SEARCH AND RESCUE HELICOPTER AND GROUND TEAM OPERATIONS

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Southwest Virginia Mountain Rescue Group
APPALACHIAN SEARCH AND RESCUE CONFERENCE

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Preface

Portions of This guide were written by Richard D. Wilburn, Dona Ana SAR Team; and may be reproduced if credit is retained.

Helicopter Operations

General

Purpose and Justification

Search and Rescue Operations often requires the cooperative efforts of many different resources to accomplish the common objective of life-saving. Helicopters can play a vital role in these missions, and because they often work very closely with ground personnel, it is the intent of this manual to describe methods to optimize the performance of both the helicopter and the ground teams. Knowledge of each other's capabilities and limitations is the key to developing a successful working relationship which is necessary under the conditions of SAR. The concept of Mutual Aid is at the foundation of Helirescue Operations.

Helicopter Involvement

Three main topics of interaction are considered:

1. The need for a marshaller.

This trained person is used because:

   a. he knows the local hazards and conditions around the area
   b. in case of a medevac, he knows where the victim is.
   c. he gives the pilot ONE person to pay attention to, which saves time otherwise spent trying to find the LZ and determining if any organization exists on the ground for safety and patient care. The pilot should be confident that the personnel on the ground know what they are doing.

2. Ground team handling stokes litter under the hoist.

It saves much effort and hover time for the aircrew if the ground team does its part preparing the patient and properly handling the litter and hookup. Not to mention, saving a penetrator ride down and backup for the medic! Additionally, a patient with possible spinal injuries requires at least three people to properly move him into the litter without risking further injury.

3. SAR team members flying to assist the aircrew with various aspects of the mission.

   a. communications
   b. location of the rescue site
   c. air observer during search
   d. transfer and loading of litter. A small hasty team can be picked up in town or at a field LZ, and then flown to the site to be inserted near the patient so that the team can bring the patient (via litter) to a safe medevac hoist, one-skid landing, or a field LZ.

General Considerations

Before requesting a helicopter for any reason, be reasonably certain that no other alternatives are available. SAR situations which could require the use of a helicopter are:

1. the ground team cannot quickly transport a critical victim to a hospital.
2. the ground team cannot safely due to terrain/manpower conditions and limitations.
3. the ground team cannot quickly locate the subject, necessitating air search in a localized area.
4. the ground team cannot expediently reach the victim for medevac without airlift to the site.

The helicopter crew will need the assistance of the ground team when:

1. hoist and litter are to be used.
2. the LZ is some distance, perhaps over rough terrain, to the victim.
3. the LZ is in a remote area, and ground personnel are needed to locate the site and coordinate the rescue.

The interface between the aircrew and the ground team is an important factor, with the goal being to perform as ONE operational team. This requires standard procedures and techniques. The object is to provide swift and safe medevac with a minimum amount of adverse treatment to the victim.

When the decision is made to use a helicopter, keep in mind several facts and rules concerning helicopter operations:

1. The pilot (AC - Aircraft Commander) has the final say on the operation of the aircraft.

2. Aircraft performance is reduced by higher temperatures and altitude. This is because thin air does not provide as much lift, and the oxygen for combustion is reduced. This situation robs power from aircraft. This condition is known as "Density Altitude". The relationship of the temperature to the effective altitude (due to air density) at which the aircraft will operate is measured in feet. At 5000 feet, a DA of 8500 feet means that the air at 5000 ft is as thin as if at 8500 ft under normal temperature. Due to power/lift restrictions, the pilot may determine that he cannot make a pickup or cannot take everyone. Also, the time in flight, especially at hover, would be reduced.

3. Always approach the helicopter from the front semicircle where the pilot can see you. Never go behind the aircraft near the tail rotor. Watch out for blade droop as the rotors are slowing down to a stop. Wait for an OK sign from the pilot before going up to an active helicopter.

4. Secure loose items when working around helicopters. Things have a way of being blown away or getting sucked up into the tail rotor.

5. Always wear goggles and helmets with a chin strap. Hearing protection is recommended.

6. Never smoke within 100 ft of an aircraft, and 500 ft of a fuel truck.

7. During cold weather, keep in mind the wind chill effects of rotor wash. All personnel and patients in the area must be properly dressed and prepared for those effects. An air temperature of 35° F can drop to -4° F near an active helicopter of Huey size.

8. Keep vehicles away from the LZ to protect windows and paint from pitting.

9. Never aim flashlights, spotlights or headlamps at approaching or hovering helicopters. That includes use of spotlights shining in the air to reveal obstacles above ground level, such as trees or power poles. Those should be located and taken into account by the LZ marshaller before the arrival of the aircraft. The choice of LZ and approach takes into consideration hazards around the area.

10. Use red tint penlights and flashlights at night.

11. When calling for a helicopter, be sure to use the **Helicopter Request Form** vie Rescue Base. The form serves as a checklist for initiating helo operations. Know the conditions around the

area where the helicopter is to operate. The pilot must know about these details before taking off from home base.

12. Wind is an obvious problem to helicopter operations. If the wind is above 20 mph, the possibility of getting a response is questionable. Above 30 mph choppers are grounded. Average wind velocity, estimated max gust, and the range of gustiness is important information for the pilot to know when deciding whether to fly the mission.

13. If no radio communications exist between aircraft and ground, the pilot can signal "no, or negative" by a back and forth motion of the aircraft. This may be used if an LZ or pick-up spot is not acceptable to the pilot.

14. Determine, if possible, the location of the nearest airport or refueling facility, and if it is open and available when needed for the helicopter. Determine if possible, the type of fuel required by the helicopter, and whether it is available at the airport.

15. In the event that a medevac is to transport a patient to the hospital, be sure to advise the emergency room of the helo ETA, and the patient's condition.

16. An Air Force Rescue Coordination Center mission number is required by the military in order to respond. The best way to activate a particular helicopter service is to call the one of choice (determined by the requirements and circumstances of the mission) and ask them if they can support the mission. If they can, tell them that Scott AFRCC will be called and advised of the request being made such that a mission number can be obtained.

17. On large scale mission, such as a mass evacuation of people from an area, or at high elevation, the Jolly Green Giants and Chinooks may be used. They have a large capacity for passengers, a higher operational ceiling than Hueys, and the Jolly Greens are capable of midair refueling.

Emergency Procedures

1. In the event that a helicopter develops trouble while hovering overhead, the ground team should move to the right relative to the nose of the aircraft, while the helicopter moves left, providing that there is clearance to accomplish this. The coordination should separate the ground team from any possible crash or emergency autorotation landing.

2. As a passenger, take special note of the following; There are survival vests and first-aid kits located aboard the aircraft. Notice as part of the preflight where these are located.

The side doors on Hueys have window exits which can be released by pulling the handles up. Use this if the door is jammed closed and cannot be opened normally.

There are emergency radios in the flight vests on military helicopters.

3. Check to see about any injured personnel and how to remove them.

4. If the pilots and crew are unable to function due to injuries, you may need to turn off the batter/generator switch to reduce the danger of fire.

5. Do not leave the aircraft until the rotors have stopped if there has been an emergency landing.

6. Never go back to a burning aircraft; get away as quickly as possible.

Landing Zones

Any helispots established will be controlled by a trained helirescue specialist to provide safety around the area, and to assist the pilot with landing, loading, and takeoff. Radio communications are needed between the LZ and Rescue Base if they are very far apart.

Selecting an LZ

Landing zones should not be placed close to Base Camp where people are running the mission (briefing/debriefing teams) or any other operating functions. Avoid proximity to parked vehicles and road accesses to the Base, which would force traffic near the helicopter. If refueling is planned, a 15 lb fire extinguisher should be available and would probably be brought out with the fuel truck. Have tie down ropes available if during an extended operation the wind comes up.

Make the LZ at least twice the diameter of the main rotor. Be sure there is adequate clearance on all sides for landing and takeoff. Remove loose debris and any obstructions from the LZ. Be certain that the surface is firm enough to support the aircraft. Avoid areas with fine sand or dust, meadows with high grass, and deep canyons especially if there are down drafts. A ridge or mountain top is safer for takeoff than from a canyon. The chopper can drop off of a high spot during the takeoff to gain airspeed and lift (translational lift), whereas it requires more power to climb straight up and over the terrain. The LZ should not have a slope of more than 10°. Operating in snow requires special care and attention. Blowing snow and lack of depth perception can hinder the pilot's view of the LZ. Pack down the snow with skis or snowshoes before landing the helicopter. Expect that the aircraft will settle and the rotor blades will then be closer to the surface. Stay well clear of the aircraft during landing and takeoff, especially on icy surfaces. Use good judgment keeping in mind the type of helicopter, weather, wind conditions, local terrain features, ground cover, and the nature of the mission, as to the choice of an LZ and its management.

Requesting a Helicopter

The LZ location, as determined by the ground team, should be expressed in terms normally used by the aircrews. For military, this can be in UTM (8 digit, preceded by a grid designator if necessary), and for pilots in general, Longitude and Latitude, or vector from VORs - either radial intersection of two closest VORs, or one closest VOR radial and DME. Be sure to reference the map name or sheet identification when calling in UTM coordinates.

The LZ Marshaller - Initial Coordination

Long Range Signalling (1/2 to 6 miles).

Day: Signal mirror. Use four sets of two flashes from the ground team. Do not hold mirror on the target! The pilot should acknowledge with flashes from spot light or landing light.

Night: Air flares and strobes are the common field method for night visual detection. Again, pilot should acknowledge with light flashes, or putting on landing light. Having a campfire near an LZ is unsafe and requires too much attention.

Communications With the Aircraft

Standard ICS communications protocols will be used when communicating with the aircraft. Clear text will be used in all communications with the aircraft. Callsigns will be by position or function. Mission Base is called "Mission Base", the Helibase is "helibase", etc. The aircraft callsign will generally be either an assigned military callsign (ex: Nighthawk 19) or a civilian one (Pegasus).

Most military aircraft will probably not be able to communicate directly with teams in the field. Civilian and State medevac helicopters are equipped with synthesized radios and will probably be able to talk to field teams directly. Aircraft can also be contacted on 123.1 MHz (National Aircraft VHF-FM SAR Coordination Frequency). Field Teams will probably NOT have 123.1, but Mission Base probably will, and can serve as either a relay or a forward air controller.

In any case, the pilot should begin attempting to contact Mission Base on the agreed upon frequencies when in probable communications range.

If the aircraft is not to land at Base, but proceed to the field for pickup of a patient with a team, Mission Base should have the helo overfly the Base Camp and vector the team from there. If common frequencies exist between the field teams and the air, then direct coordination with them will be good after Base vectors out the aircraft and "passes them off" to the ground team. If common frequencies do not exist, the Mission Base must relay as necessary for coordination and information concerning the patient's condition, etc. It is the function of the Incident Staff to facilitate and coordinate the operations of different teams and units.

In the event that NO common radio frequencies exist with anyone in the field, then the pilot should look for long range visual signals to locate Base, then when closer in, look for an LZ Mashaller and prepare to land for further briefing and directions.

Coordination By Radio

For the ground teams giving directions to the pilot, give the bearing in degrees magnetic TO your location from the position of the aircraft. That would be the back azimuth of the bearing from the ground team to the position of the aircraft. The "clock method" may be used when the aircraft is in good view. Example: (from the ground) *"We are ten o'clock from you at 1/2 mile"* Either method is good depending on the situation. The compass angle is obviously better for distances where the orientation of the aircraft is not clear, and the clock method being quicker for close-in work.

The LZ Marshaller - Hand Signals and LZ Ops

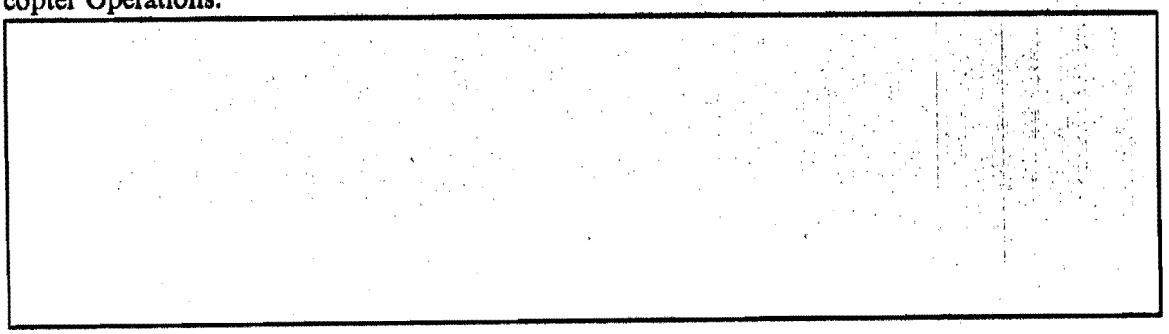
The marshaller must indicate the desired direction of approach as the helicopter nears the LZ. The marshaller stands with his back to the wind (if any) with arms held up up at a 45° angle in front of him. The marshaller must be wearing a helmet (goggles and hearing protection recommended), gloves, and an orange vest. At night, he will use chemical glow sticks held in his hands. The LZ is then directly in front of the marshaller. The pilot will probably first do a low pass over the LZ to locate the marshaller and quickly evaluate the situation. If all is well, the helicopter will circle around and come in on final approach.

Smoke will be used only on special request from the pilot. Use only as a last resort for wind indication.

At night, be certain to have all white lights, especially spotlights, turned off. Use only the chemical light wands and strobe lights. Turn off the strobe lights when helo is close enough to see the marshaller's LZ wands.

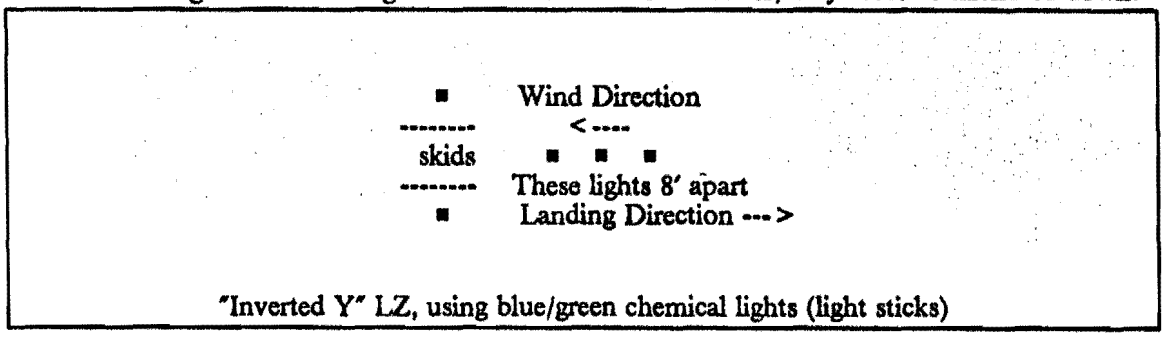
If there is a slope (less than 12°), then have the helicopter land with the skids parallel to the contour. This may require a spot turn at hover if there is a down slope wind.

Hand signals are illustrated below. The marshaller positions himself such that he can see the pilot's eyes, usually in the aircraft's right front quadrant. From the Army Field Manual on Helicopter Operations:



It is recommended that when changing approach instructions during the aircraft's final approach that the "hover" signal be used to separate each change in signals.

For flat terrain, especially around Base where helicopter operations may occur often, an alternative to hand signals at night is the "Inverted Y" LZ lights. Commonly, the Y will be made with chemical lights in the arrangement shown below. Remember, they must be anchored down!



The marshaller should have all personnel remain clear of the LZ during the landing and takeoff. That is, at least outside the Helipad area determined by the size of the helicopter; 150 is a reasonable distance for bystanders.

Another important consideration for the marshaller is personal safety when the aircraft is approaching. Be prepared for gusts from the rotor wash. If a steep slope or cliff is behind the marshaller, a safety line anchored to the ground in front of the marshaller is *highly* recommended. A kneeling position is also wise when on sloping terrain that drops off suddenly from the LZ, especially if the LZ is very small and the helicopter is to land very close in front of the marshaller.

Be sure that the approach and takeoff paths allow for a clearance of 10 feet over any obstacles with a takeoff angle of 15°.

Hoist and Litter Operations

Remember that the object of the ground team's involvement is to maximize the safety of the SAR personnel (both aircrew and ground team) and the victim. These procedure create harmony between SAR groups and limit factors which could cause safety problems.

1. One person at the pick up zone is in charge, usually the Team Leader or the most qualified helirescue specialist. This person will wear an orange vest so as to be clearly recognized by the air crew.

2. The wind conditions and the PZ will be clearly indicated by the marshaller to assist the pilot in aircraft approach and orientation. The only hand signal needed here is the raised arms with the back to the wind, or if no wind, the preferred direction of approach. The pilot will fly over to evaluate the conditions, especially as they are aloft where he will operate, and then if all is well establish a hover over the pick up zone.

3. The ground team should have no more than three members under the hoist at one time. Other personnel should remain out of the way.

4. The marshaller should stand on the pickup spot, while the team and victim are off to the side a few yards. This is to avoid the hoist cable coming down on the victim before grounding. Remember, the victim is immobile and can't hop out of the way of a swinging cable or litter.

5. The marshaller will insure that the cable or litter has been grounded before having the predesignated two members get the litter.

6. Load patient into the stokes using a blanket or sleeping bag. Provide goggles and other protective clothing as determined by the weather. Comfort and explain to the patient what is going on even if the patient does not appear conscious.

7. Clip the harness to the stokes litter. Keep spider rig and ring to one side of the litter as it is being walked to the pickup zone.

8. Marshaller should signal to the helicopter to have it return to the pickup point.

9. With the helicopter once again at hover, the cable and hook will be lowered. Allow to ground before touching.

10. Marshaller will have the team bring the stokes to the hook. All but two members should move a reasonable distance back.

11. The marshaller will keep hands on the cable, given plenty of slack from above, while one member clips the hook into the center point of the spider rig.

12. The two members will each take an end of the stokes and prepare to stand up while holding the stokes.

13. The marshaller gives an OK sign to the crew, telling the crew to begin taking in the cable. The marshaller will guide the cable so as not to allow it to loop around anything or anyone. As soon as the litter lifts off, the marshaller lets go and the two team members guide and stabilize the litter up to shoulder level. At that point, the marshaller should signal the crew to stop the raising and allow the team to walk the stokes directly under the hoist (if it isn't already). This is to prevent the stokes from penduluming and spinning which can occur if the stokes is raised before the litter is directly under the hoist. If there is no room to maneuver the litter, perhaps the helo can make adjustments.

14. When the litter is ready for final raising, the marshaller will again give the OK LIFT signal to the hoist operator and the members will then release the litter.

15. For ground team information, be aware that there is a cable cutter on the cable hoist which can be used if for some reason the litter jeopardizes the safety of the air crew or helicopter.

16. The UH-1 Huey can only lift and carry one litter at a time. Therefore it must land and discharge its first patient before returning and taking on additional patients.

17. Points to remember:

    - The marshaller *is the only one to give signals to the helicopter* and coordinate activities of the ground team.
    - NEVER load a patient into a stokes while it is still hooked to the cable. Always release it from the helicopter first. The few seconds it takes to stabilize the litter will be well worth the time, both for the patient and the hoist operator! A smooth raising takes less time to hover...good for everyone.
    - Always secure team members with a belay, and a separate belay for the litter, if on a narrow ledge or steep terrain. Down drafts from rotor wash can be very hazardous. Remember to unclip belay from litter *before* hooking to hoist cable.
    - NEVER clip the main hook from the hoist to anything fixed to the ground. Leave it free to be raised or to allow helicopter to maneuver if necessary.
    - A belay rope attached to the litter during hoisting is not recommended as it adds another responsibility to the air crew, and safety problems for the ground team.

Special Considerations and Patient Care

1. The ground team should always reassure the patient and explain what is happening. Use discretion. Prevent shock.
2. Avoid the use of air splints if other types are available, when there is a substantial change in altitude from the pick up to the hospital. A 1000' change in altitude is substantial enough to require monitoring pressure on the splint.
3. Proper Attire:
   - Protection from the cold including wind chill. Any team owned sleeping bags and blankets, etc., can be left by the air crew at the hospital ER for later recovery by the team.
   - Goggles for the patient when going up on the hoist, either by litter or penetrator.
4. Caution with patient head injuries: Pressure changes in flight may create problems. The on board medic should be advised of the possibility of head injuries during initial coordination.
5. When the patient is transferred from the ground team to the air crew's medic, the medic is in charge and responsible. Provide the medic with as much information about the patient as possible. A patient care record should be started by the team and passed on with the patient.
6. The Incident Commander should know where the patient is to be flown even if the ground team does not have that information during medevac.

Hover and One-Skid Landings

:Entry

1. Stay away from the aircraft until receiving a signal from the pilot or crew chief. Follow all standard safety rules.
2. Observe the pilot or crew chief constantly for additional signals.
3. Approach from the downhill side if the area is sloping. Always stay within sight of the pilot. Keep your head down. Do not run.
4. Pass any equipment carefully to the crew members on board prior to entering the aircraft. Do not attempt to climb on board with your pack on.
5. Upon signal from the pilot (or crew chief), climb slowly onto the skid. Be prepared for sudden movement of the helicopter due to adjustments because of weight or wind conditions.
6. Step slowly and carefully into the aircraft, get into your seat and fasten seat belts. Secure any loose gear brought on board. Use carabiners and clip into deck rings or available stantions. The crew chief should advise what to do.
7. Put hearing protection or helmets on.

Exiting

1. Watch the crew chief for signal of final approach.
2. Be prepared to release seat belt and unclip equipment.
3. With sign from crew chief, move to the door.
4. Again, with OK signal, step slowly out of the aircraft and move carefully away. Do Not Run. Watch out for terrain hazards and slope. Do not leave uphill.
5. Gear will be passed out to personnel by the crew on board.

Mountain Operations

Factors Affecting Aircraft Performance.

1. **Temperature and Relative Humidity** - An increase in both can decrease the effective operating altitude which a helicopter can lift a given load and maintain control.
2. **Wind** - A helicopter can maintain better control in a 15-25 mph constant wind during landing, takeoff, and hover, especially when out of ground effect. This is because the wind effectively creates a forward airspeed allowing for translational lift that in still air would be absent. So at hover, wind (not strong and gusty) allows for better lift and control than in calm air.
3. **Position on the Mountain** - The windward side of the mountain will have updrafts, whereas the leeward side will have downdrafts. These effects should be considered when windy conditions (1-12mph) exist.
4. **Turbulence** - Almost always exists in mountainous terrain in late afternoon when the air is mixing. This usually occurs in moderate winds (10-25mph) and creates up and down drafts on the lee side of the ridge.
5. **Icing** - As altitude increases, the danger of icing also increases, especially when there is visible moisture.

6. Pressure Altitude - Less air is available to support a given weight, with a constant power level as altitude is increased.

Indicator of Factors Affecting Aircraft Performance

1. Cloud types indicate presence of winds and turbulence. Lenticular, rotor, and cap clouds occur when enough moisture is present and show airflow around the mountains.
2. Icing should be expected when temperature is near or below freezing, and the relative humidity is high, as would be in a cloud.
3. Pressure altitude and temperature. A standard chart shows the relationship of:
   - Actual Elevation
   - Temperature at that elevation
   - The calculated effective operational altitude resulting from the previous two

The Helirescue Specialist

Minimum Duties and Responsibilities

1. Working knowledge of the material contained in this manual.
2. Know the capabilities of the various helicopter services in your area. Obtain operational details from pilots and crews.
3. Develop the trust and operational relationships of crews prior to missions.
4. LZ management and safety
5. The briefing of aircrews and any team members who will fly on a mission.
6. Any logistics involved with supporting the aircraft and crews
7. Interface with the Incident Commander to provide input on existing capabilities, optimize the utilization of personnel, reccommend the best helicopter service to task for the mission, suggest strategy and tactics for the use of helo and team members, run the air/ground radio as required, assist with the status map at Base for assignments, maintain an ICS Unit Log for the IC.
8. Assemble trained/qualified team members for helo operations and direct their activities.
9. Have the following special equipment to use as required for marshalling and other special operations:
   - Helmet w/ chin strap (Helmet should have reflective H on top)
   - Goggles, clear safety type
   - Orange gloves
   - Orange Safety Vest
   - (12) Chemlites
   - Red tinted penlight
   - Protective clothing, preferably a Nomex flight suit
   - Strobe Light (firefly type)
   - Signal Mirror
   - Thermometer
   - Aerial Flares
   - Small Smoke Grenades (skymark type)
   - (2) Orange Signal Panels
   - Compass
   - Anerometer (if possible)
   - (2) Rolls of Orange Flagging Tape
   - Air/Ground Radio
   - Flight Helmet capable of plugging into helicopter intercom
   - Aeronautical Sectional Maps

Recommended Qualifications of Helirescue Specialist

1. Experience as Mission Qualified CAP Observer
2. Qualified radio operator, preferably a Ham.
3. Advanced First Aid or EMT (minimum)
4. Experience with active helicopters dealing with all aspects of helo operations.
5. Be approved by the pilots and crews who will be working with the Helirecue Specialists.
6. Other SAR knowledge and capabilities as required by the Team.