**

**Briefing Summary**

- ☐ Overview
- ☐ Org. Chart
- ☐ Time Frame
- ☐ Communication
- ☐ Check-in Plan
- ☐ Maps / Datum
- ☐ Safety
- ☐ Terrain
- ☐ Weather
- ☐ Pickup Time
- ☐ Tactics
- ☐ Subject Info
- ☐ Lost Person Stats
- ☐ Condition Code
- ☐ Clues
- ☐ Rescue Plan
- ☐ Family / Media

**Assignment and /or Location in the Field:**



## DEBRIEFING

| all Sign | Mission Number | Operational Period | Debriefed by |
|---|---|---|---|
| | - - | | |
| | Date Returned | Time Returned | Actual Time in Segment |
| | | | |

**Explain What the Team Actually Did**

☐ Completed ☐ Not Completed Percentage of Completion: %

tion)
%
%

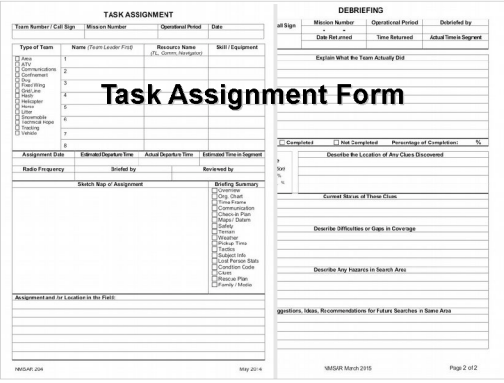
**Describe the Location of Any Clues Discovered**

**Current Status of These Clues**

**Describe Difficulties or Gaps in Coverage**

**Describe Any Hazards in Search Area**

**ggestions, Ideas, Recommendations for Future Searches in Same Area**




## Unit 20: Task Assignment Form Lifecycle



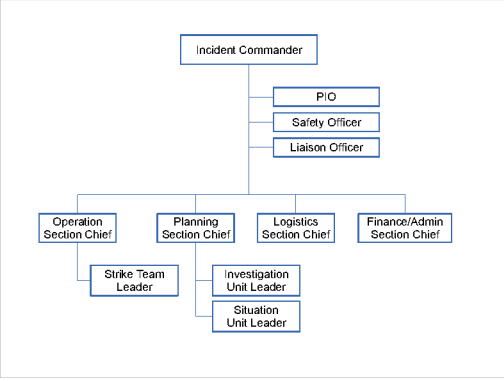
### Search Crucials

- Search is an Emergency
- Search is a classic mystery
- Search for clues not just the subject
- Know if the subject leaves the search area
- Close grid search as a last resort
- Manage by objectives
- **Search management is information management**

Back to the search crucials.

Search management is all about information management.

Why?




Use this slide to focus a discussion:

Where does the information flow?
Objectives to planning section to operations section, and back to planning section.

What are the Key elements of information to be communicated?
Searching Information, Clues, Where was searched, How well it was searched, Hazards found, field decision points. Where wasn't searched.

*Discussion point – what are the consequences of this information not being communicated back to the planning section?*

### Briefings

- Operational Period Briefing


- Briefing for assignment


So, we have briefings.

What can we expect in an operational period briefing? Highly stylized. Many people. Here's who is running the show. Here's the situation. Here's how we are going to deal with it. Here are the safety issues. Go out and do it. Not the place for questions.

What about a briefing for an assignment?

A few people, or one on one – operations section chief (or other operational supervisor) with leader of an assignment (or leaders of assignments). Specifics of assignment and logistics. Place to ask questions.

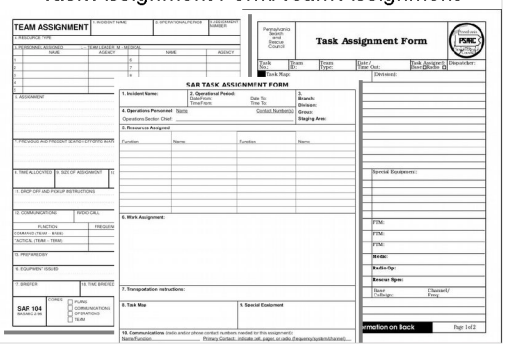
## Briefing for specific assignment

- Who should be present?
- What information should be communicated?

- Search operates under “Need To Know”
  - You will not learn everything

Leaders of SAR field assignments should be briefed on their assignments. Generally just operations section chief or a supervisor from operations doing the briefing either one on one or with a small group of field team leaders.

## Task Assignment Form/Team Assignment




Under various names and in various formats.

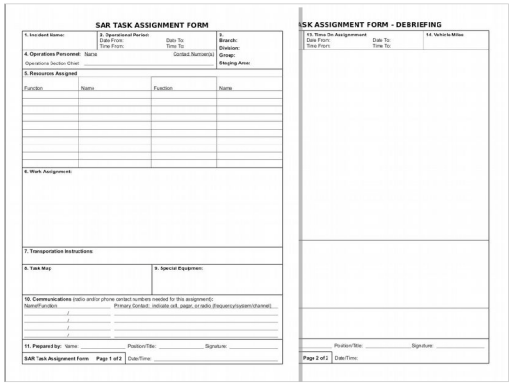
Essence is details of a specific assignment:

Who is assigned?

What are they assigned to do?

How do they get there?

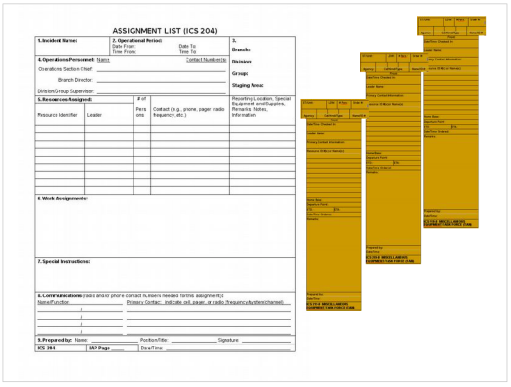
How do they communicate?




Then, when they return, what did they do?

Record of the assignment. Record of the debriefing.

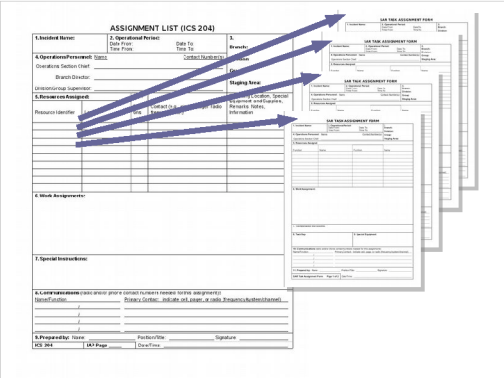
A good practice: One copy goes out with the task, copy of the cover page stays with Operations. On return, a completed copy with the debriefing goes back to Planning.



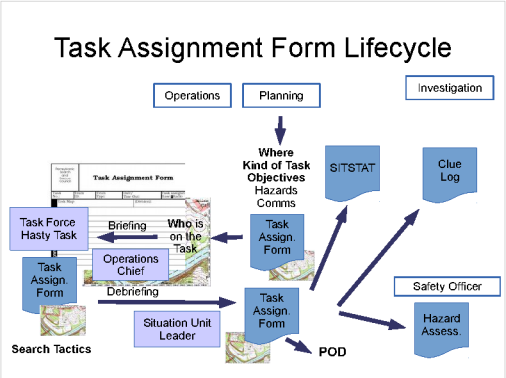

SAR Task assignment form is different from the ICS 204 assignment list and from T Cards.

ICS 204 is a summary of all the assignments in some part of the operation in an operational period. It lists the resources assigned and describes their assignments.

T Cards list the people that are part of a resource, and track their status (What are the three ICS statuses? assigned/available/out of service)




Think of each ICS-204 Assignment list going with a stack of SAR Task Assignment forms, one for each assignment listed on the ICS-204.




Search management is Information management.

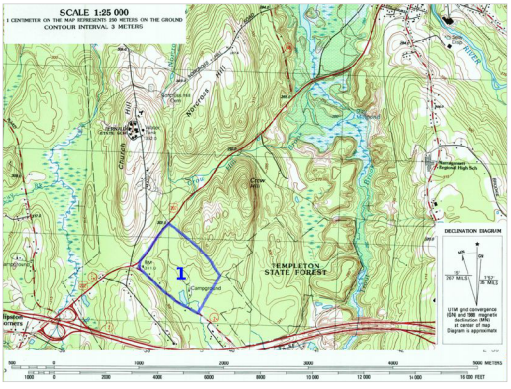
Who frames objectives?

Who determines strategy?

Who assigns particular resources to particular tactical assignments?

TAF life cycle epitomizes the information flow in SAR: TAF starts in planning, where to search, hazards, communications. Then to operations: Specific tactical assignment, who is on the assignment, brief them. Task in the field, field tactics, return, debrief, TAF goes to planning (situation unit leader), information from it into SITSTAT, clue log, hazard assessment, feeds into planning for next operational period (in particular, the reported POD).


This is the key bit. Why?




Practical Evolution:

(1) Complete a Task Assignment Form
In pairs of small groups, given a general description of an assignment have each group fill out a task assignment form for the other, then exchange, brief, review, and debrief on a simulated assignment.

# Canine and Equine SAR

## Canine and Equine SAR



Unit 17: Canine and Equine SAR



## Search Crucials

- Search is an Emergency
- Search is a classic mystery
- **Search for clues not just the subject**
- Know if the subject leaves the search area
- **Close grid search as a last resort**
- Manage by objectives
- Search management is information management

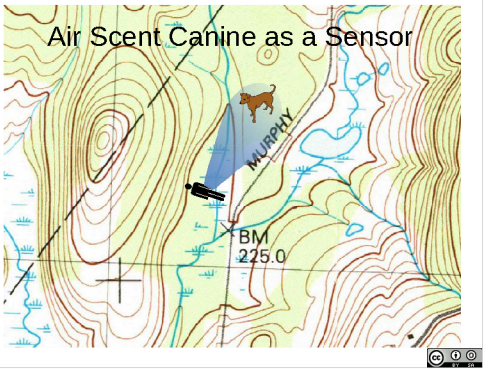
Dogs and Horses can be very effective resources for efficient, minimally destructive search.

Are there clues that dogs or horses can detect that human searchers can't?

What?

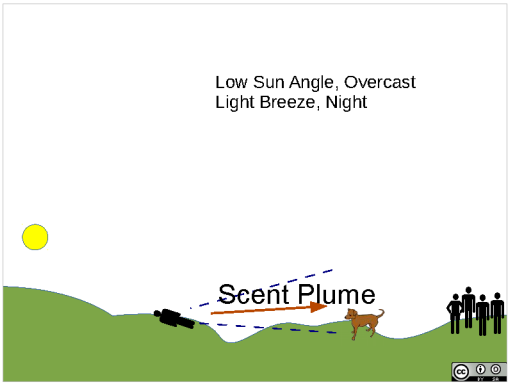
Why?

## Air Scent Canine as a Sensor




Wilderness air scent canines can be thought of as detecting a scent plume coming off of a subject.

How does this differ from a human searcher? [It isn't like the exponential detection function. Detection distance is influenced by how the air is transporting scent.]

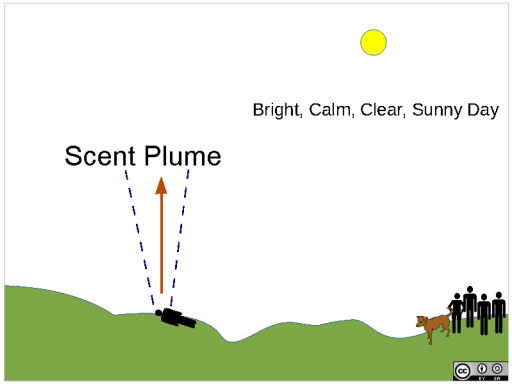



Best case – good conditions for working scent.

Atmospheric conditions are stable (air near the ground is remaining near the ground rather than rising). There's a light breeze, with a steady wind direction, making a long scent plume from the subject near the ground.

Night. Overcast. Low sun angle (morning/evening) – best conditions for stable atmosphere.

**Search Crucial: Search at Night.**




Worst case: Bright calm clear sunny day. Unstable atmosphere. Warm air near ground is rising up (carrying the scent with it).

**Search Crucial: Search at Night.**

## Instincts

- Dog – Predator
- Horse – Prey

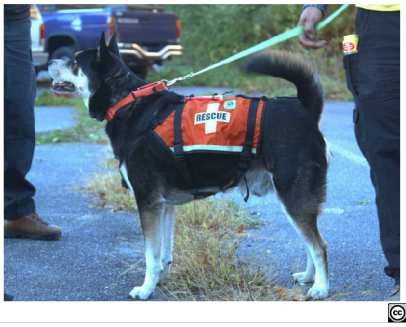
Dogs as sensors – they are predators.

Horses as sensors – they are prey.

How do they differ from humans?

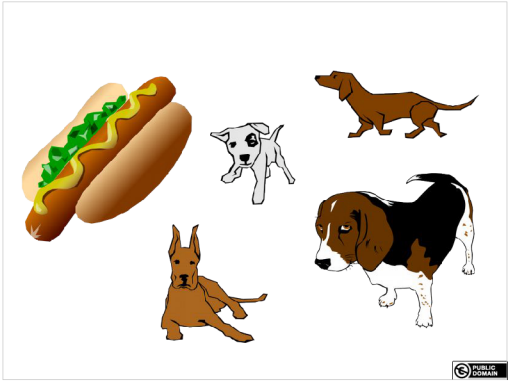
Are dogs just detecting with their noses?

Call out the dogs!




Requesting resources:

Call out the dogs...



What sort of dogs?

Public Domain graphics from OpenClipArt

## FEMA Typed Canine SAR (ESF-9) Resources

- Canine Search and Rescue Team – Wilderness Air Scent
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Wilderness Tracking/Trailing
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Land Cadaver Air Scent
  - Type I – disaster, Type II - disaster
  - Type III – non-disaster, Type IV – non-disaster
- Canine Search and Rescue Team – Water Air Scent
  - Type I, Type II, Type III, Type IV
- Canine Search and Rescue Team – Avalanche Snow Air Scent
  - Type I, Type II
- Canine Search and Rescue Team – Disaster Response
  - Type I, Type II, Type III, Type IV

FEMA, as part of NIMS, has developed resource type descriptions for SAR.

These include 6 typed canine SAR resources.

## Some Canine Resource Types

- Wilderness Air Scent
- Tracking/Trailing
- Cadaver/HRD
- Water Search
- Article
- Avalanche
- Disaster: Live Find
- Disaster: Cadaver/HRD
- Patrol (ESF-13)

There's common names for these resource types. We'll focus on the top three.

Wilderness Air Scent dogs find any person in an assigned search area. Tracking/Trailing dogs follow the scent of a particular person. Human Remains Detection dogs search for the remains of deceased people. Water search dogs search for human remains in the water from shore or boats. Article dogs detect objects with human scent on them. Tracking dogs may also detect articles with the subject's scent on them. Avalanche dogs detect people under snow. Live find disaster dogs find living people buried in collapsed structures, Disaster HRD dogs find the remains of deceased people in collapsed structures. These ESF-9 resources should be distinguished from patrol dogs (with a law enforcement function).

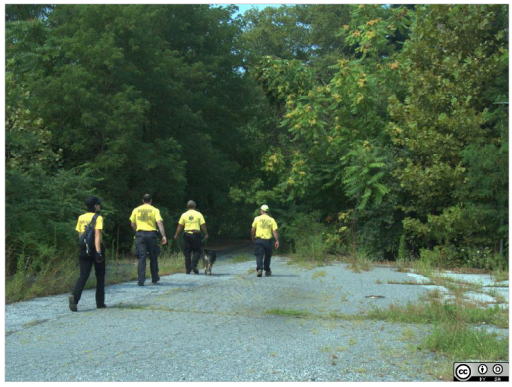

Air scent dogs. (Wilderness Air Scent, Live Find)

Air scent dogs are trained to detect and alert on any human.

Can work in urban parkland, suburban, and rural environments as well as wilderness. Can work inside structures.

Work well with clue aware searchers.

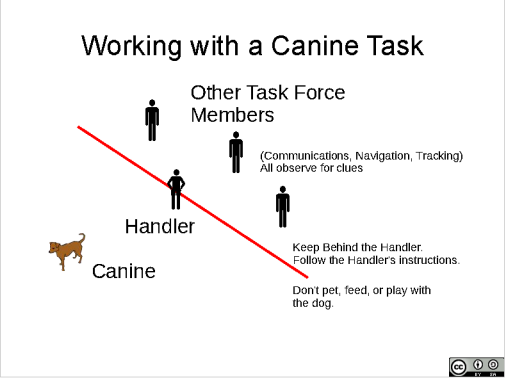
Regionally, nationally, and globally, predominantly volunteer resources.



It is more effective to split up the responsibilities in the assignment.

On a four person task force, the handler can focus on observing the behavior of the dog. The other members of the task force handle responsibilities for land navigation, communication, looking for clues, and medical care of the subject.

A four person team is the minimum size capable of splitting up without leaving anyone alone. What are some circumstances that would lead to a task team splitting up? *[injury, discovery of a crime scene – situtations where incoming resources need to be met and guided in (on a marked route) to the site]*




Draw a line through the handler's shoulders. Everyone else on the task must remain behind this line at all times. No exceptions.

On a four person task force, the handler can focus on observing the behavior of the dog, while the other members of the task force handle responsibilities for land navigation, communication, and looking for clues.

A four person team is the minimum size capable of splitting up without leaving anyone alone.

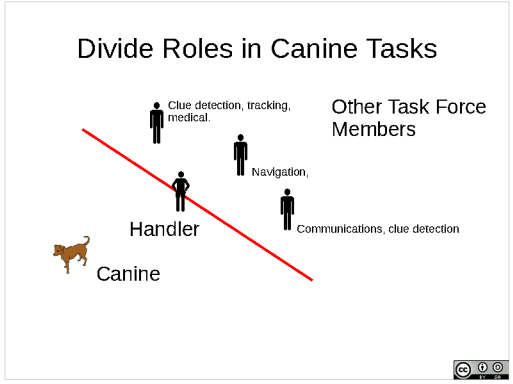
What are some circumstances that would lead to a task team splitting up [injury, discovery of a crime scene – where incoming resources need to be met and guided in (on a marked route) to the site]

Don't pet the dog, play with the dog, or feed the dog.


An air scent dog may “take inventory”, coming up to each member of the task and checking their scent.

This may be an indication that the dog has encountered a new scent.

Just let the dog work, don't pet it or pay it any particular attention.



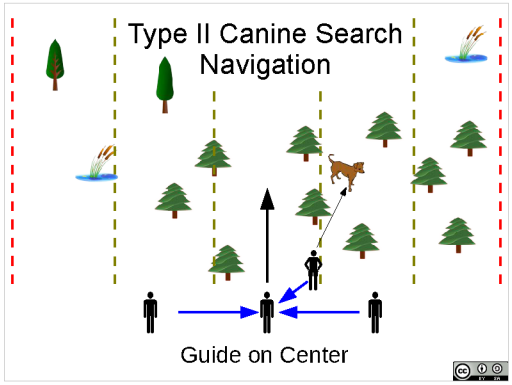

**Best practice: 4 people on the assignment.**

The handler can focus on observing air movements and the dog's behavior, planning the movement of the task force to put the dog into scent, and observing the dog for untrained behaviors indicating that it is in scent.

If on a canine task, a couple of ground rules:

Draw a line through the handler's shoulders. Everyone else on the task must remain behind this line at all times. No exceptions.

Don't pet the dog, play with the dog, or feed the dog.




Handler focuses on the dog.

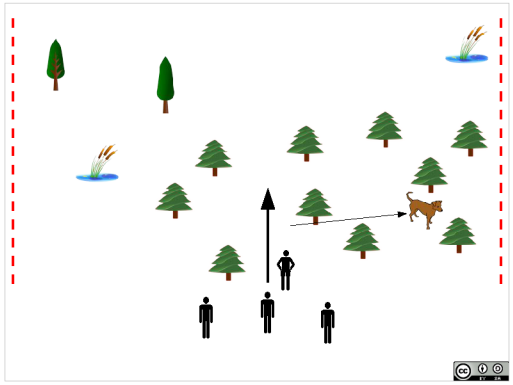
Someone else navigates and sets the control line.

Everyone else (including the handler, out front) positions themselves off of the guide person.

Searchers flanking the guide person can do purposeful wandering in their search lanes.

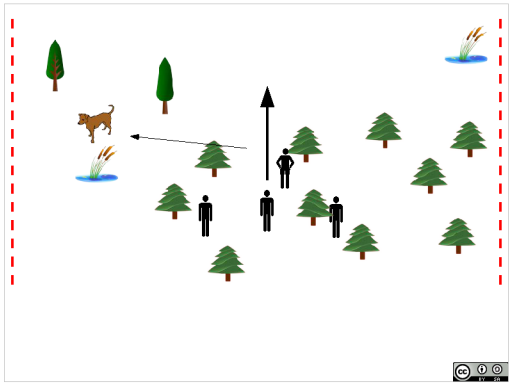
Everyone looks for clues.

Dog's sweep width will probably be wider than the human task's sweep width.

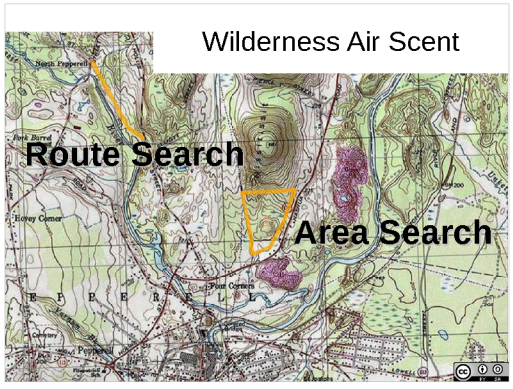


Dog typically ranges right and left of the handler's path.

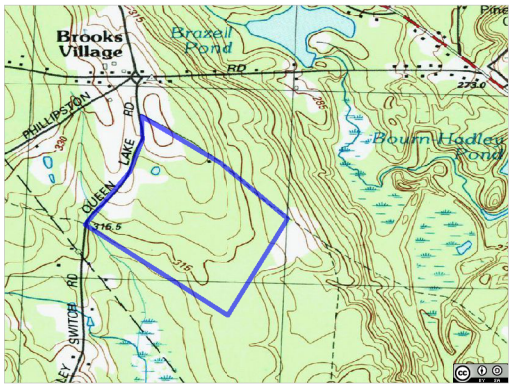
Dog's sweep width will probably be wider than the human task's sweep width.



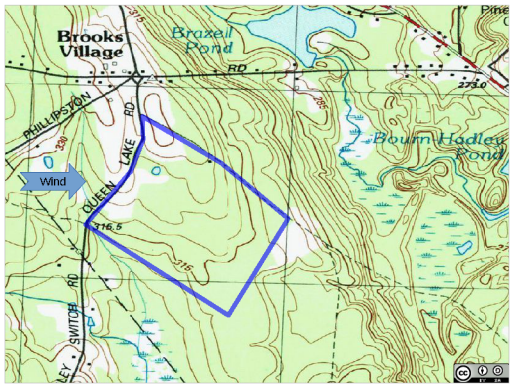
The dog's ranging may be very directed by the handler, or may not.




Air scent dogs can be assigned to search areas or routes (where routes can be trails, powerlines, drainages, or other travel corridors, not just trails).

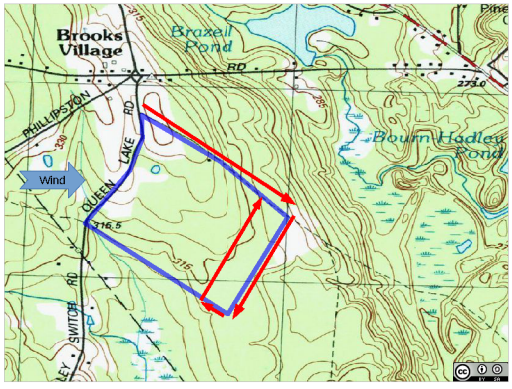



If given an area

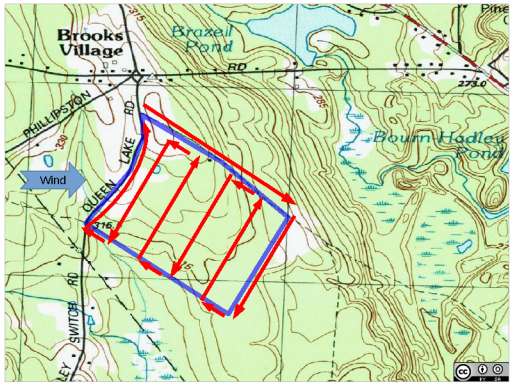



**Where's the Wind?**

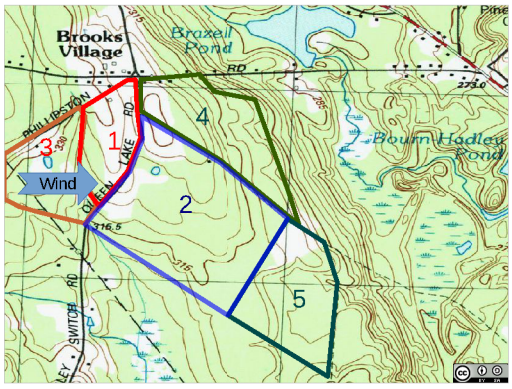
A wilderness air scent handler will ask how the air is moving – both the larger scale prevailing wind, and when they get out in the field, what the local flow of air is doing (and how it is varying (both near the ground where the dog's nose is, and higher up) – thus canine handlers tend to carry talcum powder or other fine powders for checking the wind).




The wilderness air scent canine handler with then usually try to work the segment by gridding from the downwind end up towards the upwind end – with the grid lines running cross wind. The goal is to get the most chances of putting the dog's nose into a scent plume from the subject. (This is the hander's track, the dog will probably range off of this track).




Traversing the entire segment in a grid running across the wind.




Dogs don't know where the segment boundaries are.

An air scent dog may detect searchers in an upwind segment (the dog is imprinted on any human odor).

Coordinate to try to avoid having searchers immediately up wind of a the boundary of a canine search segment (at least when the canine is near that boundary).

Example: coordinate searchers in Segment 1 with an air scent canine task in Segment 2.

Practical Evolution (Bearings and distances on map for marked segments) here.


Bloodhounds. May be that breed, or another breed.

Tracking dogs train to follow the subject's trail very closely, like mantrackers working step by step.

Trailing dogs train to follow the subject's scent trail more loosely.

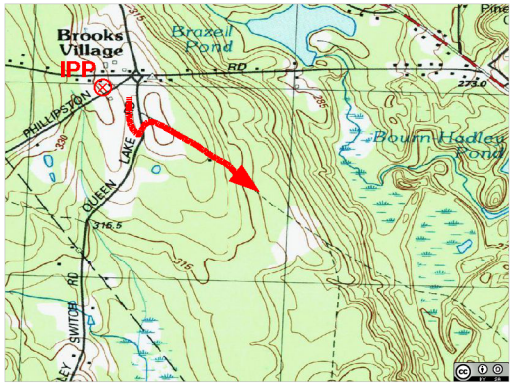
Work well with mantrackers (who may be able to see corroborant, definitively human, or identifiable sign from the subject on the scent trail the dog is following).


The handler will want to obtain an uncontaminated scent article.

Can be deployed at a PLS or LKP to determine direction of travel.

May follow a track that is not the subject's, treat a track, as with all other clues, as having some probability of being a red herring.

Work effectively when combined with mantrackers. A mantracker may be able to find identifiable sign along the dog's track.




Navigation for a Tracking/Trailing task involves keeping track of where the dog is taking you.

Tracking dog is going this way. Where do you put searchers?

Consider leapfrogging some resources out ahead of the direction of travel.

**Don't focus on just this track**. Keep doing everything else. Protect the IPP, establish containment, investigate, search the area high probability area around the IPP, search travel corridors from the IPP to the containment boundary, search high risk and high probability places.

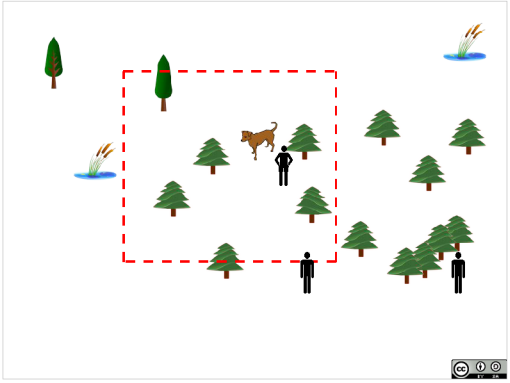

Then we've got Human Remains Detection dogs.

Imprinted on the scent of dead humans, proofed against the odors of dead animals.

Likely to show untrained alert behaviors while working into scent.

Trained final indication behavior at source.

Scent of buried human remains can travel with groundwater.



HRD dogs tend to train towards detecting small scent sources in small areas (often 1-2 acres or less). Composition of tasks and support/navigation needs different.

Typically work in pairs, one working an area, another out of sight brought in to work the same area after the first dog has finished. See if both indicate on the same locations. For small areas, may be just one handler and one observer working the area with another handler waiting out of sight.

Can work with ground searchers on probe lines (detecting areas of less compacted soil). Canb work with ground searchers looking for sufrace bone, etc.

The dog's ranging may be very directed by the handler, or it may not.


Then we have horses.

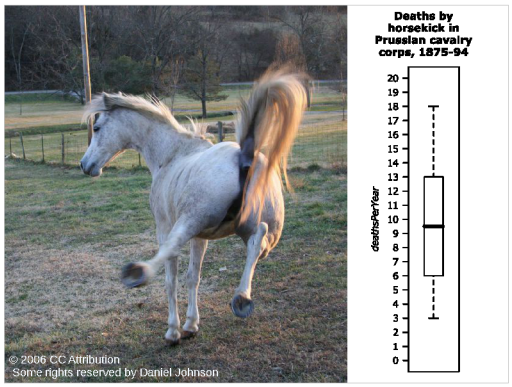
Horses can serve as sensors, as a high vantage point for searchers, and for transport.

As sensors, tapping into horses' alertness as prey animals.

[Mounted SAR Canine unit heading out on a task in training in James River State Park, VA]


Horses are large and powerful.

Need to exercise caution working around them.




There are dangers, even for those experienced and used to working around horses.

Horses can startle at things the horse doesn't expect or like.

ATV – pull over, turn off, remove your helmet, let the horse pass.

Why remove helmet? (don't look like a human)

Dog, bring the horse off the trail, sit/down let the horse pass.


The ears are one of the things that can inform you about what a horse is thinking.

Left, Ears back: upset, unhappy. Be extra cautious

Right, relaxed.


Attentive and alert.


What's going on here?

Horse is detecting an unfamiliar odor.




Horses as sensors, as logistical support, and:

Under some limited conditions, it may be possible to use equines for transport and evacuation of an injured person.

# Mechanized Platforms


Unit 19, Overview of ATVs, Mountain Bikes, Snowmobiles/Snowmachines, and Helicopters in SAR.



## Not Traveling on Foot

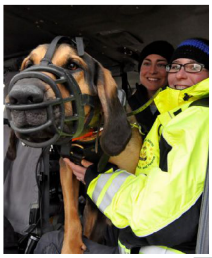
- Helicopters
  - Helicopter Operations
  - Helicopter safety, PPE
  - Landing zone
  - Flight safety
  - Air observer
- Mountain Bikes
- ATVs
- Snowmobiles

A variety of mechanized platforms can be used in inland SAR. We'll give an overview here.

## Helicopter Operations

Locate, Access, Stabilize, Transport

- Search
- Rescuer Transport
- Medivac
- Helicopter Rescue
  - Hoist Rescue
  - Short haul



RICSAR K9 Jep, UH-60 Black Hawk Familiarization
RI National Guard, public domain image by Staff Sgt. Peter Ramaglis

Helicopters can be used at any phase in LAST.

They can be used to transport searchers or rescuers.

The can be used as search platforms (most common use in search in MA – MSP air wing providing aerial platform for FLIR).

They can be used for medical evacuation.

They can be used (if properly equipt and certified) to perform some types of rescue operations.

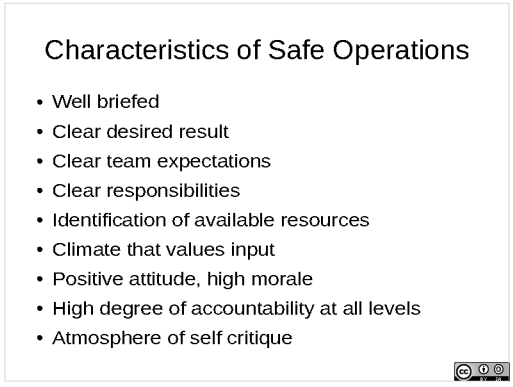
## Helicopter rescue involves unique hazards, which can be fatal


Helicopters come with substantial risks


Helicopters aren't used lightly.

Helicopters can be used for lots of things, that doesn't mean they should be.

Recognizing the risks inherent in Helicopter operations, the AFRCC includes an assessment of the benefit in the go/no-go criteria for helicopter use. Benefit must be that using the helicopter can reduce a threat to life, limb, eyesight or undue suffering.

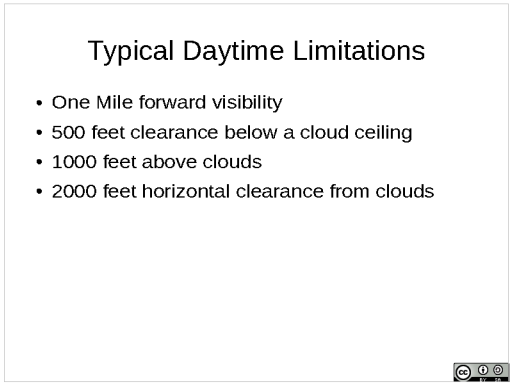



Let's think for a bit about what makes for safe operations. [Discussion].

What happens when an operation is not well briefed?
When clear objectives aren't expressed?
When there aren't clear expectations on each team?
When there aren't clear responsibilities?
When there isn't awareness of available resources?

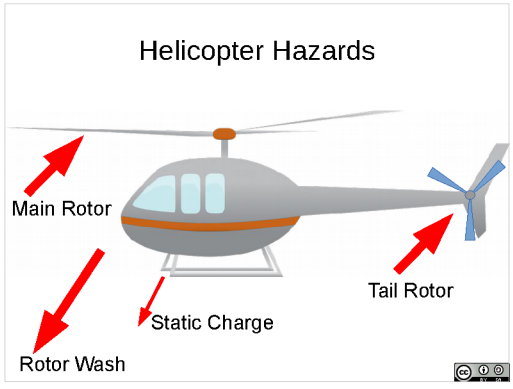
What happens when the climate doesn't value input?
When people have a negative attitude or low morale?
When there is no accountability?

What happens when we aren't willing to critique ourselves?




Back to helicopters.

Helicopters are limited by the weather. If the weather isn't good, don't be surprised if they won't fly a mission.




Working around helicopters is hazardous.

Four of the hazards posed by helicopters are:

The rotor wash (blow stuff into your eyes)

The main rotor and tail rotor.

Helicopters develop a static charge. Forming a circuit between the helicopter and the ground can deliver a very large shock.


Landing zones are dangerous

Helicopters stay up by forcing air down with their rotors.

Lots of air.

## Landing Zone Safety

- Secure loose clothing and equipment.
- Keep landing areas clear of loose debris.
- Provide visual wind indicators for landing and takeoff.
- Wear eye and hearing protection. Wear a helmet secured by a chin strap.

The rotor wash will blow things around on landing and take off – moving lots of air.

Keep the landing area clear of debris.

Keep your own clothing and equipment secured.

Wear hearing and eye protection and a helmet.

The pilot needs to know what the wind is doing: Provide an indicator of the wind (large flagging tape streamers...)


Here's a signal that can be used to indicate the wind direction.

Stand upwind of the landing zone. Face the landing zone, extend your arms to point with the wind into the landing zone.

At night, shine headlights onto the landing zone.

## Landing zone/Helispot

- Preferably: pre-planned landing zone, with ground support from local fire department.
- Check and clear the area of FOD – Foreign Object Debris.
- At night, illuminate helispot with lights shining onto the ground (not strobes).
- No Flares, No Smoking, No ignition sources.
- Site clear of overhead wires, towers, obstructions. Site clear of all obstacles taller than 12 inches. Site with less than 7 degree grade.

Landing zones are usually pre-planned and known to the local fire department and or PSAP (dispatch center).

## Landing Zone Safety - Approach

- Never approach the helicopter until the pilot or crew directs you to do so.
- Approach and depart from front or with 45° of the front of the helicopter.
- Approach crouching, in full view of the pilot.
- Do not walk toward the tail rotor.
- Approach from downhill side, depart downhill.
- Carry nothing above shoulder level.

Only approach a helicopter under the direction of the crew.

Carry nothing above the shoulder level.

## Only Approach From the Front Only on the Crew's Signal

Remain at least 150 feet away from the Helicopter.

Only approach under the crew's direction.

Medical helicopters may load from the rear. Only approach with an escort by a crew member. Why? You don't want body parts chopped off by the tail rotor....

## Landing

- Preferred: Full touchdown, flat landing zone clear of obstructions
- Slope landing: Up to 5 degree slope. Risk of striking tail on slope. Risk of dynamic rollover.
- Power on landing: Both skids on ground, running full power. Snow landings, landings next to drop off.
- One Skid landing, Toe-in landing.
- Hover Landing: Skids don't touch the ground, aircraft can move.

Preferred landing is on a flat landing zone clear of obstructions.

Landing in other conditions may be possible, but comes with increased hazards.

## Slopes

- Approach and depart from front or with 45° of the front of the helicopter.
- Approach from the down slope side of the helicopter.
- Depart the helicopter going down hill.

Approaching or leaving a helicopter on sloping ground – do so on the downhill side.

Only approach or depart from within 45 degrees of the front.

## Flight safety

- Seatbelts fastened at all times.
- Secure all loads (packs, ropes, loose equipment) under the direction of the crew.
- Secure canines under the direction of the crew (rappelling harness, muzzle).

In flight, follow the directions of the crew.

Keep seatbelts fastened at all times.

Secure all loads (including canines) under the direction of the crew.

## ICS Helicopter Related Locations

Helibase:

H Helispot:

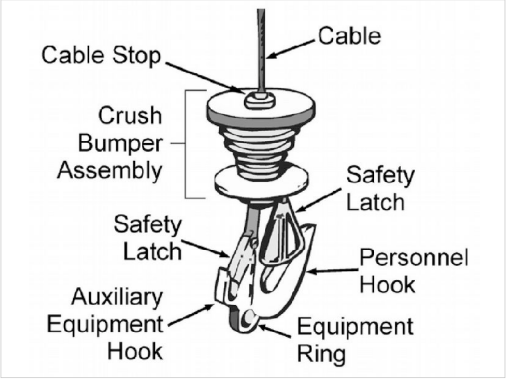
There are two Helicopter related location under ICS:

Helibase – a place where helicopters can land, be fueled and maintained.

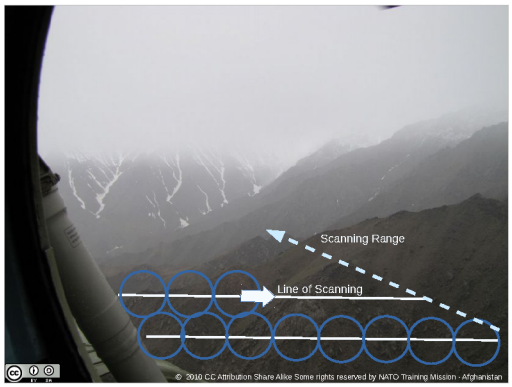
Helispot – a place where helicopters can land.

Most municipalities in MA will have pre-planned Helispots for medical helicopters known to the local fire department and to dispatchers.


Helicopters with appropriate equipment, certifications and trained crew can perform some rescue operations (vertical hoist between the ground and the helicopter; rarely long haul).



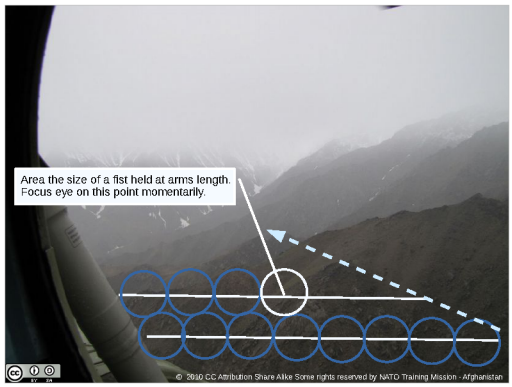

This is a typical helicopter rescue hook. Humans get hooked into the large hook (not the smaller auxiliary equipment hook or the equipment ring).




Helicopters can be used as aerial search platforms, as can other aircraft.

Air observers are trained to scan the ground in a systematic way.

Unlikely to be used as an air observer, but the technique is valuable for observing in search in general.




Hold a fist at arms length.

This is the size of the area you look at – focus the eye and your attention on this area momentarily

Don't scan your eyes across the landscape, look at one area, then move to the next, look there momentarily, then move to the next.

Looking on one side, work from the direction of travel backwards in a line, then move to the next line forward.

Time to complete one diagonal line is time it takes aircraft to advance one fist width.

## Air Observing

- Highly Fatiguing – limit to 2-3 hour sessions.
- On spotting something, point at it.
  - Note the position of the sighting with respect to landmarks.
  - Notify pilot.
  - Use clock positions to describe location of sighting.

Air observing is highly fatiguing – limit to 2 to 3 hours.

On spotting something, point at it (also standard practice for a person in distress in the water).

Tell the pilot (use clock positions, 12 o'clock straight ahead of aircraft, 3 o'clock straight off right side, 6 o'clock directly behind.

Note landmarks around the location.


How can bicycles be used in SAR?

## Safety

- Trail riding isn't like riding on the street.
- Be Fit, Hydrate.
- Ride within your skill level. Stay in control of your bike.
- Wear PPE
- Yield to horses: Dismount, wait for them to pass Talk with the riders, they may have seen the subject.
- Yield to other trail users (talk with them).

Despite the picture on the previous slide, mountain biking isn't like riding on pavement.

Terrain is irregular, there are hills, rocks, trees.

You need to be fit. You need to be competent on a mountain bike on trails.

You need PPE.

## PPE

- Helmet
- Gloves
- Eye protection
- Appropriate footwear: without laces or keep laces tucked in.
- Layered clothing when cold.
- Suitable clothing for the conditions.
  - Consider protective clothing – padding for hips, elbows, shoulders.
  - Keep pants legs tucked in.

Key piece of PPE is the helmet:

But also, gloves, eye protection, clothing suitable for the weather (hot/cold/wet/dry) while doing episodic strenuous exercise.

Make sure that boot laces and pants can't get entangled in the chain.

Trail conditions may merit padding and protective clothing. We

## Use in Search

- Rapid coverage of trails.
- Less clue destruction (physical and audible) than ATVs.
  - Stop and check for sign, particularly check track traps.
- Requires PPE
- Unlike horse, rider has to drive.

Mountain bikes are valuable tools for search.

Mountain bike teams can rapidly cover trail systems.

They are quieter and less destructive than ATVs.

Rider still has to operate the bike: Stop and check for sign, in particular check track traps.


ATVs can be used in SAR.

## ATV

- Engine driven, primarily intended for off road travel.
- Definition and regulation varies by state, generally handlebars and a seat straddled by the rider.
- Independent suspension
- Rider Active – operation affected by position of the rider.
- Most are single rider only
  - If designed to carry passengers, requires: extra seat with back, extra footrests, bars for passenger to hold.

Definition of an ATV varies from state to state, engine driven, designed for off road use, usually have handlebars and a seat straddled by the rider, usually only one rider.

Unlike a car, they are Rider Active – handling and operation is affected by the position of the rider.

## Safety

- Obtain specific training (**this isn't it**) before operating an ATV. It is a powerful, dangerous vehicle.
- PPE
- Inspection checklist before use (per owners manual).
- Know your limitations and stay within them.

Behave in their own sort of ways, thus require specific training (this isn't it) to operate.

## PPE

- Helmet (meeting state requirements) with face shield or Helmet with shatter resistant goggles.
- Gloves – thick, padded knuckles
- Boots – above ankle, keep clothing tucked in, raised heels, rubber soles.
- Protective clothing – with kneepads, chest protector, padding for hips, elbows, shoulders. Legs: over the calf cut and abrasion resistant protection.
- Layered clothing when cold

ATVs require PPE.

## ATV: Use In SAR

- Fast, can haul loads.
  - Logistic support for rescue operations
- Loud, destructive.
  - Stop to listen.
  - Stop to check for sign – particular attention to track traps
- Focus on Safety
- Interacting with mounted SAR:
  - Pull over, stop, turn off engine, remove helmet.

ATVs can be used in SAR operations.

Primary role: Logistic support.

They are loud and destructive.

When using in the Locate phase of a search and rescue operation:

Stop. Listen. Look.

Pay particular attention to tracktraps and check for sign.

If interacting with horses, pull over, stop, turn off engine, remove your helmet (so you look human to the horse).


Snowmobiles can also be used in SAR.


Like ATVs, Snowmobiles require specific training (and this isn't it).

## Snowmobile: Use in SAR

- Fast, effective cross country transport on snow.
- Loud
  - If in Locate phase, consider stopping regularly and moving away from the machine for sound sweeps.
- Destructive
  - Watch for Clues
  - Check choke points on travel routes carefully for sign.

Similar to ATVs, Snowmobiles can support SAR operations.

Good for logistic support and for travel over snow.

Like ATVs, loud and destructive.

When in the locate phase of a SAR operation:

Stop, Look, Listen.

Check for sign.

Particularly stop and check choke points on travel routes for sign.

## Advantages/Disadvantages?

- Equine
- Mountain Bike
- ATV
- Snowmobile
- Foot

What are the advantages and disadvantages of these SAR platforms?

Discuss. Some examples:

Horses: Sensor itself. High vantage point. Rapid travel. High maintenance/training/care/feeding needs.

Mountain Bikes: Rapid travel, quiet, needs maintenance

ATV/Snowmobile: Rapid, loud, destructive of sign, need maintinance, specialized training.

# Communications and Accountability



Unit 19: Communications and Accountability



## Communications

- Radio – limited resource, shared locally and globally
- International convention on shared use of radio spectrum
- National laws implementing the international agreements
  - US: FCC – Federal Communications Commission
    - Specific rules for specific Radio Services

For communications in SAR we tend to rely heavily on portable radios.

Seems simple, push the button and start talking...

Lots more than that involved in communicating effectively and professionally.

Radio frequencies are a limited resource, some sorts of radio signals readily travel around the world, so there is an international convention on how to share that limited resource, and national implementations.

In the US, the Federal Communications Commission produces specific rules for different radio services – public safety is one radio service, amateur radio another, broadcast television another, etc.

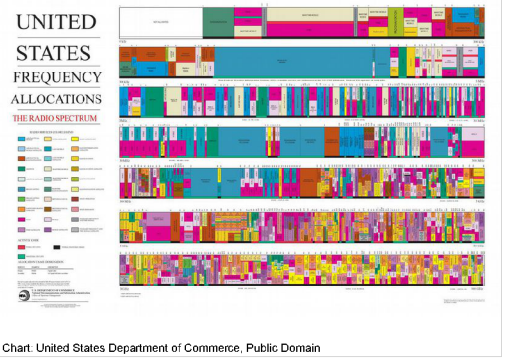


Chart: United States Department of Commerce, Public Domain

Here is a visualization of radio frequencies are allocated in the US by the FCC.

## Radio Services

- No License required
  - FRS
  - MURS
  - CB
- License required
  - Amateur Radio Service (individuals)
  - Public Safety (public safety agencies)
  - Land Mobile (commercial)
  - GMRS (families)
- [Marine]

Some radio services require a license, some do not. Capabilities of services vary considerably.

Marine radio service is limited to marine use only, land to land communication not permitted.

- FRS, No License, Small set of shared frequencies, 0.5 watt, FM, UHF.
- GMRS, License per family, Small set of shared frequencies, 7 shared with FRS, 8 repeater pairs, Typically 1-5 watt, up to 50 watt, FM, UHF.
- Citizens Band. No License. Small set of shared frequencies, AM, HF.
- MURS, No License, Small set of shared frequencies, 2 watt, FM, UHF
- Public Safety. License per agency, frequency coordination through coordination body (APCO), one or a few frequencies. May be encrypted, VHF or UHF, 11KHz FM, can be Trunked digital, often repeater pairs.
- Amateur Radio. Individual license, written tests. Multiple bands, many frequencies, repeaters, digital networks, location beacons, video, many different capabilities.

Here's some of the capabilities of some of the radio services potentially usable by SAR resources.

## Parts of a Radio

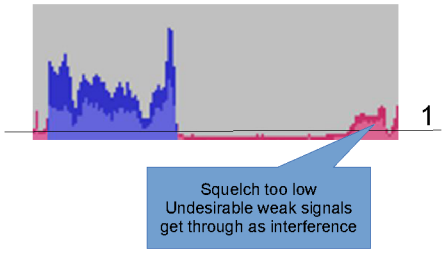
- Antenna
- PTT button
- Battery
- Volume control
- Squelch control
- Speaker
- Microphone

FRS Radio: Open Clip Art

Get to know your radios.

PTT button, location of the microphone, battery level, volume, squelch.

## Squelch

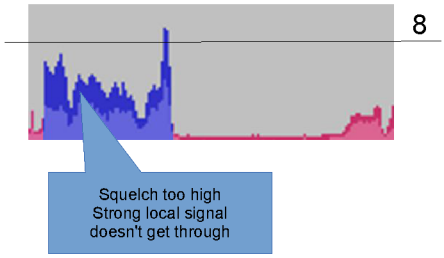



Squelch control lets you decide how strong a radio signal needs to before the radio will turn it into sound and play it over the speaker.

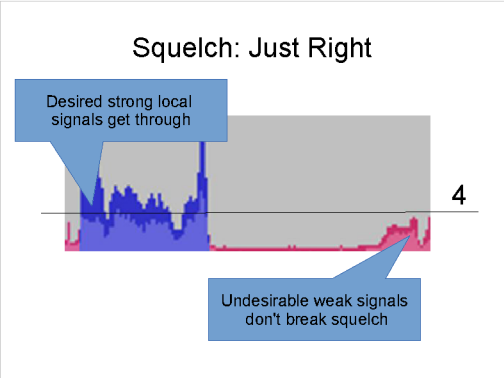
Turn squelch down to zero and you will hear the background noise of the universe – static, until a signal comes through.

Set a low squelch level, and you will hear weak signals, this may be undesirable, they may be other people at a distance using the same frequency for something else. Or, it may be desirable, you may need to turn down the squelch to hear a transmission at distance in terrain.

## Squelch

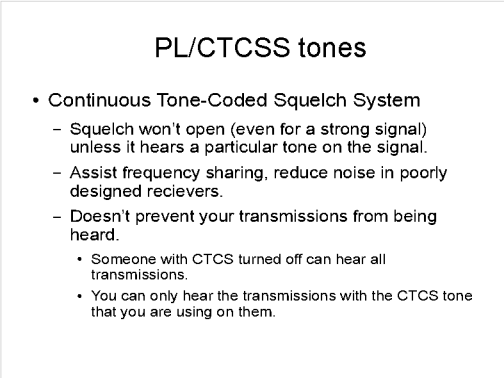



Turn the squelch up too high, and you won't be able to hear most of the strong local signals you are interested in.

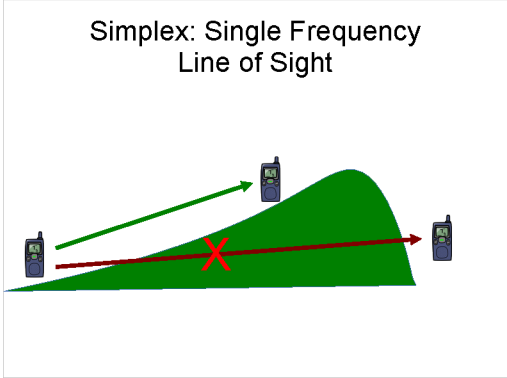



You've got the squelch set right when you can hear the signals you want to hear, but not other weak signals.

In general, you want the squelch set just above the noise background – turn the squelch down until you hear static, then turn it up slightly so that the radio goes quiet.



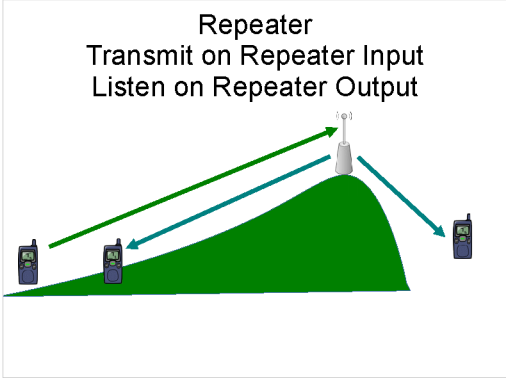

PL Tones (nothing to do with privacy): A tool that can help you to reduce the amount of unwanted noise you have to hear.




You will often be operating radios on a single frequency (simplex), line of sight.

Terrain gets in the way.

You probably won't be able to talk to another station on the other side of a hill.




In some services, repeaters can be used, an radios are programmed to use two frequencies at once.

A repeater is placed on a high point (or a tower on a high point).

Radios transmit on one frequency. The repeater listens on this frequency. The repeater re-transmits the signals it receives on a second frequency. All the other radios are listening to this repeater output frequency.

Everyone who the repeater can hear can talk with anyone else who can hear the repeater.

Radio systems can also use multiple linked repeaters.

## Troubleshooting Radio Communications

- Some common sorts of issues
  - Low Battery: Radio transmits briefly then drops out. Radio can hear transmissions but won't transmit.
  - Loose speaker/microphone connector: Radio appears to be on but isn't transmitting and/or you can't hear anything.
  - Weak, broken signals: Hold the radio up in the air, antenna vertical. Turn down the squelch. Hold the radio vertical over the top of a car. Move to higher ground

Train as you search.

Use your radios regularly in training.

Understand their capabilities.

Give problems an opportunity to arise, then work them through.

First word or so lost in a transmission?

Probably Operator error, not pausing before talking.

So:

## Using a Radio

- **Plan** what you are going to say.
- Listen to make sure channel is clear.
- Press PPT button.
- Pause.
- State your message.
- Release the PPT button.
- Establish contact then transmit message.
- Use plain English, no codes.

Think out your (brief) message.

Listen (don't step on someone else who is transmitting).

Press Push to talk.

Pause. Then start talking.

First call up the station that you are trying to reach, then when you've established contact, transmit your message.

## Establishing Contact

- One Convention:
- Your call **to** the station you are calling:
  - Ground Team 3 **to** Operations
- Another Convention:
- The station you are calling **from** your call:
  - Operations **from** Ground Team 3

Two methods for establishing contact (for initiating communications).

You TO the station you are calling.

Or

The station you are calling FROM you.

Within an agency, often one convention adopted and the pro-word left out. "Ladder 2, Control".

For multi-agency response, use a pro-word (and settle on the convention that emerges in the incident).

Doesn't particularly matter which convention.

## Failure modes
## If you start talking before transmitting:

- Your call **to** the station you are calling:
  - Ground Team 3 **to** Operations
  - This is Operations, station calling, go ahead.
- The station you are calling **from** your call:
  - Operations **from** Ground Team 3
  - ????

With one difference between the two conventions:

It is not unusual for the beginning of a transmission to be lost (someone starts talking before pressing down the PTT key, someone keys up a repeater and starts talking before it picks up the signal and starts repeating it).

The typical failure case of the beginning of a transmission being lost is more easily recovered in the me TO you order than in the you FROM me order.

Better: **Avoid the Problem:** Remember to start transmitting, pause, and only then start speaking.

## Call signs: Who are you calling

- ICS Positions
  - Command: The incident commander
  - Operations: The operations section chief
- ICS Locations
  - Base: A logistic support base
  - Staging: A staging area
- Functional call signs
  - Ground Task Force 5:
  - Ground Strike Team 3:
  - Team Pippa (Single Resource)
  - Control (or Fire Control, or Dispatch: a PSAP center)

In general, don't call people by name over the radio, call their call sign – usually a handle for their functional role in the incident.

## Acknowledge **and** Echo Back

- *task:* Task 4 to Operations
- *ops:* Go ahead Task 4
- *task:* Completed assignment, returning to pickup point.
- *ops:* **Acknowledged, task 4 completed assignment, returning to pickup.**

When someone communicates some message to you do two things:

(1) Acknowledge their message.

(2) Repeat it back to them.

Why?

Take out your notebook and a pen
Turn around
Prepare to copy a location


19T 0297385 4710843

Have most of the class turn around and prepare to copy the coordinate.

Have one member of the class read out the coordinate.

Then (click to display the text),

Have one member of the class read out the coordinate while writing it down (forcing them to read more slowly).

Discuss.

Did they read "UTM" from the second line, or just the coordinate? Did they add Easting/Northing?

Break between Easting/Northing?

## What To Say

- Radio check when departing staging.
- Call in when starting assignment.
- Welfare check, often every 30 minutes.
- Call in upon completion of assignment.
- Clues, with location (unless directed to call in by cell phone).
- UTM Coordinates in **full**, unless some other practice has been established in the search (e.g. last 5 digits of easting and northing).

Always call for a radio check before departing staging – make sure that your communications work before you begin an assignment.

Call in when you start on an assignment.

There should be a radio check of all deployed resources in a search, typically every 30 minutes.

Call in when you complete your assignment.

Call in clues, unless you've been directed otherwise.

## Choose words for clarity

- Affirmative instead of (Yes, OK, 10-4)
- Negative instead of No
- Obtain instead of Get
- Standby instead of Wait
- Received, Acknowledged instead of (OK, 10-4)
- Niner for 9
- Numbers individually: 12 as “one two” not twelve.

Get into the habit of using words that can be clearly understood over the air.

Avoid the use of codes (that’s also an ICS expectation, use plain language for communication).

## How To Say It: Be Professional

- To the point, brief, transmissions
- Speak in a clear normal voice
- Control your emotions
- Remain impersonal: no irritation, sarcasm, disgust, laughter.
- Be courteous (but not “Please”, “Thank you”)
- No Humor on the Air

People are listening.

They will misinterpret what you say.

Be professional.

## What Not To Say

- Assume all communications are being monitored (by the general public and the news media)
- Use other communication channels (cell phone) to report a find of a deceased person
- No codes, unless you have been briefed on a code to use to communicate sensitive information (such as a find of a deceased subject when cell coverage aren't available).
- You do not want someone to overhear something they shouldn’t (the perpetrator may be monitoring search communications).
- Absolutely no swearing the radio

The press is listening.

Friends and family may be listening.

The perpetrator may be listening.

Be professional.

## It is unlawful to

- Transmit false distress signals
  - For transmissions in training that could be mistaken for reports of distress, regularly state “This is a Drill”
- Transmit obscene, indecent, or profane language.
- Cause malicious interference.

Not responsible for communications on your assignment? **Turn your radio off.**

- Unnecessary noise.
- You are wasting your battery. 12 hours from now it may be needed!
- Rumor Control: Someone in hearing distance may hear something they shouldn't (e.g. a friend or family member).

On an assignment, give the communication role to one person. Other people on the assignment don't need their radios on.

## Radio Nets

- Formal Nets Have:
  - A Net Control Station
  - Check In procedure
- Some Types of Net
  - Status (PAR) check
    - Net control calls each station on a list
    - Each station replies briefly with their status.
- Traffic net on more than one frequency
  - Check in and net management on one frequency.
  - Passing of long messages from one station to another is moved to another frequency.

Tactical frequencies – arbitrary station to station communication.

Controlled Net – All calls directed to a Net Control station, net control directs stations how and when to pass messages to each other.

On Controlled Nets, net control can direct stations with messages (traffic) for each other to pass that traffic on another frequency, then return to the net.

Common controlled net in SAR: Status/PAR check.

## Personnel Accountability Report (PAR) [Status Check]

- Roll Call
- Is everyone in an incident physically accounted for?
- Initiated by Command (or a net control station) at regular intervals (20 or 30 minutes).

Status check (PAR (Personnel Accountability Report) in the fire service) – roll call of resources – checking that all personnel are accounted for.

- Fire Service: Call sign, PAR, personnel count, location
  - IC: *Command to all stations stand by for a PAR.*
  - IC: *Ground Task 1, PAR*
  - Ground Task 1: *Ground Task 1, PAR 8, segment 3.*
  - IC: *Ground Task 2, PAR*
  - Ground Task 2: *Ground Task 2, PAR 6, segment 5*
- More usual in SAR: call sign, status
  - IC: *Command to all stations stand by for status check.*
  - IC: *Ground Task 1, status check*
  - Ground Task 1: *Ground Task 1, on task*
  - IC: *Ground Task 2, status check*
  - Ground Task 2: *Ground Task 2, on task*

Fire service typically has a stylized form – when called on by net control (or command) each resource replies with its call sign, PAR, number of personnel accounted for, and location.

SAR, typically more relaxed, reply with call sign and brief status "on task".

## Accountability Systems

- Location of all personnel at all times.
- Identity and location of all responders to the incident.
- Use at every incident (including every training).
- Location and assignment (or other status) of all responders at all times.

## Managing Accountability

- Who has been mobilized for the incident. (sign in)
- Who is out on which task. (SAR task assignment form)
- What is the status of each resource. (T cards)
- Communications to support accountability: (test, on task, regular check-ins, off task).
- Regular status checks – may include location.
- Demobilization: Did everyone get home safe. (demoblization plan and implementation)

Communications are partly about command and control, but also heavily about accountability: Knowing where everyone is in a search all the time.

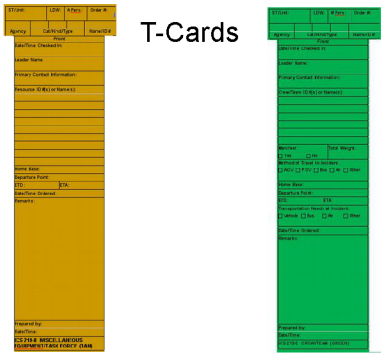
Searches tend to send people off on assignments in a flurry of activity. It is very easy to loose track of who is where.

Always take the time to carefully track who is where doing what.

Make it a habit in training – sign ins, signouts, task assignment forms, status checks.

Train as you search. Make accountability a habit in training so it will be habitual under the pressures of a search.

T-Cards



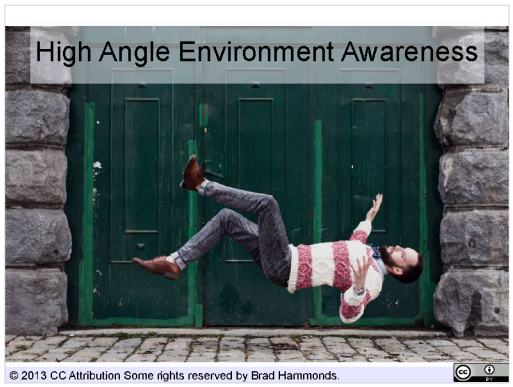
As we've seen before, t-cards, one form for keeping track of who is where.

What are others?

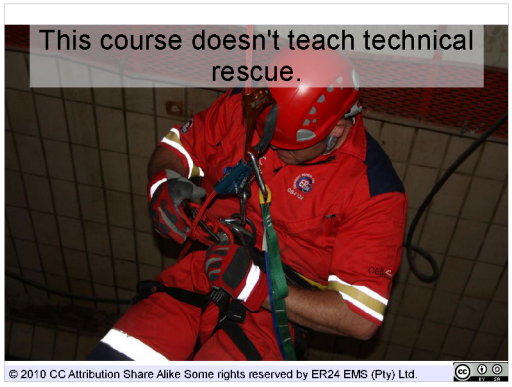
# Ties and Rope


Unit 21: Ties and Rope






Gravity is dangerous.




This course doesn’t teach technical rescue.

Only foundation knots.

This course doesn’t teach you how to operate in the high angle environment, just how to recognize it.

Knot tying skills are a foundation you can build on later with more training.


There is hardware, metal things, and:

**Software**: Rope, Webbing.

Rope comes in lots of sorts. This is a natural fiber **laid rope**.

Fibers are twisted into bundles, which are then twisted into bundles. Fibers don't run the full length of the rope. Load bearing fibers are exposed to damage.

Natural fiber ropes can rot.

Neither laid rope nor natural fibers are used for life safety applications.


This is Kernmantle rope.

Outer mantle provides abrasion resistance. Inner core (kern) of fibers that run the length of the rope and provide its strength.

Almost all modern climbing rope and life safety rope is kernmantle (made of various synthetic fibers).


Rope can be low stretch (bottom) or high stretch (top).

Climbers use high stretch, dynamic rope. They climb, putting their weight on the rock. When they fall, they are caught by the rope, and the rope stretches to absorb the energy of the fall.

Technical rescue almost entirely on static or low stretch rope – the system is rigged to hold the rescuers' and victim's weight on the rope all the time. Anchors and system hold the load all the time.

In High stretch rope, fibers in kernel twisted to have lots of stretch.

In Low stretch rope, fibers in kernel run much more in line with the length of the rope.

[*Parenthetically, a distinction can be made between low stretch and static, not discussed here*]


Software also includes webbing – flat or tubular.


Watch where you put your feet around ropes.

Never ever step on a rope. Why? (grinds sand grains into kernel, these undetectably cut the strands in the kernel and weaken the rope).

Rope under load cuts very easily – needs edge protection running over sharp edges. Avoid having knives around rope systems.

Nylon rope is damaged by exposure to battery acid.

Important to learn to wash rope, inspect rope, care for rope properly.

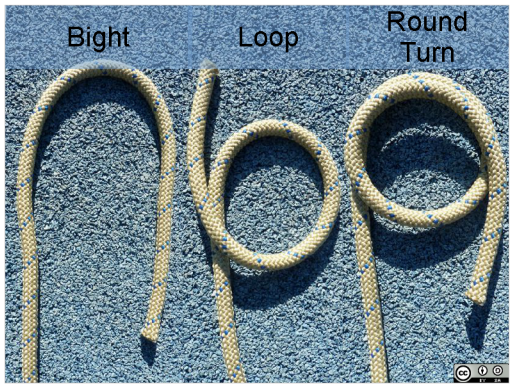
(Image is of damaged kernmantle rope. Outside mantle is damaged, exposing the white core within.)


Rope, webbing, harnesses – software.

Then there is hardware.  Carabiners and all sorts of specialized hardware.

Designed for specific loads in specific directions. Will fail if you load it improperly.

Example: Load carabiners on their long axis, ensure the gate is closed and locked.

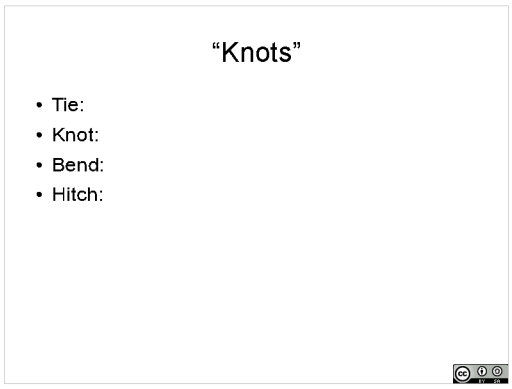



Names (again) to help us see things.

Bight: just a 180 degree bend in the rope.

Loop: Keep going to form a closed loop, with the rope exiting the opposite direction from where it entered the loop.

Round turn: Keep going, there's a full loop, and the rope exits from the same direction that it came in on.




Tie = technical term for what we mean by knot in everyday language.

Three sorts of ties:

Knot = tie that forms a stopper knot.

Bend = a tie that joins two ropes (or two ends of the same rope) together.

Hitch = a tie that attaches a rope to something else.


Running End = Working End – the end you tie a knot in.

Standing part – the rest of the rope, usually the part under load.

## Practice Ties

- Figure 8.
- Figure 8 on a bight.
- Figure 8 on a bight, with barrel knot safety.
- Figure 8 bend, with barrel knot safeties.
- Figure 8 follow through (tie in), with barrel knot safety.
- Double overhand bend.
- Prusik hitch.
- Water knot.
- Expedient Harness (Swiss seat).
- High strength anchor.
- Clove Hitch
- Girth Hitch

Hand out rope and webbing, demonstrate and have everyone tie each of these ties.

Images of each follow. *[You can use the images while teaching the knots if that is helpful, there are some comments on the knots in the speaker's notes]*

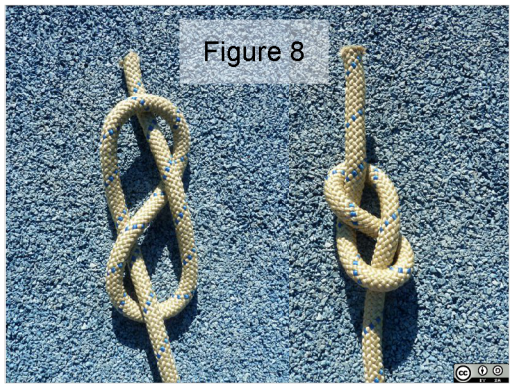



Figure 8 stopper knot.

Foundation life safety knot. Easy to recognize , easy to see that it has been tied correctly.

*The Figure 8 family of knots all take a lot of rope, and can be hard to untie after being heavily loaded.*

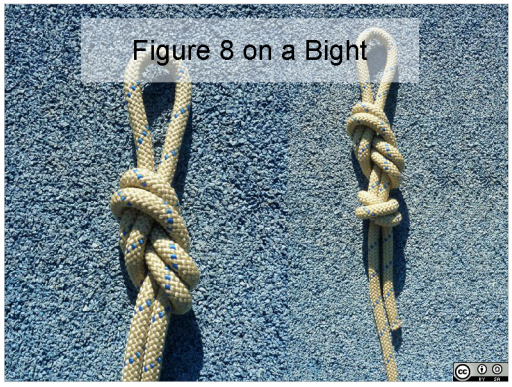



Figure 8 on a bight.

Dress your knots. That is important for their strength.


Barrell knot safety (on a figure 8 on a bight).

Make the loop on your figure 8 just large enough for its purpose.

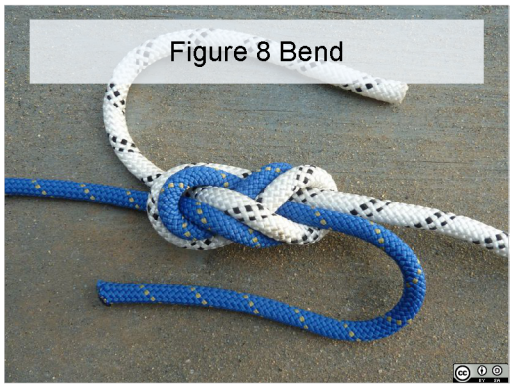
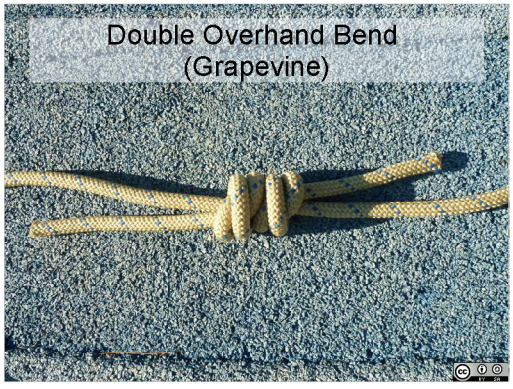



Figure 8 bend.

Bend – joins two ropes together


Figure 8 follow through

Exactly the same knot as the figure 8 on a bight, but tied in a follow through (to attach to a harness or some other closed ring).




Double overhand bend.


Prusik hitch.

Hitch, joins a rope to something.

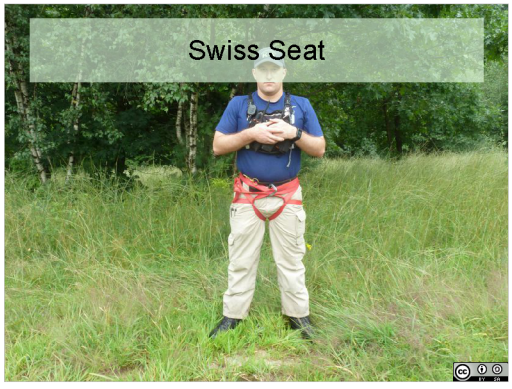
Prusik hitch slides, but locks when loaded.


High Strength Anchor/Tensionless hitch.

Put edge protection around the anchor.

Precisely three wraps [*See the discussion in "On Rope"*].


Water Knot – bend to tie in webbing.




Expedient harness.


Clove hitch.

Two ways to tie (in the air and drop onto something, or around something) .




Girth hitch.

[*Girth Hitch and clove hitch can be used to attach webbing to a litter*]

# Land Navigation IV
# Communicating Location


Unit 22, Land Navigation IV: Communicating Location (Grids and GNSS)



## Describing location on a map

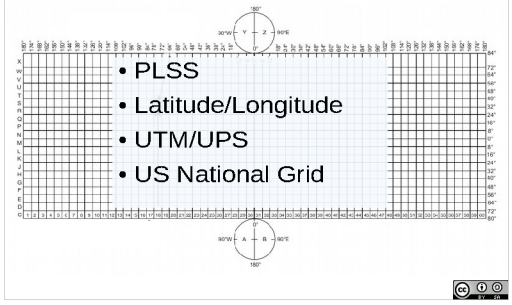
- PLSS = Township, Section, Range
- Latitude and Longitude (Geographic coordinate system)
- UTM: Universal Transverse Mercator
- MGRS: Military Grid Reference System
- USNG: US National Grid
- UPS: Universal Polar Stereographic
- Ordinance Survey (GB) Grid
- State Plane Feet
- etc....

There are many ways to describe a location on the surface of the Earth.

Most place some sort of a grid on the map.

Some are only used in some parts of the world, some can be used anywhere.

## Map Grids



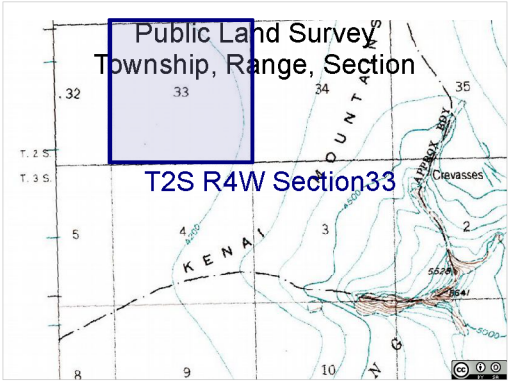

We will look at a few of them.

Public Land Survey System (Township/Section/Range) widely used in the central US and Canada.

Latitude and Longitude.

UTM: Universal Transverse Mercator

and a variant of UTM: US National Grid.

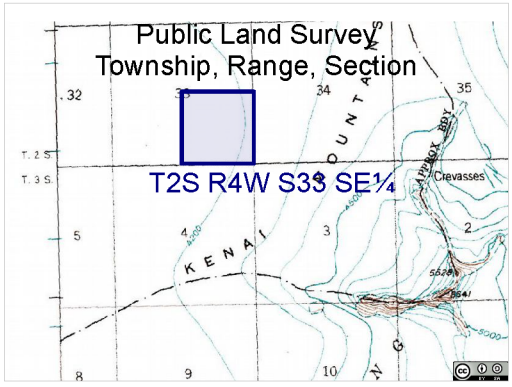



The Public Land Survey System divides portions of the world into a grid of east-west Township lines and north-south Range lines. Township and Range lines are each 6 miles apart from each other and form a grid of 36 square mile squares (these run off of baselines, thus Township 2 South is the second township south of some baseline).

Each Township/Range is divided up into 36 one mile squares called sections. The sections are numbered (with one pattern in the US and a different one in Canada).

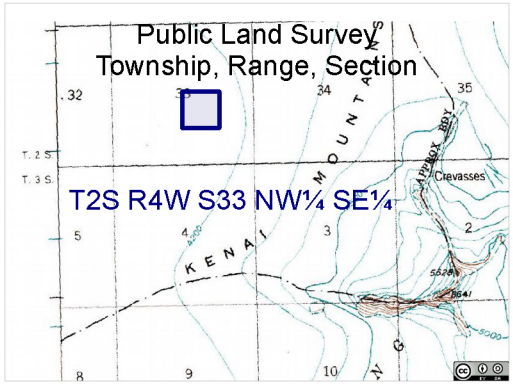
A single one mile square can thus be referenced by township, range, and section: Township 2 South, Range 4 West, Section 33.

(Locations aren't unique, there are multiple baselines).




To describe a position more precisely than a one mile square, sections can be divided into quarters.

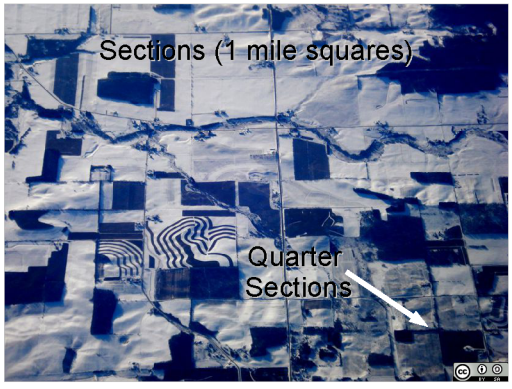
Here is the South East quarter of Township 2 South Range 4 West Section 33.




Quarter sections can be further divided into quarters.

North West quarter of the South East quarter of Township 2 South Range 4 West Section 33.

And so on.

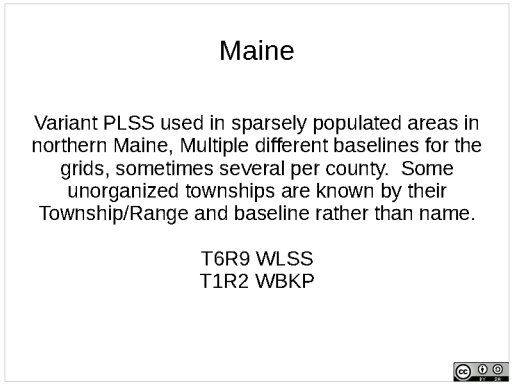



You fly over the middle of the country and you see the PLSS grid laid out on the ground in roads and fields.

The PLSS dates from the time of settlers moving west.

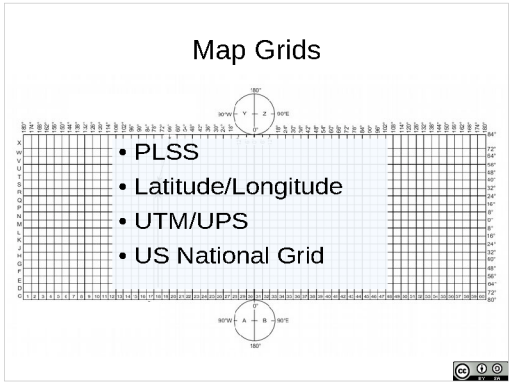
In the central US and Canada, the grid has the advantage of being laid out physically on the ground with roads, fences, and fields.

What use in New England?



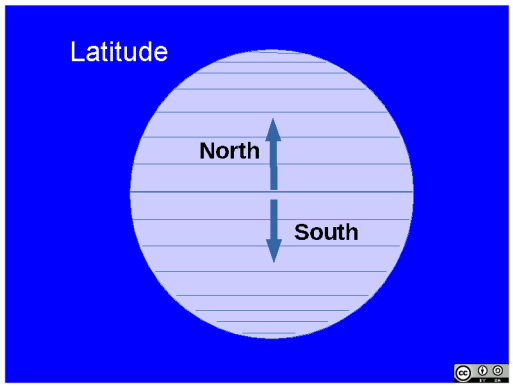

None, except in some parts of rural Maine.

There are unorganized townships in Maine known by their Township and Range, not by name.




Next: Latitude and Longitude.

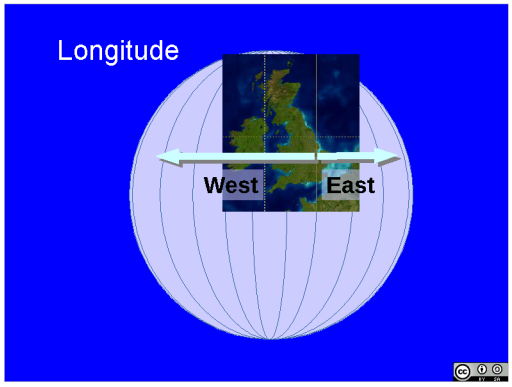
Latitude and Longitude allow you to describe your position anywhere on the surface of the Earth with a pair of numbers.




Latitude is position north or south of the Equator.

Equator is 0 degrees. North pole is +90 degrees. South pole is -90 degrees.

Lines of Latitude are evenly spaced on the surface of the Earth. One degree of latitude is 60 nautical miles (or 69 miles or 111,194 meters). (one minute of latitude is 1.85 km, one second of latitude is 30.8 meters).

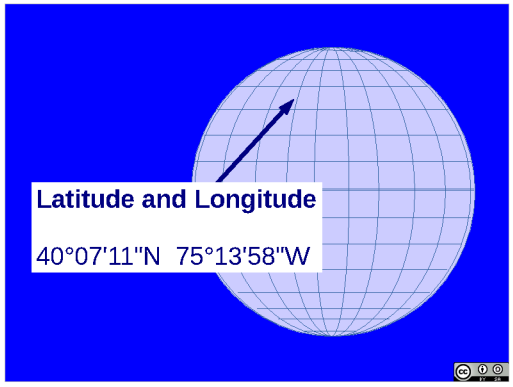



Longitude is position East or West of an arbitrary line (which runs through Grenwich, England). Lines of longitude are called meridians.

Longitude is conventionally a number in the range 0 to 180 degrees West or 0 to 180 degrees East.

Meridans converge towards the poles, so the distance represented by one degree of longitude varies depending on how far the position is from the Equator. At the Equator, one degree of longitude is 111,194 meters (or 60 nautical miles). Move north or south and this gets smaller.

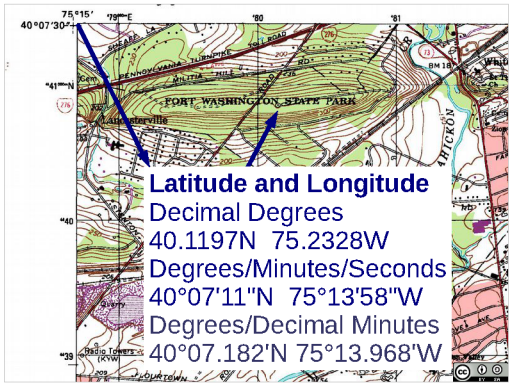
Degrees of longitude do not translate easily to distances (in miles or meters). This is a disadvantage of Latitude/Longitude.




A particular point on the surface of the Earth is described with a Latitude and a Longitude.

Latitude and Longitude can be expressed in Degrees, Minutes, and Seconds (with 60 Minutes to a Degree, and 60 Seconds to a Minute.

Here we have a position of 40 degrees 7 minutes 11 seconds North, 75 degrees 13 minutes 58 seconds West.



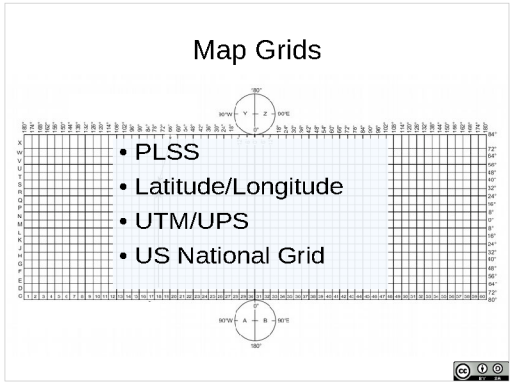

Latitude and Longitude can be expressed in three different ways:

Most common: Decimal Degrees (widely used by Geographic Information Systems (GIS), and by Google Earth and Google Maps).

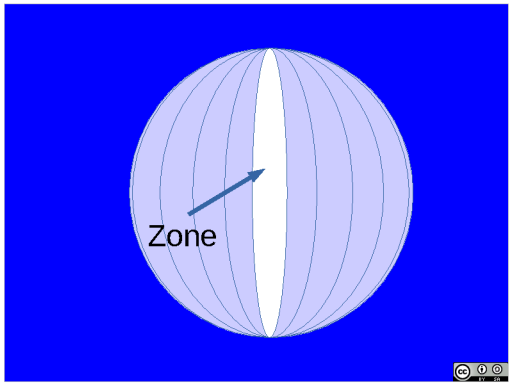
Decimal degrees are often represented with North and East positive, and South and West negative (you can type “40.1197, -75.2328” into Google maps).

Also used (and printed on USGS topographic maps) are: Degrees, Minutes, and Seconds (one second of latitude is 30 meters, Lat/Long tics on the edge of the maps are typically 2’30” (or 4.6 km apart)).

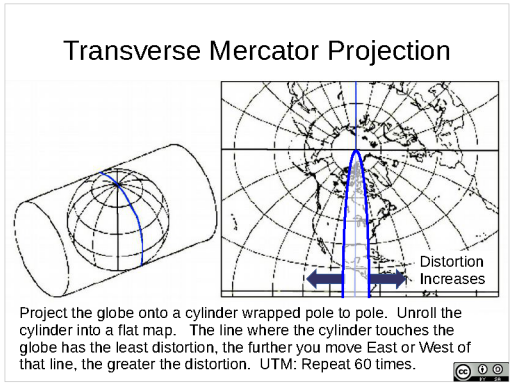
Sometimes used: Degrees and decimal minutes.




Next: UTM: Universal Transverse Mercator.

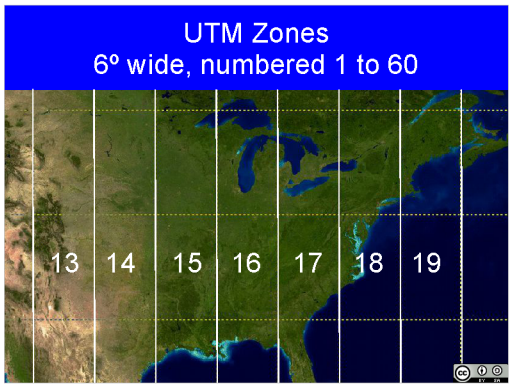



UTM starts by dividing the world up into 60 6 degree wide zones (60*6=360).



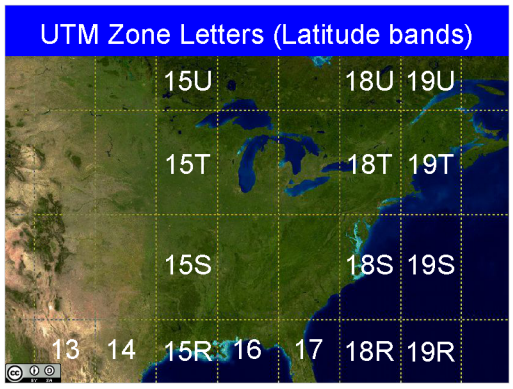

UTM is Universal Transverse Mercator. In UTM, each of the 60 6 degree wide zones is projected separately onto a cylinder touching the surface of the earth in the center of the zone (the cylinder is then unrolled into a flat map (and the 60 zones can be spliced together to make a map of the world)).

In the Mercator projection, the cylinder touches the Earth at the equator, and distortion increases towards the poles (Greenland looks much larger than it really is) It the transverse mercator projection, distortion increases away from the center of each zone. Since the zones are only 6 degrees wide, distortion on maps of small areas is minimized.



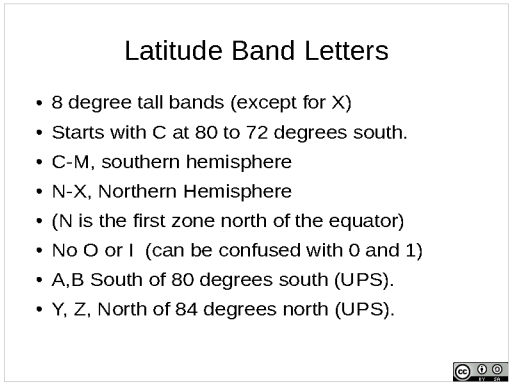

These zones are numbered 1 though 60 (starting at 180 degrees West (the zone 30/31 boundary runs through the Greenwich meridian)).

New England falls into zones 18 and 19.



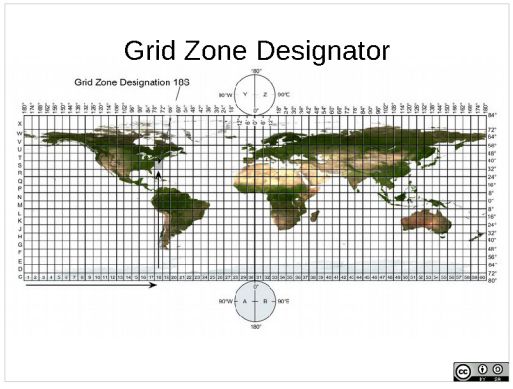

Zones are divided into 8 degree tall bands, each band is given a letter.

New England falls into the T band, thus into 18T and 19T.




Band lettering starts at 80 degrees south latitude with C. N is the first band north of the equator. Not all letters are used, O and I are left out as they are too easy to confuse with numbers.

The poles are handled separately (we'll come back to that).




Here's a map showing the layout of the zones and bands.

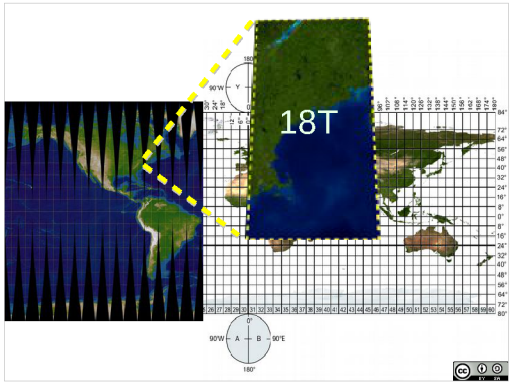
Zone 1 starts at 180 degrees west. The zone 30/31 boundary runs along the Grenwich meridian (at zero degrees Longitude).

(Band letters start with C at 80 degrees south latitude, N is the first band north of the equator. Poles are handled separately (bands A,B, Y and Z).

A Zone number and band letter provide a Grid Zone Designator (e.g. 18S, zone 18, band S)

Locations within each zone are described with a pair of numbers: an Easting, and a Northing.

The poles are handled separately.

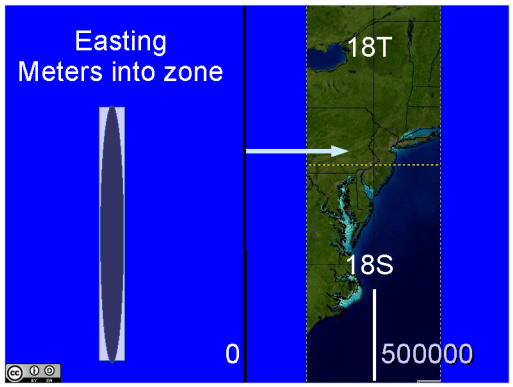



So we've got a Grid Zone Designator.

This describes an area on the surface of the Earth.

But the Earth isn't flat – zone 18 is a curved pie slice (left), not a neat rectangle (left, the distorted projection onto a flat surface), so 18T isn't a nice neat rectangle – it's a piece of a curved pie slice, it gets narrower as we go North.

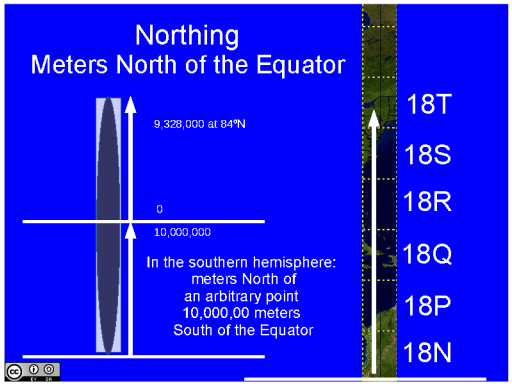
The problem becomes: how do we describe a position in this curved pie slice with a nice neat rectangular grid (where numbers in the grid represent distances on the ground (unlike latitude/longitude, where one degree of longitude varies in length depending on how close to the poles you are)).




UTM solves this problem with a grid of two distances in meters, the Easting, and the Northing.

The Easting is the distance in meters into each zone from an imaginary base line for that zone, placed so that the 500,000 meter (500 km) Easting lies in the center of the zone.

At the equator, zones are 6 degrees (= 360 nautical miles = about 667 km) wide. They get narrower towards the poles.



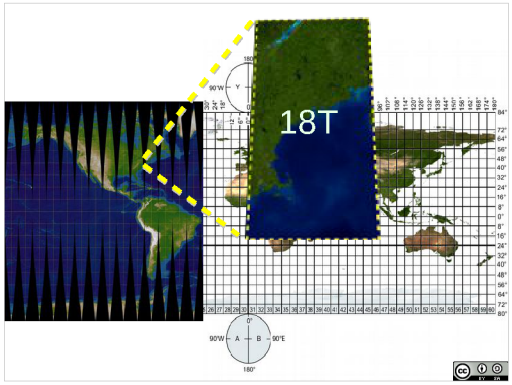

Northing is measured as distance in meters north of the equator.

Or, in the southern hemisphere, meters north of an imaginary base line 10,000,000 meters South of the Equator.


Putting Zone, Band Easting, and Northing together let us describe a point on the surface of the Earth to a precision of 1 meter.

Here: 19T 0355000 461350

Zone 19, Band T, easting of 0355000 meters, northing of 461250 meters.




We've laid a nice neat rectangular grid on the curved pie slice.

There are a few consequences of this.

First is the difference between True North and Grid North.

The 500,000 meter meridian runs right up the center of the zone, but the east and west edges of the zone converge on each other – while the grid lines run straight.

Map projection to left: Author: Lars H. Rohwedder
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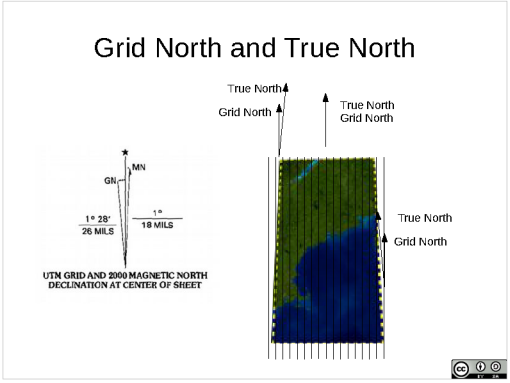
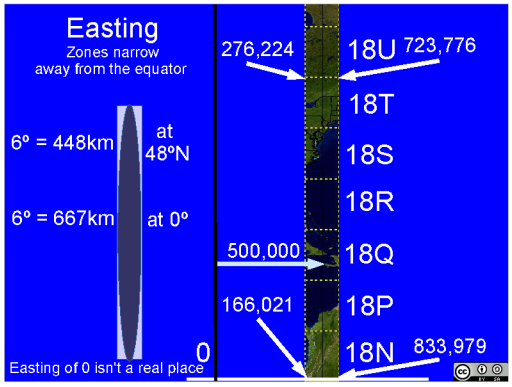



Thus, Grid North (the north of the UTM grid lines) is the same as true north at the 500,000 meter eastings. But Grid North is slightly off from True North near the Zone Boundaries.

Near the center of a zone (with Eastings about 500000), place your compass along the UTM grid lines and it will be aligned with True North.

Near the edge of a zone, place your compass along the UTM grid lines and it will be slightly off from True North.

USGS Topographic Maps and US National Map maps will have a description of how far off grid and magnetic north are off from True North. In mid-latitudes the difference between grid and true North will be relatively small

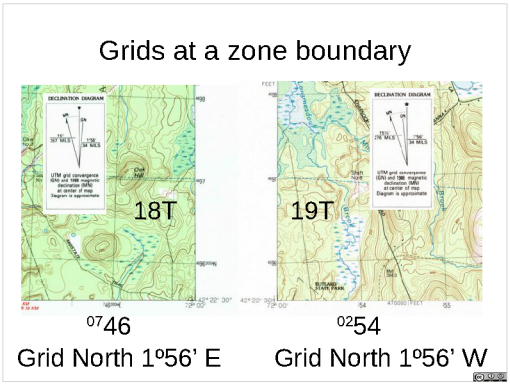



Second: Since the zones are slices through a spherical globe, they are widest at the equator and narrow towards the poles. Since the UTM grid lines form a rectangular grid, the smallest Easting in a zone gets larger as you move North.

Thus the smallest Easting at the Equator is about 166,000 meters (and the largest Easting at the Equator about 833,000 meters), and each zone is about 667,000 meters (667 km) wide at the equator.

Moving north, the zone narrows, so the smallest Easting within the zone gets larger, and the largest gets smaller. At the north end of band T (48 degrees north) the 6 degree wide zone is down to a width of 448 km, with a smallest Easting of 276224 meters, instead of the smallest Easting of 166021 meters at the Equator.

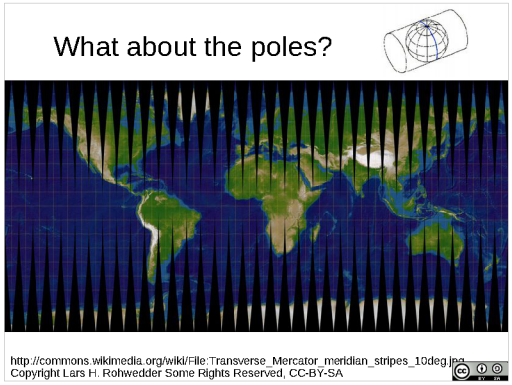
The 500000 m Easting lies right down the middle of the zone (right on the 75 degree West Meridian for Zone 18).




Here's the 18T/19T zone boundary (the 72 degree meridian) in Massachusetts (Barre quardrangle to the left, Sterling quadrangle to the right). Grid North in Sterling is 1 degree 56 minutes West of True North. Grid North in Barre is 1 degree 46 minutes East of True North, about 2 degrees.

Declination diagrams also note the difference in mills (1 mill is 1 meter at 1 km) difference at the edge of the Zone between grid north and true north is 34 mils, thus 34 meters in 1 km of travel, not particularly significant for navigation on foot. (Difference here between true north and magnetic north is about 15 degrees, 267 mils, 267 meters in 1 km of travel, much more significant.)

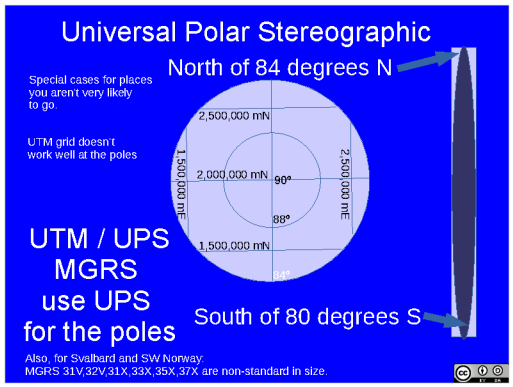
Easting of last gridline on the left is 0746000, on the right 0254000, largest and smallest of their zones at this northing.




Remember the 60 separate projections onto a cylinder, each 6 degrees wide?

UTM Zones keep getting narrower the closer and closer you get to the poles – short travel distances would move you between zones (at an extreme, near the North pole, a few steps could have you traversing tens of zones).

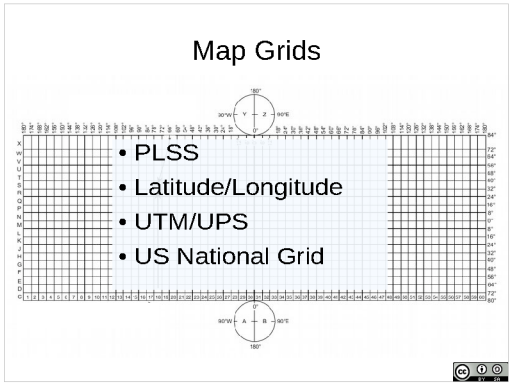
So, at some point North and South, UTM becomes an ineffective system.




Thus, North of 84 degrees North, and South of 80 degrees South, a different system, Universal Polar Stereographic is used.

In your GNSS, you will have an option for a coordinate system called UTM/UPS.

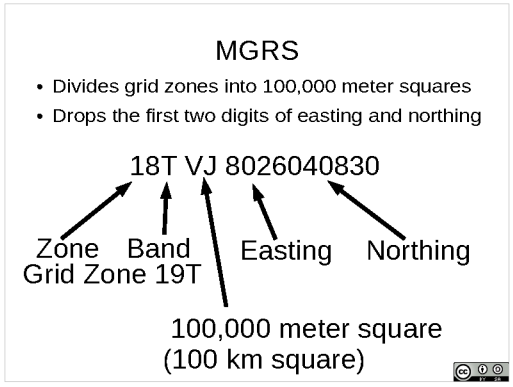
UPS is a similar sort of system to UTM, there are Bands (A,B,Y,Z), and Eastings and Northings are measured in meters off of imaginary base lines (with the poles set at 2,000,000 meters).




Next coordinate system: a variant of UTM: US National Grid.

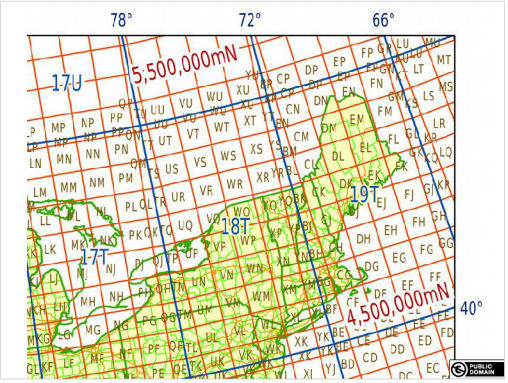
UTM allows us to describe a position on the surface of the earth: 19T 0355000 461350 Big long list of numbers.

US National Grid allows us to simplify this position to just communicate the minimum amount of information needed for the situation.




US National grid is based on Military Grid Reference System (MGRS). US National Grid coordinates (anywhere in the US) are same as the MGRS.

MGRS and USNG use UTM coordinates, but represent them slightly differently – key difference is that they divide the grid zones into 100,000 meter (100 km) squares, each defined by a letter (VJ in this example), and drop the first two digits of the Easting and the Northing, so that the Easting and Northing have 5 digits each instead of 7 at 1 meter resolution.




Here are the 100 km squares for Grid Zones 18T and 19T. Boston is within 19T CG, the Berkshires span 18T XM and 18T XN.

Note that 18T YN and 19T BH aren't square and are cut off by the 18/19 zone boundary (at 72 degrees (we saw the Barre/Sterling quad boundary earlier)). Note how the 100 km grid lines converge on the zone boundaries as you move North – the 100 km grid lines are Grid North, the 72 degree meridian is True North.

## US National Grid

- FGDC standard: FGDC-STD-011-2001
- http://www.fgdc.gov/usng

18T VJ 8026040830
VJ 8026040830
8026040830
80264083

"USNG coordinates shall be identical to the MGRS numbering scheme over all areas of the United States including outlying territories and possessions."
USNG not defined for N of 84°N, or S of 80°S (UTM and USNG grids differ from MGRS in Svalbard and SW Norway)

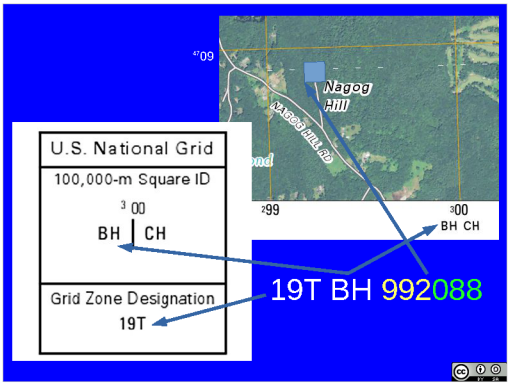
US National Grid coordinates are identical to MGRS in any US territory.

(USNG only differs from MGRS off the coast of Norway (where NATO expanded some of the grid zones so that operations off the coast of Norway wouldn't continually change zones) and at the poles where USNG doesn't formally adopt UPS.

USNG defines specific ways to leave out parts of the coordinate to limit how many numbers and letters need to be communicated to just those needed for the situation.

## US National Grid: Simplifying

- 18T VJ 8026040830
- VJ 8026040830
  - Leave off grid zone
- 8026040830
  - Leave off grid zone and grid square
- 18T VJ 802408
  - Leave off some numbers (leave off 2 = 100 m square)
- 802408
  - Leave off grid zone, grid square, and some numbers




US National Grid: **Goal: Keep things as simple as possible.**

For global communication, the grid zone designator and grid square need to be included.
For regional communication, the grid zone designator may be left out.
For local communication, the grid square may be left out.

If you don't need 1 meter precision, leave off some numbers.

8026 4083 – to 10 meters

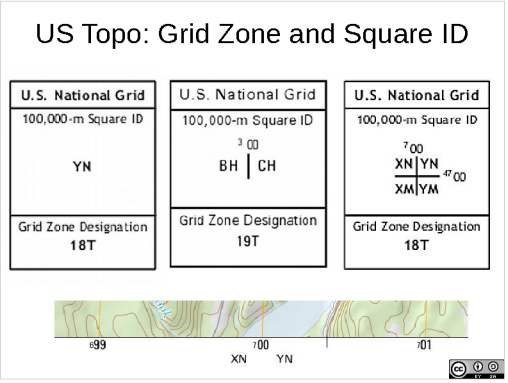
802 408 – to 100 meters

80 40 – a 1km square

So, how do you work with USNG with maps? The US Topo Map series make things easy.

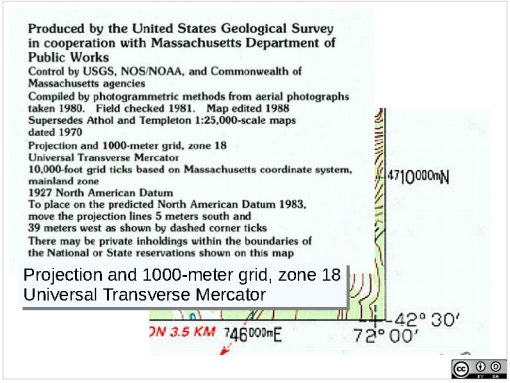
Border of the map has a box with the Grid Zone Designation and the 100,000 meter square. If (as in this case) the map spans more than one 100,000 meter square, both (or all) will be listed in the box, and shown on the border of the map.

The map border has tic marks every kilometer, labeled with the Easting or Northing for that tick. The first two digits of the USNG position are in large font. Digits before them from the UTM coordinate that are replaced by the 100,000 meter square are in a small font (with leading zeros omitted). Thus the UTM Easting starting with 0399 is shown as ³99, and would be BH 99... in USNG.




On the border of USGS US Topo maps you can find a box with the US National Grid Grid Zone Designator and Square ID. If the map spans more than one 100,000 meter square, then the Square IDs can also be found at the square boundaries on the edge of the map.

Most maps will cover only a single square. Some will span 2 squares, a few will span 4 squares.




USNG is a bit harder on 1980s 1990s series USGS topographic quadrangles. On more recent maps the UTM grid is shown, and the UTM ticks are marked.

The metadata at the border of the map will contain the Zone Number, but not the band letter or the 100,000m grid square letters.

Easy to use with UTM or with USNG when just communicating local coordinates (e.g. 46830942).

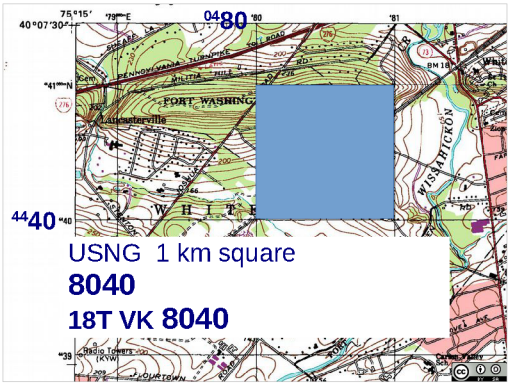
Historical USGS topographic quadrangles tend to not have grids printed on them, and tend to only be marked with latitude longitude (and sometimes other systems like state plane feet).


If we are just working on this map (or inside an area ov about 60 miles), we can describe the location of the 100 meter square North of Nagog Hill as 992089 (dropping the grid zone designation, the 100,000 meter square, and the 10m and 1m digits).

This is easy to read on the map. 992 is the Easting. Find the Easting of 99 (in big numbers), then go 2 tenths of the way to the next (00) grid line. 089 is the Northing. Find the Northing of 08, then go 9 tenths of the way to the next (09) grid line.

If we need to communicate outside about a 60 mile area, then add the 100,000 meter square "BH".

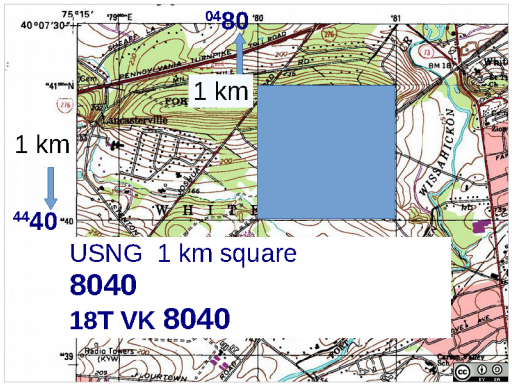
If we need to communicate globally, add the grid zone designation: 19T, thus: 19T BH 992089.




USNG lets us use the big numbers along the edge of the map to easily describe a 1 km square: 8040 (Easting of 80, Northing of 40, dropping the 100m, 10, m and 1 meter digits).

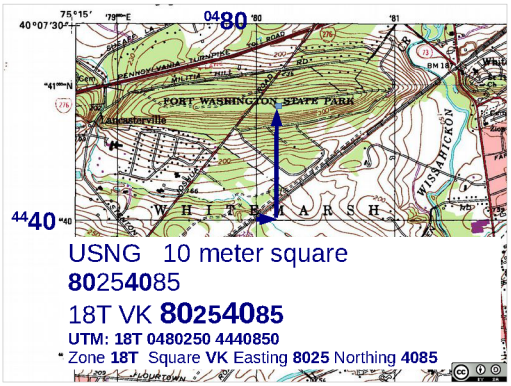
8040 is the point at the lower left of the square (leaving off the digits, USNG means an Easting of 80000 to 80999, and a Northing of 40000 to 40999).

USNG reads off the digits as a single string, so split 8040 into 80 for the Easting, and 40 for the Northing. USNG coordinates will always have an even number of digits.




The big numbers and the grid lines on the map mark 1 km intervals (1km=1000m, thus we've dropped off three digits from the Easting and three from the Northing in the USNG position 8040.

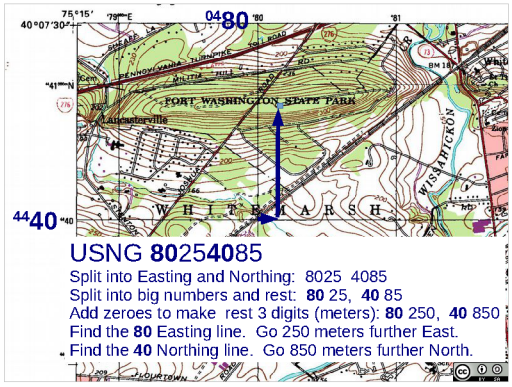
Knowing this makes it easy to find more precise locations.




A 1 km square isn't a particularly precise location for navigation for SAR purposes (get into the center of the square and you might be able to hear someone whistle).

A square 10 meters on a side is a nice precise location for most SAR purposes. It approximates the accuracy of modern GNSS receivers, and you should be able to spot a flagged clue within a 10 meter square.

USNG can describe a 10 meter square with just 8 digits: 80254085 describes the square shown on the map. Start on the 80 Easting grid line, go 250 meters further East. Then find the 40 Northing grid line, and go 850 meters further North. There's your square. To communicate globally, add in the grid zone designator and the 100,000 m square letters.




USNG can describe a 10 meter square with just 8 digits: 80254085 describes the square shown on the map. To find this location, first split the coordinate into Easting (8025) and Northing (4085).

Now split the big numbers off from the rest, starting with the Easting 80, 25. 80 represents a 1 km grid line, that means 3 digits should follow it (to get to meters), so add a trailing zero to the 25: 80 250.
Now we know to find the 80 Easting grid line and to go 250 meters further East.
Same thing with the Northing, split into 40, 85, 40 is in km, make the 85 into meters (add a trailing zero to make 850), so go 850 meters North from the 40 Northing grid line.

Or think 80 25: find the 80 Easting and go 25% of the way to the next grid line.

US National Grid
Describing a 10 meter square

| | |
|---|---|
| Local: | 99250895 |
| Regional: | BH 99250895 |
| Global: | 19T BH 99250895 |

For GPS: 19T BH 992500895**0**

So, a reasonable position to communicate in a simple ground search would be just the 8 digit USNG position for a 10 meter square: 99250895.

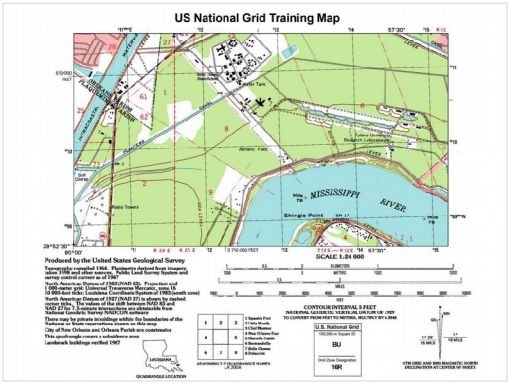
For regional communication, add in the 100,000 meter square, for global, add in the grid zone designator.

To enter the coordinate into a GPS, add in two zeroes (one at the end of the Easting, one at the end of the Northing) to bring the precision down to 1 meter.

US National Grid
Describing a 1 meter square

Local: 9925308956
Regional: BH 9925308956
Global: 19T BH 9925308956

For GPS: 19T BH 9925308956




If you want to describe a location to a precision of 1 meter in USNG, use 10 digits (5 for the Easting, 5 for the Northing).

Add the 100,000 meter square to communicate outside about a 60 mile local area (100,000 m = 100 km = about 60 miles, number alone is a unique position within that distance).

Add the grid zone designator to communicate globally, or to enter the position into a GPS.

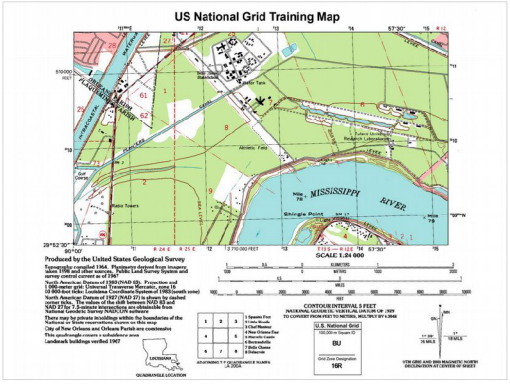
Practical Evolution: (1) Determine USNG coordinates of points on a map.

(a) water tank near Planters canal

(b) + that marks Mile 78 on the Mississippi river.

Which Coordinate System do I use?

- MA Land SAR: USNG with WGS84.
- NSARC Georeferencing Matrix:
  - Land SAR Responder
    - USNG Primary, Lat/Long Secondary
  - Land SAR coordination with Incident Command
    - USNG Primary, Lat/Long Secondary
  - Land SAR Responder with Aeronautical SAR
    - USNG Primary, Lat/Long Secondary




Which system to use?

Emerging MA SAR community standard: USNG with WGS84

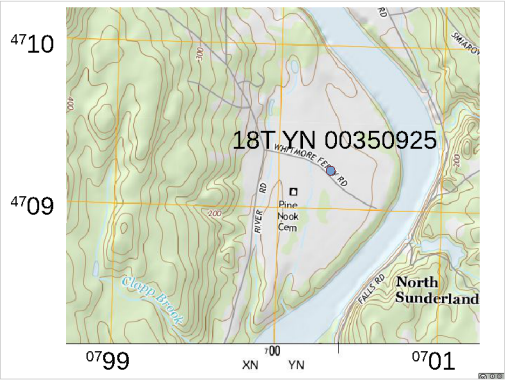
National SAR Council matrix:
Primary for Land SAR responders: USNG.

UNSG Training map and Instructions.

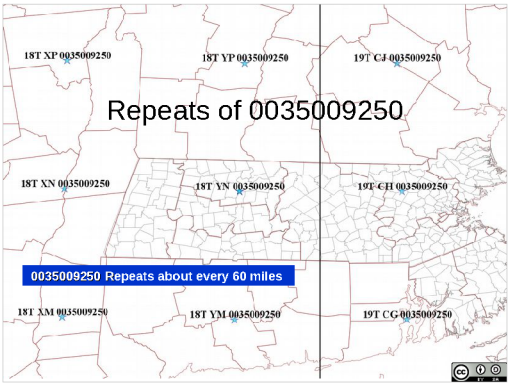
Practical evolutions with locations and communicating locations on the USNG training map.

(1) What is the UTM coordinate of the water tank near Planters canal?
What is the UTM coordinate of the + that marks Mile 78 on the Mississippi river.

(3) Communicate UTM coordinates of points on map via radio (or back to back) in pairs.




Let's take a location: 18T YN 00340925




If we just take the Easting and Northing: 003509250 (for local communication), this same local coordinate repeats in each 100,000 m grid square, thus about every 60 miles (100,000 m = 100 km = about 60 miles).

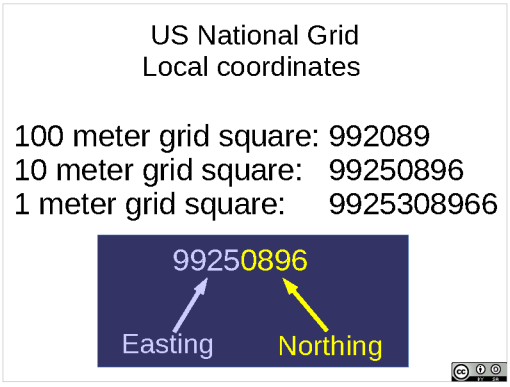
So, local coordinates mean local within a distance of a few tens of miles.

(Black vertical line is the zone 18-19 boundary, map shows outlines of counties and in MA the outlines of towns.)


If we add the 100,000m grid square: YN 0035009250, then this location repeats in each zone where there is a YN grid, about once every 1000 miles.

So, including the 100,000 m grid square provides for regional communication, where regional means within a few hundred miles.

(Black vertical lines are UTM zone boundaries, black horizontal lines are bands, the A-Z lettering system for the 100,000 m grid repeats about every three zones, thus zone 16 and zone 17 don't have northern hemisphere YN 100,000 m grid squares).

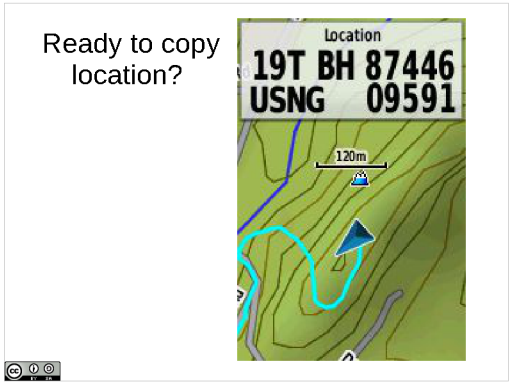



So, to review: In USNG, local coordinates are always an even number of digits. Split in half to get the Easting and the Northing. The first two digits of Easting and Northing will be the big numbers for the 1 km grid on USGS maps.

6 digits, 100 meter square, first 3 Easting last 3 Northing (leaving off the 10 m and 1 meter digits). 992 will be 200 meters East of the 99 Easting line (2/10ths of the way to the next Easting line).

8 digits, 10 meter square, first 4 Easting, last 4 Northing (leaving off the 1 meter digits). 9925 will be 250 meters East of the 99 Easting line.

10 digits, 1 meter square, first 5 Easting, last 5 Northing. 99253 will be 253 meters East of the 99 Easting line.



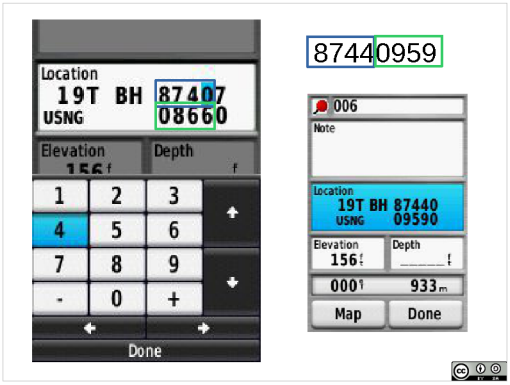

19Tango Bravo Hotel 8744609591

Or (much simpler):

87440959

What did I just give you?

How do you enter this (local) position into your GPS?



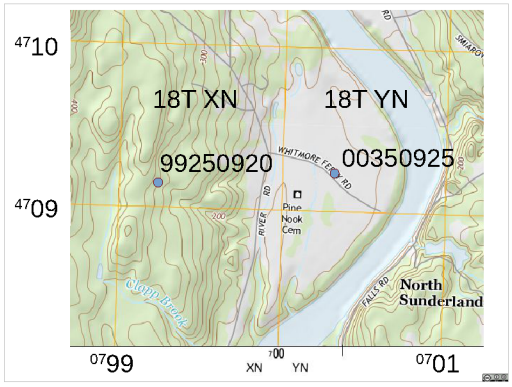

Position transmitted as: 87440959 What do we have?

USNG, Easting 8744[0] Northing 0959[0] (10 meter)

(split the position in half, first half is Easting, second half is Northing).

Create a waypoint in your GNSS. Edit to match. If you are working nearby in the same grid square, then the zone, zone letter, and grid square will be the same (USNG has 5 digits after the grid square to get to 1 meter resolution, so start at the leftmost digit and fill in zeroes after you run out of numbers).

If you are working near the edge of a grid square you may need the grid square as well. Working with a map it should be obvious, working with a GPS you may get a location some 60 miles away.

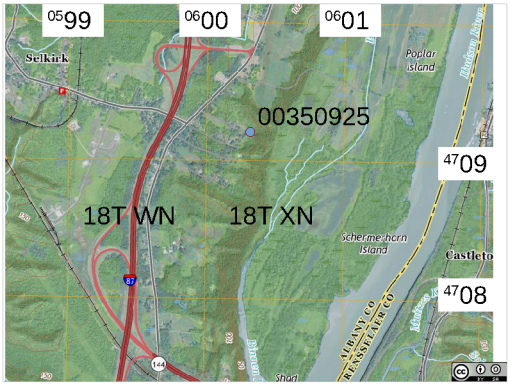



These two points should be about 1 km apart.

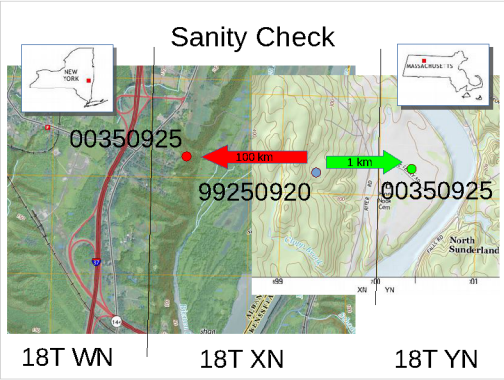
Communicate without the XN and YN, and you might end up with 18 T XN 00350925, about 100 km away.

You are in 18T XN. You receive the local coordinate 00350925. You create a waypoint in your GNSS reciever. You edit that waypoint so that the coordinate is 18T XN 00350925. You ask your GNSS to go there, and it says the distance to that waypoint is about 100 km away. That's a point about 100 km away at the far Western edge of Square XN.

When a search area spans a 100,000 m square boundary, you need to be aware of the which grid square a coordinate is in. Working with a map, this is simple. Working with just a GNSS, you may need the full USNG coordinate transmitted to you.




Here's 18T XN 00350925 – about 60 miles away from the search area, across the Hudson river, in New York.



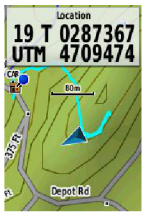

Working near a 100,000 meter Square boundary, sanity check coordinates you enter into a GNSS receiver (that is, how far away is the new point from your current location)

A local coordinate should be in the search area, not about 100 km away.

When working near 100,000 meter Square boundaries, it may be appropriate to include the Square ID in coordinate transmissions – particularly when transmitting to a resource that will be entering the location into a GNSS reciever.

Conventionally:

19 Tango
0287367
Break
4709474




Communicating UTM coordinates, conventionally break (say Break, then release the mike and listen briefly) between the Easting and the Northing. Words Easting and Northing usually aren't included.

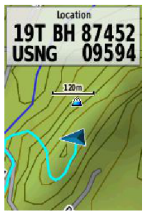
Common errors: Reading UTM as part of the coordinate. Only reading the Grid Zone Designator and the Easting,

Save a waypoint, or write down the location before you transmit. The meters digit will probably change while you are standing in one place reading off the numbers.

19 Tango
Bravo Hotel
8736709474

or

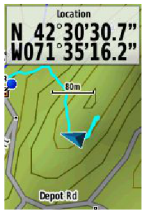
87450959




UTM is conventionally read with the Easting and Northing as a single string of numbers, instead of separate parts (no pause and no break in the transmission).

42 Degrees
30 Minutes
30 decimal 7
Seconds
North

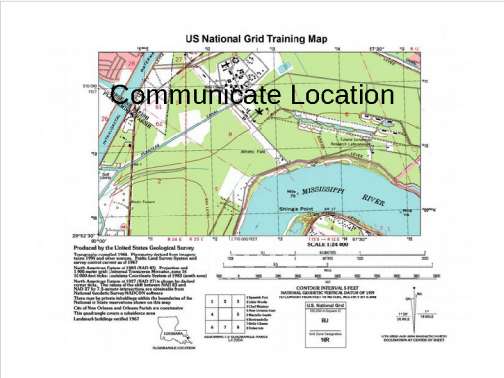
71 Degrees
35 Minutes
16 decimal 2
Seconds
West



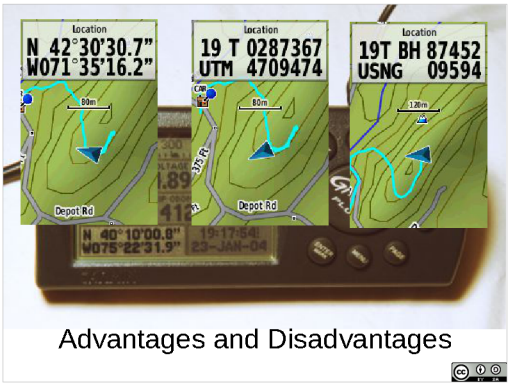

Latitude and Longitude.

Transmitting the degrees/Minutes/Seconds format takes lots of words.

Decimal Degrees format is less wordy.




Practical Evolution: (2) Communicate UTM coordinates of points on map via radio.




Each system has advantages and disadvantages:

**Latitude/Longitude:**

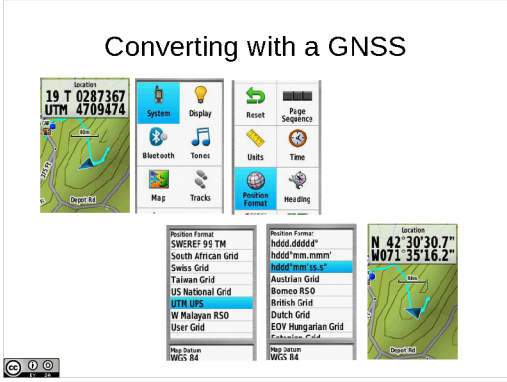
Single grid for anywhere in the world.
Coordinates are angles and don't readily translate to distances on the ground.
Longitude lines on a map always run true North/South (grid north is true north).

**UTM**

60 separate grids (one for each zone).
Coordinates are distances in meters. Easy to understand distances between two points in the same zone (but not across zones).
Grid North is slightly off from True North near zone boundaries.

**USNG**

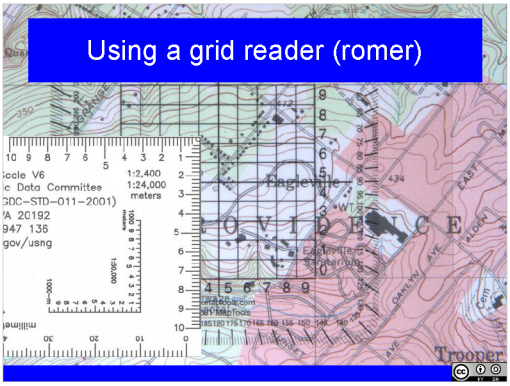
Defined way for simplifying the coordinate for the situation.
Distances within the same 100 km square are easy to see from the coordinate (but not across squares or zones) (coordinate on the right is about 150 m NE of the two on the left).




It is straightforward to use a modern GNSS receiver to convert from one position format to another.

With your GNSS receiver set to one position format, record or enter a position. Then using the menu system, change to a different position format.

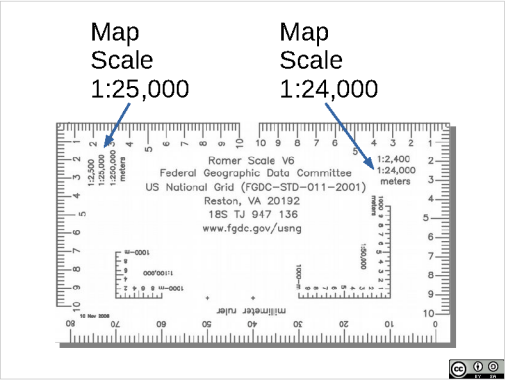
Here the location is in UTM in the upper left, working through the menus, the position format is change to latitude/longitude, degrees minutes seconds – and the display changes to show lat/long.




If you have a map printed out at a standard scale (true for the printed USGS topo quads, and US Topo maps, not true for print on demand maps), you can use a grid reader to find locations within 1 km grid squares.

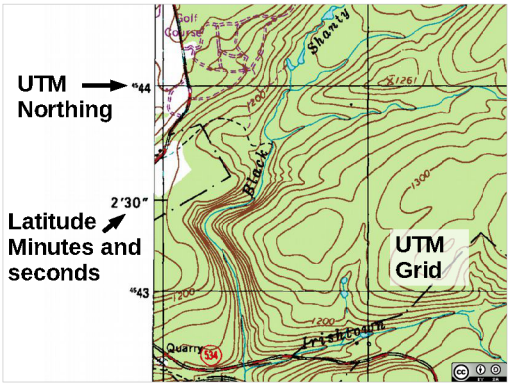
Two different grid readers shown: one transparent 1 km square, with 100 m grid lines; other L shaped, printed with 100m and 10 m tic marks.

Grid reader must match the scale of the map (which is why the work well for maps printed at standard scales, but not for print on demand maps, which can be arbitrarily rescaled for printing).

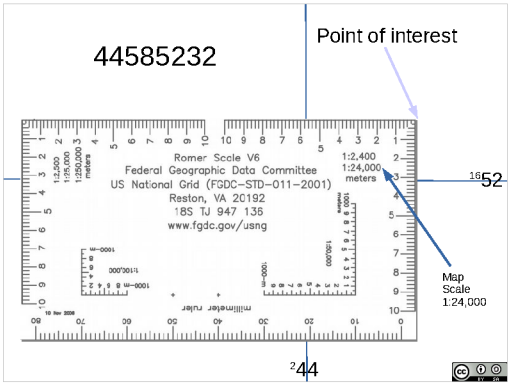



This is the FGDC (Federal Geographic Data Committee) romer (available from www.fgdc.gov/usng). When printed at the correct size, one corner is for use with 1:24,000 scale maps (the distance from the corner to 10 on the scale is 1 km, matching the 1 km UTM grid). The other corner is for use with 1:25,000 scale maps.

The numbered scales running into the corners are numbered at 100 meter intervals, and have small ticks at 10 meter intervals (for the 1:24,000 and 1:25,000 scales).



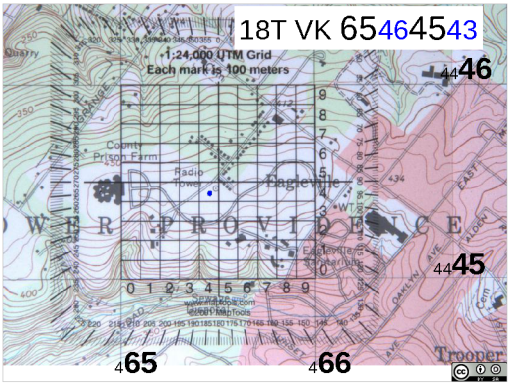

The romer works with the 1 km UTM grid printed on the USGS topo quad and US Topo maps.




To use the romer, first confirm that when the corner is placed on one grid line, the 10 on the scale is on the next grid line. If that is true, then the romer and the map are at the same scale and you can use that romer on that map.

Then place the corner of the romer on the point of interest, identify the grid line for the easting (here 44 (using USNG so we ignore the small 2)), and read off the number where the roamer crosses that easting line (here 5 and 8 small ticks). Put the numbers together for the easting: 4458 (down to a 10 meter square). Repeat with the northing: find the northing line (52), and read tens of meters off the scale (32) for a northing of 5232. If desired, estimate meters in the distance between the ticks (to go to 5 digits for easting and northing 4458052320),

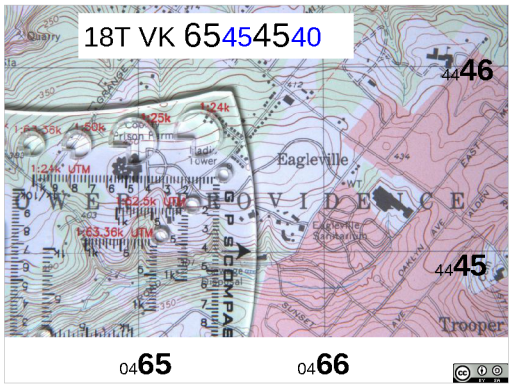
This works in reverse, given a coordinate, you can use the scale on the romer and the UTM grid to put a point on a map.



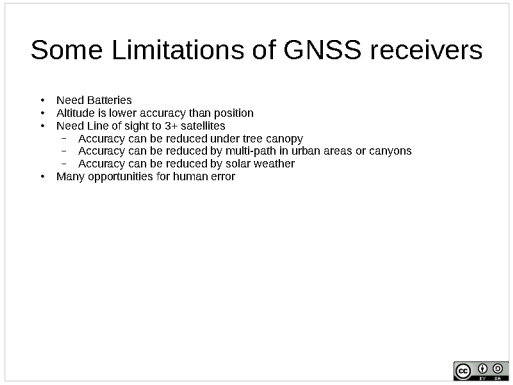

Other grid readers can be a transparent grid 1 km square at the scale of the map.

Use by placing the grid reader on a 1 km grid square, find the number for the Easting line (65), then find which square the point of interest lies in, and read off the 100 m easting digit from the edge of the grid (here 4). Then you can estimate the 10 meter easting digit (6), for an easting of 6546. Repeat with the northing, grid line (45), 100m square (4) and estimate 10s of meters (3) for a northing of 4543, thus USNG local coordinate of 65464543.

Where do we get the 18T VK from?




Some compasses have grid readers printed on the base plate – often with a hole at the corner of an L. Place the hole on the point of interest and read off the easting and northing 100m and 10m digits, or given a coordinate, find the easting line and northing lines for the 1km grid square of interest, line up the compass with the easting line and, move the easting scale to match the rest of the coordinates, repeat with the northing to put the hole over the point (then you can mark the map with a pencil or pen through the hole).



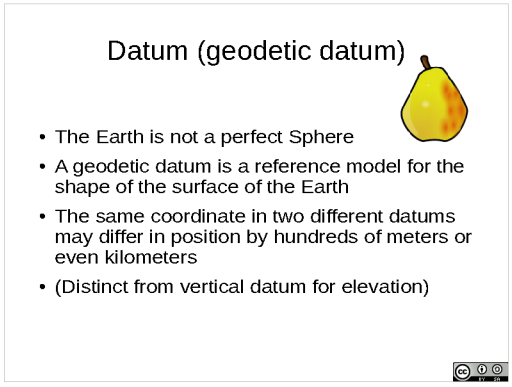

GNSS receivers have limitations.

They need batteries to work. What can you do to help mitigate the risks around batteries dying? (Carry spare batteries, change out the spares, check the battery charge before leaving staging, carry a compass...)

The receiver needs good signals from at least 4 satellites to calculate a precise location and elevation. Trees, buildings, things getting in the way of satellite reception can reduce accuracy.

Solar storms can affect the travel time of GPS signals, and thus GPS accuracy.

Complex tools, practice with them regularly.

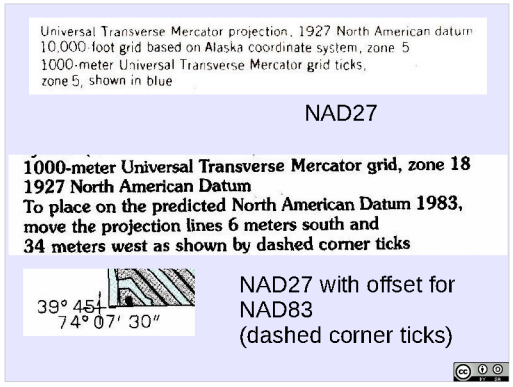



Since the Earth spins, it bulges slightly at the equator – it isn't a perfect sphere. A geodetic datum (like WGS84) is a mathematical model of the shape of the Earth used in producing a map projection.

Some datums were designed to work well in one particular part of the world (and not work well anywhere else). Other datums (like WGS 84, the world geodetic system of 1984) were designed to work anywhere in the world.

If you report a position using one datum to someone else who enters it using another datum, the position might end up as much as 3.6 km off.

Having your GNSS receiver set to the wrong datum is one source of human error.

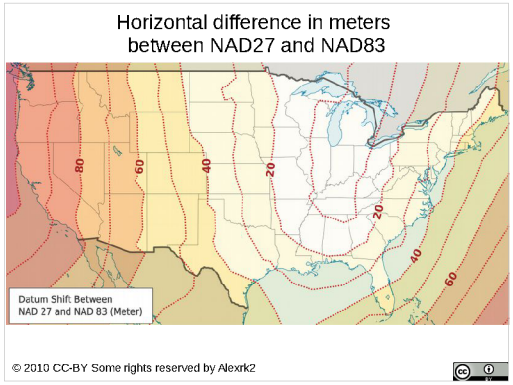



A map is projected using a particular datum. This datum should be included somewhere in the metadata on the border of the map.

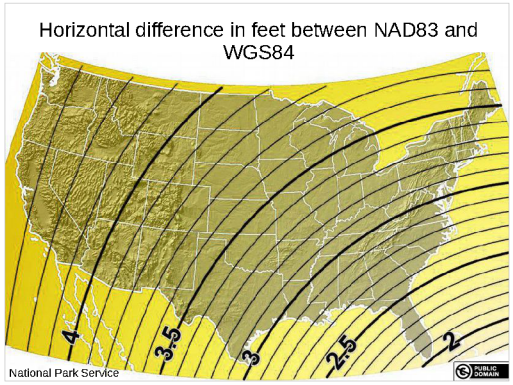
At the top is an older USGS topographic quad which used NAD27, the 1927 North American Datum (which is a good fit in the continental United States).

Below is a 1990s USGS topographic map which also used NAD27, but includes markings on the map showing how much positions need to be shifted to between NAD27 and NAD83, the 1983 North American Datum. In this case, the difference is about 36 meters.

Current USGS maps use WGS 84 (and may show the offset between WGS84 and NAD27).

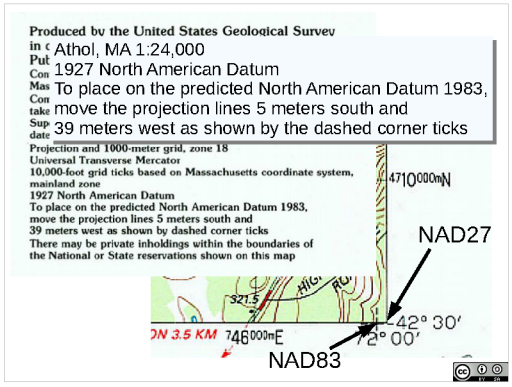



Here's a map showing how much NAD27 and NAD83 differ from each other in the continental US. In New England, these are typically about 40 meters different from one another.




NAD83 and WGS84 are not very different in the continental US. This map shows the difference between them in feet (about 3 feet to a meter).

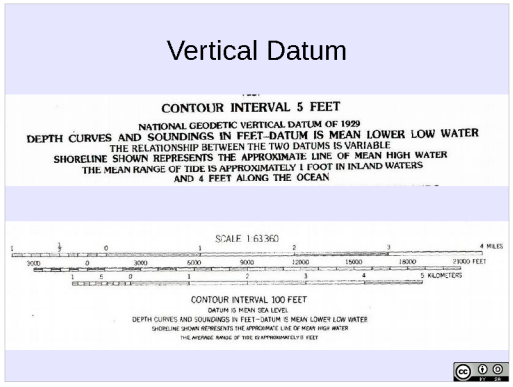
In New England, NAD83 and WGS84 are on the order of 1 meter different from one another.




Here is metadata from the border of the Athol, MA 1:25,000 USGS topographic map from 1998. How much difference is there between the grid on the map (NAD27 datum) and WGS84?

Difference between NAD27 and NAD83 is shown on map (5 m south, 39 m west). Difference between NAD83 and WGS84 in the NE US is just over one meter (previous slide), so for navigating on the ground in New England, NAD83 is effectively the same as WGS84. Difference is just over 40 meters.

So if you have your GNSS receiver set to WGS84, and you are communicating a position in Athol to someone who is plotting it on this map, without realizing the datums differ, they will plot the point about 40 meters east of where it should be. 40 Meters is easy shouting distance, but could be on the wrong side of a stream or other terrain feature if someone tries to navigate to your position using a different datum.




Geodetic/horizontal datum is different from the vertical datum (also marked on the edge of maps).

Geodetic datum is a model of the shape of the earth used to project the map.

Horizontal datum is the local zero for elevation, usually mean sea level.

Horizontal datum is usually important to know in coastal areas.

## Some Key GNSS receiver Settings

- Position format:
  - Latitude/Longitude
    - Decimal Degrees
    - Degrees, Minutes, Seconds
  - **USNG**, UTM/UPS, MGRS
- Datum: NAD27, NAD83, WGS84, etc.
  - Use **WGS84**
  - Unless using a map with a different datum
- Units (elevation, speed): English, Metric
- Bearings: Magnetic, True
- WAAS (on, off)

One set of opportunities for human error are the GNSS receiver settings. You must be able to locate and change all these settings on GNSS receivers.

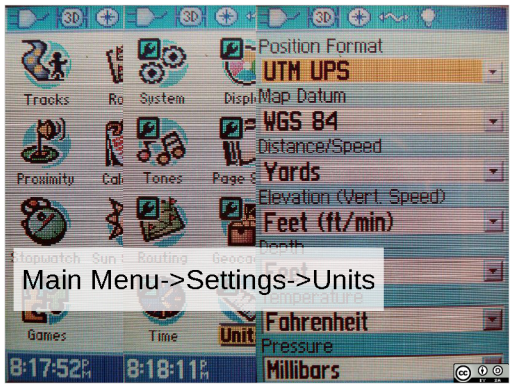
You could be working with a combination such as Latitude/Longitude as the position format, NAD27 as a datum, and magnetic bearings.

Or you could be working with a combination of US National Grid as the position format, WGS84 as a datum, and true bearings.

Working with one set of settings, and communicate with someone else using a different set – certain to cause confusion and navigation errors.

Setting bearings to magnetic may be desirable when working with a lensatic compass. Make sure communications follow the convention (magnetic or true) adopted for the search.

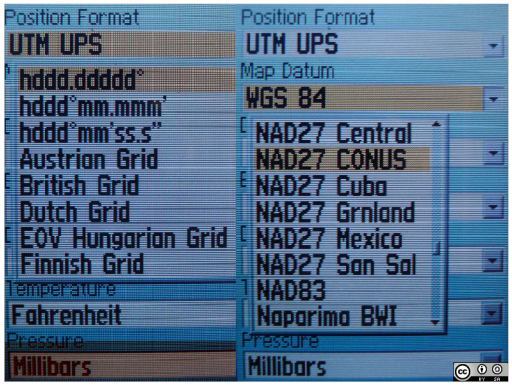
Turn on WAAS (Wide Area Augmentation System) for higher accuracy positions, but uses batteries faster.




How to get to the settings varies from GNSS receiver to GNSS receiver. Typically there is a main menu with access to units and/or position format settings.

Here, in an older Garmin GPS 60 series GNSS receiver, there's a main menu page with a Setup page with a Units page where you can find the position format, datum, and distance units settings.

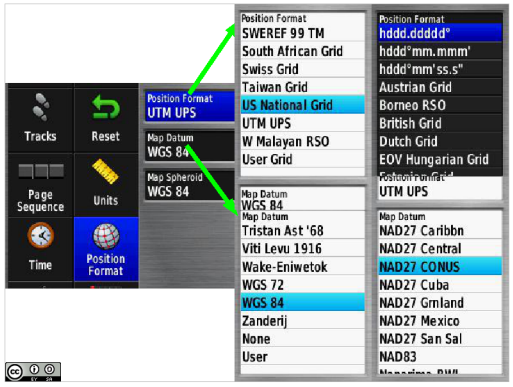
Main Menu->Settings->Units




For Position Format and Datum you will have many choices.

USNG, UTM/UPS, or decimal degrees (here hddd.dddddd) are the likely position formats (at the the top and bottom of the very long list).

WGS84 or NAD27 CONUS are the likely Datum choices (again from a very long list).




Here's the menu system for a more recent Garmin GPS 62 series GNSS receiver, with position format and datum accessed from a Position Format section on the main menu.

GNSS receivers vary.

Learn yours. Learn your teammates.

## With your GNSS Receiver, Set:

- Position readout to Latitude/Longitude
- Latitude/Longitude Format to Decimal Degrees
- Datum to NAD27
- Units to Feet/Yards/Miles
  - Write down your location

## Now change to:

- Position readout to USNG
- Datum to WGS84
- Units to Metric
  - Write down your location

Take out your GNSS receiver.

Practical Evolution: (3) Set datum and coordinate system on a GPS.

Set to: lat/long, decimal degrees, NAD27, units: feet yards/miles.

Then change to: USNG, WGS84, units: metric.

## SDMRT coordinates

- Everyone has identical maps.
- Communicate points on the map from measurements in inches on the map from the edge of the map (read in like Easting, read up like Northing, but in inches measured on the printed map.
- Maps must be exactly identical (they can't be copied in different resolutions or positions).

San Deigo Mountain Rescue Team coordinates.

Make a set of absolutely identical copies of a map (can be any arbitrary map, including local trail maps or street maps). Everyone communicating location needs an absolutely identicalcopy of the map (same scale, same position on photocopier, same enlargement, etc).

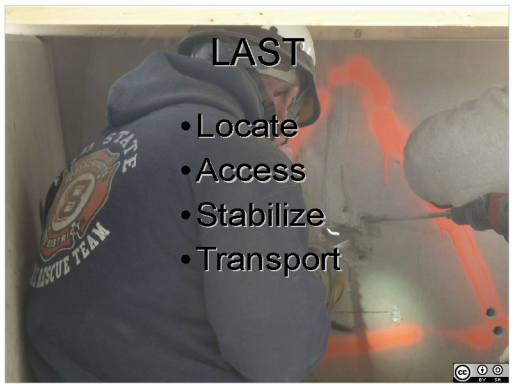
Mark a point on the map. Measure the distance from the left edge of the map in inches to the point. Measure the distance from the bottom of the map to the point. Communicate these two distances.

If the maps at the receiving and sending ends are identical in every way, then the point on the map can be communicated successfully. Any difference, and the wrong location will be received.


Rescue


Unit 23: Rescue






Search phase involves locating the subject, Rescue phase involves accessing them, stabilizing them, and transporting them.

What phase are we looking at here? [Access]

Any of these, including locate, might involve technical rescue environments and resources.


Is this a technical environment?

Sometimes it is obvious.


How about this, is this a technical environment?

Is access dangerous? [yes, confined space]

What do you do here?

**Stay out, report it.**

Recognize technical rescue environments: high angle, confined space, cave, mine, water, mountain rescue.

## Access/Stabilize/Transport

- May be easy, subject may be able to walk out.
- May require lots of people for a litter carry out.
- May require technical rescue resources.

- Decisions to be made.

Once you've located the subject, things may be simple.

Or they may not.

Why?

Subject might need medical care.

Subject might need to be carried out.

Subject might be in a technical rescue situation.

Decisions to make.

Let's think about the decision making process.


What is the situation?

Your safety comes first.

## Risk Management Process

- Situational Awareness
- Hazard Assessment
- Hazard Control
- Decision Point: Go or No go.
- Evaluation
  - Individual: experience, distractions, fatigue, attitude
  - Everyone: Changing Situation

Decision making follows a risk management process.

Be aware of the situation.

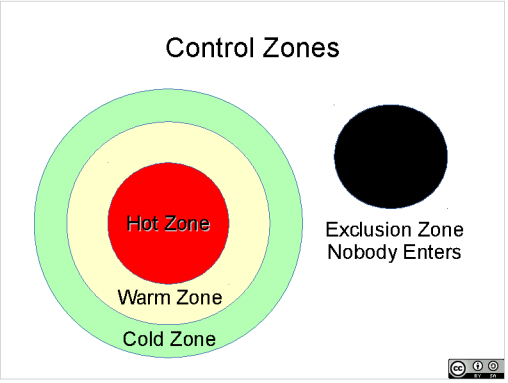
Assess hazards.

Control hazards (obtain resources to manage them)

Have a clear go/no go decision point.

Continually evaluate.


How are we going to control the hazards here?




One of our tools for managing hazards – keep people out of them....

Review:

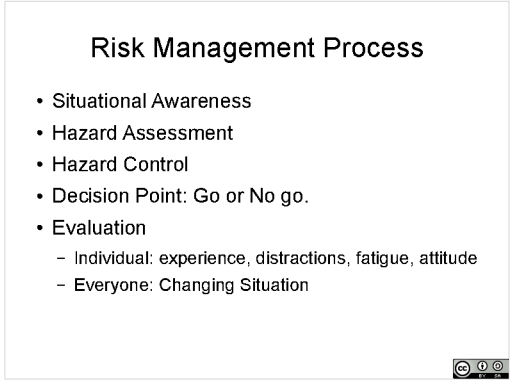
What goes on in each zone?

Cold Zone: ICP, Staging
Warm Zone: Support for entry into Hot Zone
Hot Zone: Enter only with appropriate PPE and with a specific assignment.

General public kept out of the cold zone.

Exclusion zone, nobody is to enter.

Where do you put tag in/tag out access controls?




Continually evaluate.

Conditions change.

Suppose it is getting colder, it is starting to rain, the rain turns to freezing rain.

How does that affect our approach to the person at the bottom of the cliff?


Another situation: You've located your subject.

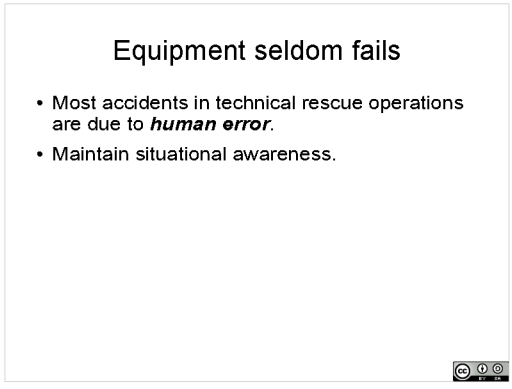
Down in there.

They are unresponsive.

What is the process for figuring out what to do (or not do)?

Situation?
Rescue? Recovery?
Hazards?
Hazard Control?
Go – No Go?

What could go wrong here?




Very easy to get tunnel vision focusing on the subject – maintain situational awareness.

What can you do to avoid tunnel vision?

And situations change.

## FAILURE

- F – Failure to understand the environment
- A – Additional medical implications not considered
- I – Inadequate rescue skills
- L – Lack of teamwork and experience
- U – Underestimating the logistical requirements
- R – Rescue versus recovery mode not considered
- E – Equipment not mastered

Acronym: Failure: Reasons why technical rescue operations fail.

Particular risks for SAR:

Failure to understand the environment – hazardous environments not recognized as such (tunnel vision, inadequate training).

If there's a door, don't assume there's a floor on the other side.

Inadequate rescue skills, lack of experience, equipment not mastered – call for help – get trained technical rescue resources.

## FAILURE

- F – Failure to understand the environment
- A – Additional medical implications not considered
- **I – Inadequate rescue skills**
- L – Lack of teamwork and **experience**
- U – Underestimating the logistical requirements
- R – Rescue versus recovery mode not considered
- E – Equipment not mastered

Highlight: As searchers, this course isn't training or preparation for technical rescue.

Key aspect is to recognize that additional trained and experienced help is needed.

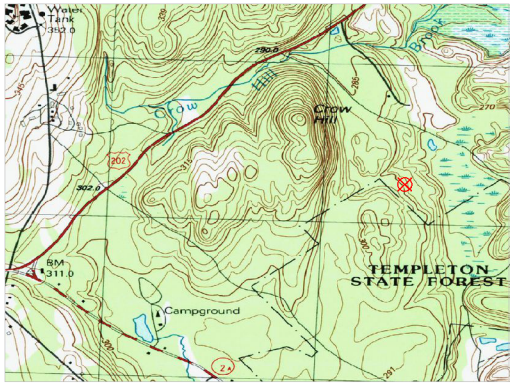

Sometimes getting help is easy. Sometimes not...

If it isn't easy - if the subject can't simply walk out, what will you need? (resources, how do they get there?)

Directing resources to your location.

Planning a route out.

Will the route out be the shortest?




Here's your find.

How are you going to get resources there?

What is your route out?

## Establish a common set of signals

- Example: SUDOT whistle signals
  - One: Stop
  - Two: Up
  - Three: Down
  - Four: Off Rope
  - Long Blast: Trouble.

What happens when you don't?

Particularly when people from different agencies and disciplines are working together, important to review signals.

## Communicate for Safety

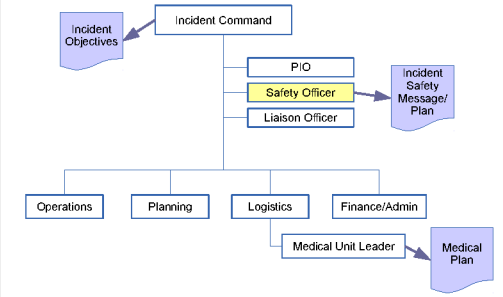
- Be direct – don't worry about seeming rude.
  - *"Lieutenant – Get away from that edge."*
- Communicate safety concerns by being direct
  - Address relevant person by name (or title)
  - Say: "I" (think/feel/believe)
  - Clear message
  - Demand a response: "What do you think?"
  - "*Nancy: I think that compartment has a low oxygen atmosphere. Responders need SCBA. Don't you agree?*"

How do you communicate a life safety issue?

Who can communicate a safety issue?

## Anyone can call **Stop** at any time

Anyone can call **Stop** at any time.

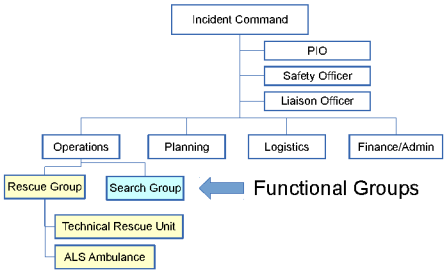



What are some of the things baked into ICS for safety as a priority?

What else?

Discuss.

## Possible ICS Organization




Rescue tends to require tight local tactical control – people who know what they are doing working together on a focused problem.

One mechanism for encapsulating that in ICS is functional Groups – a Rescue Group that carries out the rescue.

Rescue also tends to involve hazards, how can those be addressed? (among others: Site Safety Officer)

## Stabilization

- F – Failure to understand the environment
- **A – Additional medical implications not considered**
- I – Inadequate rescue skills
- L – Lack of teamwork and experience
- U – Underestimating the logistical requirements
- R – Rescue versus recovery mode not considered
- E – Equipment not mastered

That's a matter for medical training.

Plan ahead:

What medical training for SAR responders?

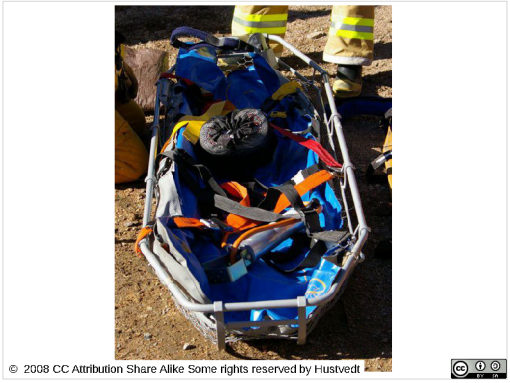
Multiple functional roles to be filled in an assignment: leadership, clue aware searchers, navigation, communication, medical...

Report what you've got, get skilled help.

# Litters and Carry Out


Unit 24: Packaging and Level Ground Litter Carry Out



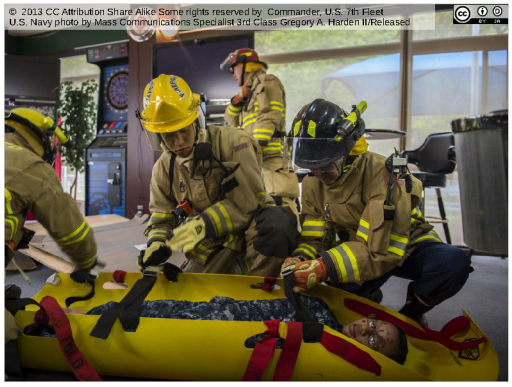



Locate, Access, Stabilize, Transport.

After finding a subject, it may necessary to carry them out of the woods.

Takes lots of people. Litters are good tools for that.

Here's a rigid stokes Litter.




And here is a flexible litter (a sked).


6 people, just holding the litter (rail or straps) good for short distance flat carry (as is being done here in a transfer to a helicopter).

Carrying like this takes a lot of effort.

You can reduce the effort by holding the litter rail in one hand, and holding a strap looked over the shoulders in the other hand – transfer more of the load off of your arm.

10-12' length of tubular webbing, bend the ends together with a water knot, then girth hitch the loop to the litter rail, and wrap it over your shoulders.

The person in gray in the center is using the litter strap properly, over both shoulder.


It still takes a lot of people to carry a litter more than a short distance. Here are two teams switching out.

Think of 18 people (three rotating teams of 6) as a reasonable number for carry outs on level ground. Add more for rigging haul assist systems in low angle terrain.

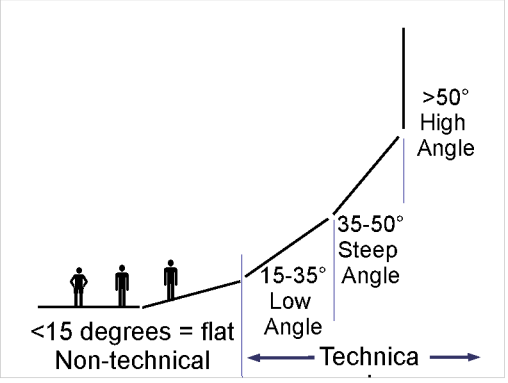

It is possible to improvise a litter, but it will take a lot of people to do a carry out.

Clove Hitch

Girth Hitch


Packaging described here is not adequate for anything other than litter carries on flat terrain.

More training is needed for high angle packaging.




Definitions for high/low angle conditions vary:
NFPA: High Angle = Weight supported by rope system.
Low Angle = Weight supported by ground.
Common (somewhat variable definition) we'll use here:
Flat ground: 0-15 degrees
Low angle: 15-35 degrees
Steep angle: 35-50 degrees (most dangerous)
High angle: 50-90 degrees

Quality of footing also factors in – poor footing, loose scree, etc, makes for more dangerous conditions.

Anything more that 15 degrees calls for support from technical rescue resources.

We are talking here about carry out on <15 degree (<27% grade, less than 2.7 rise in 10 run), non-technical terrain.


Concerns for packaging:

Protect the subject from the environment: (heat, cold, rain, snow, sticks in the face...).

Put eye protection on the subject.

Make sure the packaging doesn't interfere with the subject's ability to breath.

Adjust the packaging to support medical needs (splints, airway access, IV access, spinal immobilization, etc).

One packaging method for warmth – lay a waterproof barrier over the litter, then put blankets (one for legs, one for upper body), or a sleeping bag over it.

You can lay a reflective thermal layer (space blanket) over the blankets.

Then put the subject in the litter and wrap them in the thermal layer, the blankets, and the outer moisture barrier.

Then lash them in to the litter.

One lashing method – take a 40 foot length of 1” tubular webbing, girth hitch the center to the rail at the feet.

Start wrapping the litter with 1 inch tubular webbing (here with one 40 foot length).

Girth hitch the center of the webbing to the top rail at the foot of the litter.

Criss-cross the litter on the verticals – wrap the verticals to lock the webbing.

Avoid wrapping the webbing around the upper rail, easier to abrade it rubbing on things.

Criss-cross up to the subject's head.

Make sure the webbing isn't straight across the subject's neck (or so they'll slip down onto it). Make a steep V over the shoulders.

Work the slack out of the webbing.

Make sure the subject's breathing isn't compromised.

Tie off the webbing with clove hitches that capture a vertical bar.

Then tie an overhand safety in the webbing.

Put safety glasses on the subject (protect their face and eyes).

Lifting off the ground (two of the 6 bearers demonstrating position)

Litter strap over both shoulders, hold in outside hand.

Hold rail with inside hand.

Kneel, back straight.

On command (from person at the head)

**Lift with the legs, not the back.**

Same for lowering to the ground, lower with the legs, not the back.


Protect from the environment as appropriate.

Hot and sunny, shade may be more appropriate than a mummy wrap.

Is this going to take more people?

If the subject isn't mummy wrapped, tie their hands in a handcuff knot and lash it to the foot of the litter so that the subject isn't able to reach out and grab on to things while being carried (with the potential of throwing the litter bearers off balance).