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8.0 Survival

Introduction

Mineral exploration employees often work in hostile terrain and weather conditions where the risk of facing a survival situation is higher than for the average person. A crisis may develop for individuals or crews on traverse, at a work location or during travel to and from a work site. A project drill site or a field survey crew could become isolated due to sudden storms, flooding, avalanche, forest fire, a whiteout or the loss of backup transportation (e.g., mechanical breakdown, the loss of a boat or helicopter). Field camps are vulnerable to fire, which can leave people with serious burns and without shelter, food, water, clothing, communication and transportation in temperature extreme conditions. Although people often ignore the possibility, a survival crisis may develop very near civilization. Therefore, employees need to take survival equipment on every job at all times.

Proper preparation in advance may mean the difference between life and death in a crisis. Preparation should include seeking local expert knowledge about the area (e.g., the location of safe water and emergency shelters such as a remote cabin).

Try to locate a small survival book suitable for the region where you work. It should be small enough to carry in your pack so it is available to help prioritize your actions during an emergency.

Acronyms

CPR – Cardio Pulmonary Resuscitation

ELT – Emergency Locator Transmitter

EPIRB – Emergency Position Indicating Radio Beacon

ERP – Emergency Response Plan

GPS – Global Positioning System

PFD – Personal Flotation Device

RCMP – Royal Canadian Mounted Police

SAR – Search And Rescue

OLAS – Safety Of Life At Sea

SOP – Safe Operating Procedure

8.1 Risks and Hazards

The attitude that “it can’t happen to me” is foolhardy and unacceptable, as no one is immune to accidents or unexpected risks and hazards. If you have previously worked in an area, it is important to guard against becoming complacent and presume conditions will be the same as before.

Injuries or death to individuals may result in a survival situation due to the following risks and hazards:

- Getting lost or disoriented caused by:
 - Lack of training to use a compass or GPS unit, poor map reading skills

- Loss of battery power for navigation and/or communication equipment
- Inadequate map coverage, old and/or out of date maps
- Weather conditions (fog, whiteout), sudden storms
- Stranding caused by:
 - Injuries severe enough that one is unable to complete a traverse
 - Lack of preparation (e.g., poor map coverage, inadequate transportation, lack of training)
 - Loss of equipment (communication, navigation, day pack)
 - Transportation breakdown or crashes, bad weather
 - Not following SOPs
 - Adverse weather conditions: streams become impassable, water becomes too rough, fog grounds the air support, dust storms, avalanches
- Slips, trips and falls caused by inadvertently entering dangerous terrain or poor map reading skills, wearing inadequate footwear
- Hypothermia caused by working in cold, temperature and/or wet conditions, wearing inadequate clothing, failing to recognize and/or act regarding the signs and symptoms
- Hyperthermia caused by working in high temperature and humidity conditions, lack of acclimatization, dehydration, wearing inadequate clothing, failing to recognize and/or act regarding the signs or symptoms
- Dehydration caused by carrying and/or drinking inadequate quantities of water
- Search and rescue people who are placed at risk caused by:
 - Employees who are inadequately prepared and/or trained
 - Employees who do not follow SOPs and ERPs
- Aggressive animal attack (e.g., bears, moose, cougars, jaguars, leopards, snakes, crocodiles, elephants, Cape buffalo)
- Work at high altitude may cause minor or sudden and serious forms of altitude illness
- Personal risks caused by kidnapping, civil insurrection

Camp destruction caused by:

- Fire in camp caused by: fuel spills, exploding propane tank or generator, electrical short circuit, kitchen fire, careless smoking, fuel storage fire, forest fire or bush fire
- Weather related hazards (e.g., buried under a heavy snowfall, avalanche, flash flood)
- Natural disasters such as mudslides, floods, earthquakes, tsunamis, volcanic eruption
- Bear invasion when everyone is out of camp

8.2 Responsibilities (Due Diligence) and Survival

Companies

- Make certain the health and safety of each employee at a project is protected.
- Carry out risk assessments and develop safe operating procedures (SOPs) that address the risks and hazards related to project work, including travel. Helpful information is available in the following sections of the PDAC Health and Safety Guidelines:
 - 6. Safe Traversing Practices
 - 9. Weather and Environmental Risks
 - 10. Wildlife
 - 12. Travel Safety and Security
 - Transportation Sections: 13. Vehicles, 14. All-Terrain Vehicles, 15. Snowmobiles, 16. Aircraft and 17. Boats, Canoes and Inflatables
 - 19. Communications
 - 22. Abandoned Surface and Old Underground Mine Workings
- Make sure that emergency response plans (ERPs) and procedures are in place to address the potential survival situations that may occur. Refer to Section 3. Emergency Response.
- Provide employees with sufficient training that includes survival skills appropriate for the project location, work conditions and the time of year.
- Provide appropriate communication equipment.
- Provide appropriate survival kits for the season, terrain and work environment.
- Provide adequate emergency cache supplies.
- Evaluate charter aircraft companies for safety performance. In addition to flying hours, specify the required level of emergency training that charter air crews must have. Specify the requirement for survival kits, training and emergency procedures as part of a contract or agreement with the charter services company. Incident free flying does not qualify a pilot to lead a survival crisis after a crash, especially in Arctic conditions. Refer to section 16.3 Aircraft Charters.
- It is advisable to set and enforce limitations and restrictions for work and travel in extreme weather conditions or with inadequate equipment. For instance a company may impose a “no work” order during whiteout conditions or if wind chill temperatures are below, say - 45°C. This removes pressure for employees to push their luck to get a job done and end up in a crisis situation.

Project Supervisors

- Develop and implement site specific SOPs and ERPs and procedures.
- Make sure employees are aware of the local risks and hazards and have sufficient training to address potential survival situations.
- Provide appropriate communication equipment and survival cache supplies for employees working on traverse or at remote work sites away from a main camp or base. Make sure communication equipment is kept in good working condition so it is available when required. Make sure employees are trained and competent to use the equipment.

- Where air support is used, implement periodic reviews of emergency communication procedures, survival kit contents, emergency plans and cached supplies. Take into consideration the time of year and relevant requirements for emergency procedures, survival kits and supplies (e.g., extra warm clothing, bug jackets, bug spray).

Employees

- Follow established company and project SOPs, especially regarding traversing and transportation. Follow check-in routines
- Be aware of the project ERPs that address survival, search and rescue (SAR) and evacuations. Know what emergency procedures to follow and how to signal for help should you require it.
- Be trained in appropriate survival skills for the environment where you work. Practice survival skills when you have the opportunity. Complete a first aid and cardio pulmonary resuscitation (CPR) course and renew certification as required.
- Take your survival kit on every traverse and to each work location. It is your responsibility to take your survival kit with you every time a vehicle, aircraft, or boat drops you off. Do not send it ahead or leave it behind. Keep it with you so it is available. Know how to use your equipment.
- Carry sufficient essential medication in case you become stranded or delayed. Co-workers must know about allergies, understand the symptoms and how to treat a co-worker if they experience an attack (e.g., bee and/or ant stings, diabetes, asthma, food allergies such as nuts.)

8.3 Prevention and Preparation for Survival Situations

The nature of mineral exploration work requires that each employee is ultimately responsible for his or her own personal safety; this is especially true during a survival situation. Therefore, employees should become as self reliant as possible through training, experience, and planning.

Experts claim that survival is:

80% ATTITUDE

10% KNOWLEDGE

10% EQUIPMENT

8.3.1 Attitude

A tough mental attitude is required for survival during a crisis. A clear-thinking, innovative mind is your best ally. This is best developed through taking formal survival training courses appropriate for the terrain and climate to prepare to meet the physical and mental challenges you may face. Training should include emphasis on the following points that are dependent on attitude:

1. You need a very positive attitude and a strong will to live. You must think rationally in order to withstand the challenges and stresses that threaten your well being. It is essential to avoid panic.
2. Improvise to solve problems. Think your way through the challenges. While working with limited resources is one of many challenges during a survival situation, people usually have more resources to work with than they realize. When you lack something, find an

alternative or create a substitute. Keep trying because success will probably not come on the first effort. Keep trying because there is always something you can do that will make a positive difference and increase your chances of survival. Humans are the toughest species on earth – they are survivors – be one.

3. Keep on track until rescue arrives. Devise a plan and stick to it. Enhance a strong positive attitude by creating daily proactive routines. Keep doing something useful to occupy time and improve your situation (i.e., collect fire wood, purify water, improve your shelter, improve your ground signals.) You will have the greatest energy level during the first three days so use this to your advantage. Continue to carry out activities to combat apathy and despair.

Pitfalls to guard against:

- Weather is likely to be the most serious challenge over which you have no control. Be alert for and assess changing weather condition in order to return to camp, or set up, adapt or reinforce your shelter if you are already stranded. Hypothermia, hyperthermia, dehydration and fatigue will affect your mental and physical condition and all these conditions can be affected by weather.
- Lack of self-confidence can greatly affects your chances of survival. Accurately assess your mental and physical condition and work to improve both through proactive routines.
- Avoid overconfidence and complacency or you may place yourself in additional danger. This may occur through ignorance, being oblivious to hazards, or even by believing that you are so prepared and experienced that nothing will happen that you cannot handle.
- Do not disregard your own emergency plans and preparations because other people around you disregard theirs. If others are just waiting for rescue and not working to solve problems, it is even more important for you to have a strong attitude and continue to work to resolve them.

8.3.2 Knowledge

Familiarize yourself with the field area. **C**arry the complete, latest Google Earth satellite photo coverage in addition to maps because maps are always out-of-date. Obtain local knowledge regarding essential information such as the location of potential shelter (a remote cabin), safe water, the location of recent logging roads, clear cuts, beaver dams and ponds, snow, ice and rock falls, changes in river courses due to flooding and bank collapse etc.

Survival Training and Planning

Employees should have survival training that is relevant to the project area, the job conditions and time of year. Survival skills must be appropriate for summer conditions or winter conditions, as required. Skills that may be relevant for one type of terrain may not be appropriate for another terrain. For example, different skills are required in alpine mountain terrain, Arctic tundra, high altitude or a hot desert. Periodic refresher training will help keep skills sharp.

Companies can augment survival safety training and planning in various ways:

- The site orientation meeting should include time for employees to examine contents of both aircraft survival kits and survival caches. Make sure that employees know how to use the contents; if a tent is included they need to know how to erect it quickly.
- Allocate time for everyone to propose and debate potential “scenarios” relevant to the program. People who traverse and people in camp should debate the potential

emergency scenarios, agree on the best plan and know what each other would most likely do in each emergency situation. Take into consideration the variables of climate, terrain, means of transportation and how they may impact employee behaviour and the emergency response procedures.

- When inclement weather confines everyone in camp, use some of the time to practice and rehearse survival skills. Practice building and lighting a fire and setting up a survival tent or shelter under very adverse conditions. Practice using a signal mirror under various weather conditions to develop competence.
- Regular safety meetings can occasionally address relevant survival skills or provide refresher information about proactive routines to prevent hypothermia, hyperthermia, dehydration, the necessity to avoid fatigue, symptoms of mountain sickness etc. Refer to sections 9.9 Cold Injuries, 9.10 Heat Illnesses and Solar Injuries and 8.6.5 Water and Food.

Integrate survival training with relevant outdoor knowledge.

- Know what is safe and what is not safe – obtain local knowledge if you don't know.
 - Which local materials will burn when wet?
 - Where is water safe or not safe to drink?
 - Which vegetation is safe to eat and which vegetation is dangerous?
 - What dangerous terrain is in the area besides the obvious?
 - Which access routes are subject to unexpected closure?
 - What constitutes “bad weather”? How is the onset recognized? When are certain weather patterns likely to occur?
- Survival equipment has limited value if you cannot use it. You need basic skills to use a compass, maps and signal mirror, how to operate an aircraft emergency locator transmitter (ELT) etc. Be able to start the emergency stove and erect the tent in the survival cache. Practice starting fires with fire starting equipment other than matches and a cigarette lighter.
- Learn and practice survival techniques. Practice skills until they are automatic. This will enhance your self-confidence and mental attitude, which in turn will help minimize fear that leads to panic.

Pro-active routines to prevent survival situations

“Be Prepared.” The better prepared you are before starting work, the better prepared you will be to meet a survival situation and the more likely you will have a successful outcome.

1. Take care of yourself: Your physical well being in a crisis is affected by how well you dressed and ate before you started work. Be prepared to face the weather conditions and terrain. This means:
 - Wear clothing that will protect your body from heat, cold and dehydration. Take enough clothing to meet the worst weather you may encounter that day *plus* enough to get you through an unexpected night away from the project. Dress in layers that allow for ventilation as you work. Carry insulating outer wear and rain gear, as required. Remember, deserts as well as tropical forests at moderate and high altitude may be cold at night. (Refer to 6.3.5 Clothing.)

- Start each day with a nourishing meal and plenty of fluids. Eat sufficiently and drink enough water throughout the day to prevent dehydration and fatigue. Then, if you must face a crisis your body will be better prepared to cope. Take plenty of fluids and nourishing food for snacks.
 - Consider the means of transportation that you will be using and wear (or have easily available) appropriate clothing in the event that your transportation breaks down, has to make a forced landing, crashes or sinks.
 - Carry a suitable survival kit. It contains the makings for a shelter to combat hypothermia and hyperthermia, plus supplies combat fatigue and dehydration. Don't skimp, but don't overload yourself. See section 8.4 Survival Equipment Lists.
 - Carry a suitable first aid kit to deal with injuries. Refer to section 18.5 First Aid.
 - Develop and use an equipment and routines checklist and methodically tick off against the checklist before leaving to make sure you are prepared for the day's traverse or work.
2. Communication and tracking routines: Follow communication tracking and check-in routines outlined in Chapter 19. Communications. Leave accurate details, including grid coordinates of travel destinations and traverse routes. If you do not return or make contact at the appointed time, a search can be initiated shortly thereafter.
- Use appropriate communication equipment for the area. The importance of good communication in emergency situations cannot be overemphasized. In cold areas, keep batteries warm next to your skin and use them sparingly. Refer to section 19.6 Emergency Communications.
 - Carry extra communication devices (e.g., fluorescent orange signal cloth, whistle, signal mirror). Wear brightly-coloured clothing, especially when working in brushy or forested areas, working from boats and/or during hunting season. You will be easier to locate from the air and less likely to be mistaken for game.
 - Keep track of your location throughout the day by pacing, using air photos or other methods – don't just rely on your GPS or your best guess. Refer to 7. Knowing Your Location.
 - Immediately relay any changes in plans, traversing routes or dangerous developments to the responsible person (e.g., impending bad weather, vehicle breakdown). If you don't inform the base communication station, they may search in the wrong direction or the wrong area.
3. Traversing routines
- If your work includes traversing, prepare yourself each day taking into account the tips and routines in the relevant sections of 6. Safe Traversing Practices. Information and knowledge cannot be restricted to one person. *Everyone*, not just the traverse/party leader, needs to know and understand:
 - Where they are going – including the details of the route(s), meeting points as well as the destination
 - How and when they will be dropped off and picked up, the means of transportation on the traverse etc.
 - What the objectives of the traverse are, what risks and hazards to expect, what the check-in schedule is etc.

- Look out for good emergency camp sites or places to seek shelter as you traverse.

4. Transportation routines

Follow SOPs for all means of transportation used at a project. Some of the most important considerations to prevent survival crises are listed below. For additional information see the chapter listed.

- Vehicles: Make sure vehicles are in good mechanical condition and are properly equipped with first aid and survival kits and manuals. Field vehicles should be equipped with reliable communication devices. Refer to Chapter 13. Vehicles.
 - Deserts: Carry water and a survival kit any time you leave the vehicle. Always carry extra water if you walk farther than 30 minutes from the vehicle. During hot days do not work too far from the vehicle as hyperthermia can set in quickly (and hypothermia at night).
 - Cold environments: Carry appropriate survival equipment including plenty of extra warm clothing, blankets, food and water; keep the vehicle fuel tank at least half full.
- ATVs and snowmobiles: Plan for potential survival situations that include mechanical breakdowns or accidents in the most remote part of the project area. Carry appropriate survival equipment and supplies when working on ice. Refer to sections 14. All-Terrain Vehicles and 15. Snowmobiles.
- Aircraft: Develop a plan of action in case the weather closes in and your air support cannot return. In most situations it is far safer to stay put. Whenever you fly, dress for the outdoor conditions – wear sufficient clothing for warmth in case you are stranded, cannot reach your destination, and cannot retrieve your pack/baggage after a crash. Refer to Chapter 16. Aircraft.
- Boats: Use a boat of the appropriate size and type for the waters and wear a PFD (Personal Flotation Device). Use checklists before departure to make sure all safety equipment and supplies are on board. Refer to Chapter 17. Boats, Canoes and Inflatables.

5. Good judgment and awareness

- Try to obtain the daily weather forecast and heed warnings of potential problems (e.g., major storms, high winds, heavy rains, a major drop or rise in temperature, snow).
- If stranded, consider the risks involved should you try to return to the project site. Don't risk getting lost or crossing barriers that you would not ordinarily cross (e.g., rivers, streams, cliffs).
- Keep track of your location on your map or you may become lost. STOP anytime you are not sure where you are. STOP if you discover you are not where you think you are. Back track, if necessary, to place yourself accurately on your map. Do not continue until you know where you are. If you are truly lost... STOP.
- Recognize when risks and problems are adding up. Work to reduce the risks that produce hypothermia, hyperthermia, dehydration and fatigue.

8.3.3 Equipment

Carry some basic essential survival equipment with you at all times and know how to use it automatically. For equipment suggestions, see section 8.4 Survival Equipment Lists.

- Assemble a personal survival kit in a waterproof container with items appropriate for your project area.
- Keep your kit in a waist pack or attached to a belt rather than inside your pack, which may be lost in a capsizing or a helicopter crash. Keep the most essential items zipped in your pockets. Keep fire lighting equipment in at least 3 different places – in the pockets of your pants, field vest and pack, plus more inside your pack.
- Employees who do occasional field work should assemble and carry a small personal survival kit.
- Take the survival kit on every traverse and to each work site every time a vehicle, aircraft or boat drops you off. Do not send it ahead or leave it in a vehicle. Keep it with you so it is available at any time.
- Companies should equip vehicles with sufficient survival supplies for each potential passenger.
- By law, all charter aircraft in Canada, the USA and Australia must carry survival equipment. Employees should make sure it is on board for each flight; know where it is stowed and how to retrieve and set it up correctly.
- Carry a small survival booklet appropriate for the region in your survival kit (and vehicle) to help focus on priorities.

8.3.4 Confronting a Survival Situation

Be aware of the risks and hazards where you work and that they may change from day to day. Recognize when various risks are “adding up”. During daily work routines, events that begin as a series of small predicaments may escalate and become a serious situation. It is far easier to address the small problems over which you may have some control than to cope with a situation that has grown out of control.

If you suddenly face a survival situation, you can expect rescue within an interval of as short as a few hours to two to three days – *if* you have followed the established communication and check-in procedures with your base.

Challenges

Your survival depends on (1) your physical and emotional reactions, (2) the planned actions you carry out and (3) how you adapt to challenges as they arise. Prior preparation will make it is easier to deal with a crisis.

Recognize that challenges and stresses may include many of the following: injury and pain, cold and/or heat, thirst, hunger, fatigue, fear, boredom, loneliness and group dynamics. You need skills to combat any combination of cold or heat and thirst, which along with fatigue can dull your mind so you cannot think clearly. When you do not think clearly, you may make poor decisions that compromise personal safety and that of others.

There are three levels of reaction to a survival crisis that end with panic.

1. Concern – It is easiest to think clearly at this stage.
2. Fear – Do not deny fear; use it to direct your actions in a positive way.
3. Panic – It is almost impossible to reverse panic once it starts. As difficult as it may be, try to remain calm.
 - Because panic often leads to death, you must control any urge to panic. Work to **KEEP CALM. PANIC IS A KILLER**
 - If part of a group, panic can be averted through careful organization, good leadership and working as a team. Group dynamics can accentuate or reduce problems so good leadership is essential. A group leader must constructively focus the group to address their physical needs and keep the anxiety level at the stages of concern and/or fear.
 - If you are alone, it may be more difficult to cope and to control the urge to panic. It is essential to manage your emotions and assess the emergency situation quickly and correctly with a calm, clear mind. Confirm your feelings of fear and utilize them to direct your actions to meet your immediate requirements to increase your chances of survival. People frequently die if they deny fear and refuse to admit the existence of danger.
 - Refer to the small survival manual to remind yourself how to tackle and prioritize problems.
 - If you start to travel blindly – stop; you are dangerously close to panic.

8.4 Survival Equipment Lists

The contents of a personal kit and survival cache will vary depending on the season, the geographic location and terrain. Assemble a personal kit using the best products available. Off the shelf kits do not usually contain high quality products and are rarely suitable for Arctic or other extreme conditions. Test the contents of kit and survival caches to make sure they work and perform under the worst potential weather conditions.

Suggested items for a personal basic survival kit:

- Large brightly-coloured, heavy duty plastic garbage bags
- Matches – waterproof or in a waterproof container, cigarette lighter, plus another type of fire making equipment (see section 8.6.4 Fire)
- Water purification tablets (follow instructions carefully)
- Transpiration bags to collect water (as appropriate)
- Candle
- Knife
- Signal mirror
- Mountaineering tarp (or space blanket depending on region and preference)
- Whistle (plastic in cold climates)
- Insect repellent
- Mosquito head net, bed netting (depending on region)
- High energy food packets, soup cubes, tea bags, chocolate bars, dried fruits etc.
- Container for the kit – (heavy-duty plastic bag, small metal or Tupperware-type sandwich box). Use as a water container; a metal containers can be used to boil water.

- Adhesive tape
- Nylon line – 15 metres brightly-coloured braided fishing cord or parachute cord
- Flares and flare gun
- Tin foil – for boiling water, signalling etc. Fold or wrap it around a flat item
- Small survival book – appropriate for region
- Small first aid kit and booklet

Additional Items for a Personal Survival Kit

- Wire saw
- Length of plastic tubing for siphon
- Extra space blankets
- Solid fire starter cubes
- Metal cup
- Small gas cylinder and stove burner attachment
- Aspirin, Benadryl
- Water-treatment filter
- Light sticks
- Extra socks
- Fishing hooks and line

Survival Cache Contents

- Tent
- 35 metres of nylon cord
- Sleeping bags – 1 per person
- Flares and flare gun
- Candles
- Waterproof matches, lighter
- Solid fire starter cubes
- Signal cloth and mirror
- Fishing gear – hooks and line
- Small gas cylinder and stove burner attachment
- Extra batteries for radios, GPS
- First aid kit including first aid book (appropriate size for several people)
- Cooking pot
- Extra clothing, appropriate for region
- Food supplies – totally animal proofed
- Insect repellent
- Insect head net, 1 per person (depending on region)
- Axe, small cross-cut saw, knife, small shovel
- Ensolite Pad
- Sheet of plastic

Equipment Tips

Tarps versus space blankets: Many field experts prefer to carry a high altitude mountaineering tarp as they are light, wind and waterproof, and have corner grommets to facilitate use. Tarps come in various sizes, fabrics and weights and are suitable for alpine, Arctic, desert (shade) tropical and temperate rainforest (wet) conditions. Space blankets come in various sizes and qualities; they are more fragile than mountaineering tarps and rip more easily. They do not provide as much protection as they are usually thinner. Once the reflective surface is abraded, they are no longer able to provide the same insulation.

Cook stoves: a small gas cylinder and stove burner attachment is quite lightweight and easy to use. They can provide a warm drink or soup when working in cold or wet conditions.



Figure 8.1: Survival kit for day pack © Matt Turner



Figure 8.2: Survival essentials for pockets © Courtney Mitchell

8.5 General Advice for Survival Situations

- If an accident occurs, assess the situation and if possible, contact others for help before attempting a rescue.
- Remain at the destination or pick up point if your transportation fails to arrive. Co-workers will know where to find you.
- Remain with your vehicle. If the vehicle becomes stuck or disabled, you are safer remaining with a well supplied vehicle than walking out alone. It can provide shelter from hot or cold climatic conditions. It is more visible from the air than a person, especially when the doors are opened wide.
- Leave your stranded vehicle, crash site, pick-up point etc., only if conditions are too dangerous to remain. Then, travel only until you find a safe location for an emergency camp. Leave a complete windproof and weatherproof note to indicate your intentions, state your destination, route, time of departure and the date. Mark it with flagging tape to draw attention to it and mark your trail as you proceed so rescuers can follow you.
- If you break down in forest or jungle terrain where a vehicle is not visible from the air, it may be necessary to seek a clearing to signal for help if no road traffic is forthcoming.

If you fall into water or capsize your boat or canoe, you must avoid hypothermia. While it is difficult to accomplish, make every effort get into dry clothes and build a fire for warmth, if necessary. Follow the advice in section 17.12.3 Cold Water Immersion Hypothermia.

Direction Finding

Everyone in the party should carry a copy of the map/air photos/Google Earth satellite photos in waterproof Ziploc-type bag on their body. Everybody should carry a compass and a watch for keeping track of traversing progress and finding direction if necessary.

- Shadow-tip method: Place a stick vertically in the ground and mark where the tip of the shadow is located. Wait 20 minutes and mark shadow tip again. Draw a line between two points and that is general East – West line. Draw a perpendicular line, which will indicate the North – South direction. This method can be used on both level and sloping ground.
- Simple watch method: On the ground, mark the location of the sun between 9 AM and noon and again between 3 PM and 6 PM. Draw a line between the marks to determine the East-West direction. North-South is perpendicular.
- Watch method: Use your watch set to standard time to roughly determine the North and South directions. This method is not very accurate within 23° of the equator.

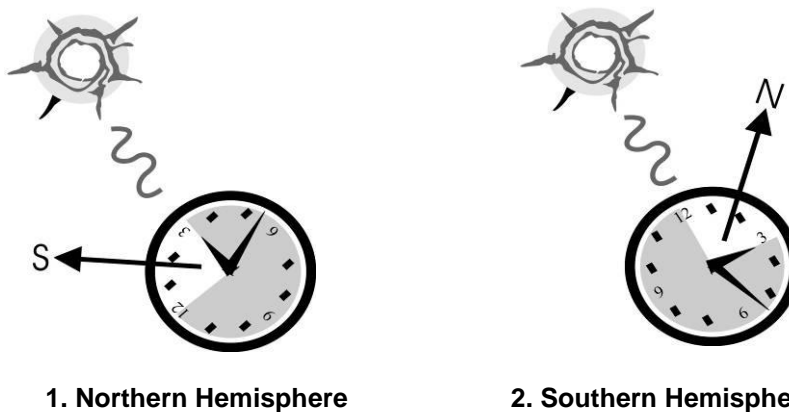


Figure 8.3: Finding your direction

1. In the Northern Hemisphere, point the hour hand at the sun. South is located half way between the hour hand and the 12 on the watch-face.
2. In the Southern Hemisphere, point the 12 on the watch-face at the sun. North is located half way between the hour hand and the 12 on the watch-face.

6.5.1 Survival Advice for Cold Climate Conditions

If something goes wrong, immediately go into survival mode. Do not wait to see if someone shows up or if the situation suddenly improves.

- Know how to prevent hypothermia and other cold related issues (refer to section 9.9 Cold Injuries).
- Keep the vehicle fuel tank at least half full so you can run the engine intermittently to heat the interior should you become stranded.
- Ensure that the exhaust pipe is clear of snow or dirt to prevent asphyxiation when you use the engine to heat your vehicle. Leave a window slightly open for ventilation while the engine runs but do not allow exhaust to enter.

- Always tie a cord to yourself and the steering wheel or door handle if it is necessary to leave the vehicle during whiteout conditions.
- Create a tent within a vehicle using three space blankets.
 1. Tape one edge of a blanket to the windshield. Bring the blanket over your head and behind your back.
 2. Tape a second blanket over the inside of the window and door on the windward side to create a wind screen.
 3. Spread another space blanket on the floor. Curl up on the seat inside the blankets.
- Use a coffee can candle, sterno “canned heat”, or an emergency candle on the floor of the vehicle to generate heat once your fuel is gone. They are easily made one by filling a 1 kg coffee can with wax and two wicks.
- If a group is stranded in a vehicle, it may be warmer to huddle together. Coats spread out as blankets may provide the most warmth. Loosen any tight clothing.

When faced with a survival situation without a vehicle or transportation to use for shelter:

- Immediately recognize the need for action; do not delay and wait for help.
- Organize yourself or your group immediately. Use your strength and resources during the time left before darkness and build a shelter and a fire.

8.5.2 Survival Advice for Desert Conditions

Seek shade when stranded in a desert. Keep activity to a minimum to control your body temperature and control your sweat rate. Follow these guidelines:

- Remain still in the shade, rest during the day and do required work at night. Know how to prevent hyperthermia and sunburn.
- “Ration your sweat, not your drinking water” (see section 8.6.5 Water and Food).
- Cover as much skin as possible. Wear a long sleeved shirt, long pants and a broad brimmed hat. Loose fitting light coloured clothing is best.
- Do not sit and rest directly on the ground; the surface temperature is often much warmer than the air temperature. Find an elevated place 1-2 m off the ground to rest (e.g., a tree limb, a rock ledge). At night, it is advisable to sleep in the shelter of a stranded vehicle or up off the ground to avoid encounters with scorpions, snakes or other venomous creatures.
- A vehicle interior can become very hot during daytime hours, even with all the windows open. The shade cast by vegetation or rocks may be cooler than the shade cast by the vehicle. Nevertheless, during the day it may be coolest under the vehicle, especially if you can scrape away any loose surface material that has retained heat.
- If a vehicle is unavailable, dig a hole or trench to access cooler ground. Scrape away at least 25-50 cm of the surface dirt to create a cooler resting area. The deeper you dig, the cooler the hole – but this requires more energy and produces more sweat. Create a roof over the hole with two layers of plastic spaced 50 cm apart to create an air layer that will help insulate the hole from the heat of the sun.
- To create shade: Rig a canopy out from the side of your vehicle with a sheet of opaque plastic (white is best). Leave about 125 cm (4 ft) of open space below it for ventilation.

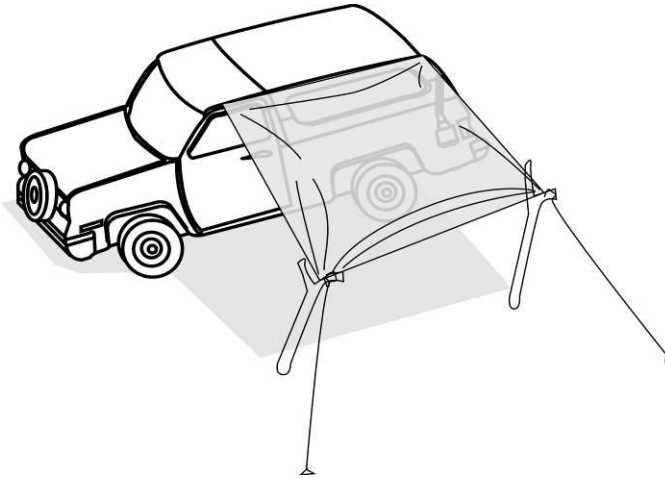


Figure 8.4: Creating shade in the desert using a canopy

8.5.3 Survival Advice for Forested Areas

All forests

- Good map and compass skills are essential. Locating yourself is difficult when you are off a grid system or off a known track or road. It is difficult to find a point to take a sighting and it may be necessary to climb a tree or a hill to get your bearings if you are lost. Do not depend totally on GPS technology as battery power will disappear if you are stranded for any length of time.
- Make yourself visible for searchers. This is a challenge due to the dense underbrush and forest canopy. Go UP to be seen by aircraft – a ridge or hill. Try to find a clear cut or burned area. It may be dangerous to follow water courses downstream as they frequently become steep waterfalls. You will probably be invisible next to an overgrown water course with dense vegetation.
- Gauging the distance you have travelled can be difficult when it requires a lot of work to traverse dense growth. You may think you have gone much farther than you actually have.
- Depending on the season, starting a forest fire may be a serious concern; take care with signalling fires, especially if the torch tree method is used.

Temperate rainforests

In addition to the above, weather may cause transportation difficulties, especially when relying on air support, as clouds may sock in an area (sometimes routinely). Fog may affect the coast and disrupt boat schedules. Local knowledge regarding weather is important.

- Lighting a fire can be very challenging because tinder, kindling and fuel are likely to be very wet – and you will probably need a fire for warmth and to dry out. Always carry foolproof methods to light a fire.

Tropical rainforests

- It can get quite cold in mountainous areas, even near the equator so carry sufficient clothing to be dry and warm. Hypothermia is a risk at elevation, especially if you cannot keep dry.
- Survival kits and caches should include mosquito netting. Carry the means to make a hammock in order to make sleeping area up off the ground to help prevent insect and other bug bites.
- Rain flows into streams and tributaries so be prepared to move if water levels start to rise. Flooding can be sudden and deep; mudflows can be a hazard as well. Flash floods can develop in mountain stream beds and may be routine in some places.

8.6 Priorities for Survival Situations

Prioritize problems and work to solve the most pressing ones. In order, these usually are:

1. First Aid
2. Location
3. Shelter
4. Fire
5. Water and food
6. Signalling for help

You increase chances of survival if you immediately recognize when there is a potential crisis and maximize efforts to help yourself and control the situation. You will have the greatest energy level during the first three days, so use this to your advantage. By the fourth and fifth days, depression frequently sets in and people lose their will to live and ability to think clearly. To combat apathy and despair, it is essential to have a plan and stick to it (see section 8.7.1 Guidelines for the Lost or Injured Person). If you survive these days, your attitude usually improves as you grow familiar with the situation. Only a very strong will to live and a positive mental attitude will pull you through. As described in section 8.3, prior planning and practice will increase your awareness of potential survival challenges so you can respond appropriately.

In a crisis, first check for injuries and administer any necessary first aid. After this, your priorities are location, shelter, fire, water/food and signalling for help – usually in that order. Signalling may be a higher priority as in the case of an aircraft mishap when you should make certain that the aircraft ELT is transmitting a distress signal as soon as first aid is administered. Take action in the following order of priority.

8.6.1 First Aid

Injuries may be part of a survival situation with additional challenges, or an injury itself may be the focus of a survival situation. Administer first aid as necessary. The injured need shelter as soon as possible, but try not to move them too far. Project emergency response procedures should cover the following potential injuries:

- Vehicle, ATV, snowmobile, boat and aircraft crashes
- Falls with broken bones, internal injuries, abrasions
- Axe and chainsaw wounds

- Hypothermia, hyperthermia, dehydration, and altitude illness (depending on region)
- Serious burns
- Animal attack

Refer to section 18.5 First Aid for information regarding treatment priorities and section 3.0 Emergency Response.

8.6.2 Location

- If you have radio or satellite telephone contact, give a clear, accurate description of your position so rescuers can locate you easily. If you are familiar with the area and location, you can utilize nearby features to aid your survival (e.g., water sources, safe shelter).
- If you are completely lost, stop and remain where you are and do not waste energy wandering around. Proceed with the priorities – avoid exhaustion so you can think clearly. If you continue to wander, you may walk out of the area where rescuers are focusing the search. This has occurred when employees were unable to competently use a compass and/or GPS unit.
- Remember to remain with or very close to your transportation, crash site or traverse route.

8.6.3 Shelter

Use care when selecting the site for a shelter. You need protection from the elements (cold, snow, rain, heat, and wind) to avoid hypothermia, hyperthermia and dehydration. Use your ingenuity to create shelter that is as comfortable as possible without expending much energy. Allow enough daylight to build any necessary shelter – it is a much harder job to build one in the dark. Always remember to insulate yourself from the ground by making a mat of boughs or grasses to rest on to prevent heat loss. Make use of local materials and use the contents of your survival kit (tarp, garbage bags, or space blankets) to your best advantage depending on the climate.

Criteria for Shelter Sites

Shelter should be located so you are visible yet prevent exposure to the local risks and hazards. Stay dry. Keep warm or cool. It is important to avoid exposure to wind unless wind will keep insects away. The ideal location provides good water, materials for shelter, and fuel for a safe fire for warmth and signalling.

- Remain with your transportation. Incorporate it or use it as shelter, if appropriate. Suspend plastic or space blankets etc., from the vehicle, aircraft or boat.
- Avoid obvious dangers such as wet overhanging branches or potential avalanches, mudslides or rockslides. Also avoid low flood-prone areas and wet insect-infested areas.
- In cold or wet weather it is vitally important to have protection from the wind. Avoid the bottom of a valley or hollows, which may be cold and damp.
- In hot climates find or create shade in an elevated place, as the temperature there will be lower than at ground level.
- A hillside or ridge may provide a breeze to relieve insect annoyance, but may not be warm enough and it may provide a target for lightning.

- Check any tree you use for shelter for insect nests (bees, wasps, ants). Check for rotting or dead branches that might fall if it becomes windy. Avoid a solitary tree (lightning target).

Types of Shelters

Plastic garbage bags

These are an essential part of a survival kit as they can be used for many purposes. Carry fluorescent or bright orange garbage bags for high visibility and signalling.

- Two large plastic garbage bags (opened at the ends and taped together to form a tube) can create shade or immediate shelter from water and wind.
- Crawl inside the tube or suspend it to make a tent. Use a rope or stick to prop up one end. Insulate beneath yourself. Anchor the edges to the ground with rocks, bark or vegetation. Note: When plastic garbage bags are used for a tube shelter, water from your sweat and respiration may condense on the inside of the plastic tube so you end up soaking wet and chilled. Plan for ventilation to avoid this dilemma.
- Slit the bags to open them up flat. Use separately or tape them together to form a large tarp. Use as a ground sheet and a cover for wind and/or rain protection.
- Use them for waterproofing for a roof on a shelter built of boughs, rocks, logs, etc.

Lean-to shelter

This simple shelter can be constructed from a wide variety of materials and is adaptable to many environments.

- Build your lean-to only as long as your height so you do not waste energy heating extra space. Allow at least two hours of daylight to build a lean-to.
- For a simple lean-to, suspend a tarp between trees, bushes, rocks etc., for a windbreak. Position it to protect yourself from the wind. Insulate beneath yourself.
- Build a framework from trees, sticks or tree branches – or even in combination with rocks. Make upright supports by using trees or two or three crossed, freestanding poles. These must support a ridge pole against which you lean more upright sticks at a 45° to 60° angle. This slope will allow rain to drain away efficiently. Place smaller sticks horizontally on these sticks to support the roofing material. Tie the components together using ropes, vines, grasses, shoelaces etc. Roof coverings for a lean-to shelter can consist of a plastic tarpaulin, evergreen branches, bark, palm leaves, split bamboo stems or whatever is available. Build up vegetation in layers from bottom to top as though shingling a roof.
- Make sure that layers of evergreen branches are at least 15 cm thick so rain does not penetrate. If there are heavy rains or winds, use the plastic covering on top of the branches.
- Thick bark (split bamboo in the tropics) can be laid like pan tiles. Make a gutter to drain water away. The roof need not extend to the ground in a warm climate where ventilation is desirable.
- Stuff the ends of the lean-to with vegetation to stop winds. Insulate beneath yourself.

- Build a long fire at the opening of the lean-to. Do not build two lean-tos facing each other with a fire between, as one shelter will fill with smoke.

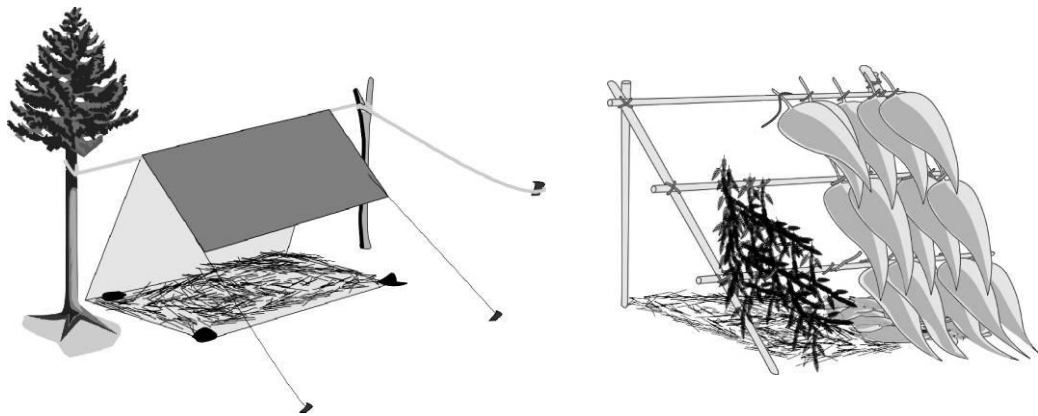


Figure 8.5: Examples of a lean to shelter

Rock shelters

- Arctic and alpine areas above tree line are challenging terrain to find shelter. Rock can be used for shelters by creating a stone wall and windbreak combined with a tarp for a roof to control wind. An old fashioned bee hive shape can work well.
- In hot desert terrain, utilize rock overhangs and look out for caves to use for shade and shelter.

Other Simple Shelters

- Use an overturned canoe or inflatable boat as the foundation of an emergency shelter. Insulate beneath yourself.
- Use a fallen tree as the foundation of a lean-to shelter.
- Use two adjacent logs of unequal size with a plastic sheet stretched over them for shelter with drainage. Or, use mounds of sand or rocks to support and control the placement of a tarp or space blanket. Scoop out dirt between the logs and insulate.

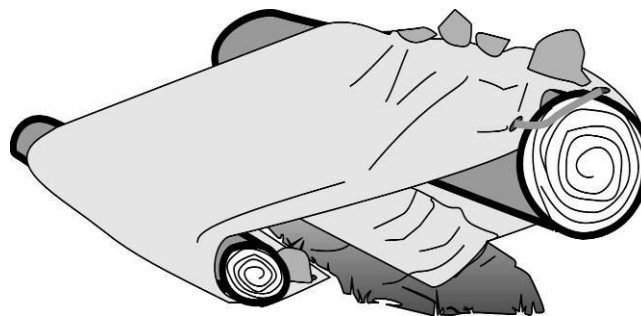


Figure 8.6: Example of simple shelters

Cold Climate Shelters

Shelters built into snow are relatively quick to make but you need a shovel or snowshoe to dig one with any ease. Carry a lightweight, collapsible avalanche shovel. This item should be standard equipment in a survival cache for snow areas.

Keep the shelter space small – not much bigger than your body. Line the area with plastic where your body will contact snow so you don't get wet. It can be surprisingly warm if you have a small source of heat. Place the entrance to a snow shelter in the downwind direction. Always remember to insulate beneath yourself.

Hazards of snow shelters

- **Asphyxiation:** If you block the entrance to retain warmth, you must create an air hole to avoid asphyxiation. Ensure the air hole remains open throughout the night, which may be difficult if there is a storm or windblown snow. Don't forget to create an air hole in any solid snow shelter.
- **Collapse:** Tent shelters may collapse from heavy snow and bury and/or asphyxiate the occupants. Snow shelters may collapse if they are not strong enough or if a storm adds more weight. Keep a stick inside to help burrow out if this occurs.
- **Hypothermia:** Melting snow from heat generated within the shelter may get you wet. Snow shelters require a lot of energy to build so that you may become sweaty and then chilled from the construction.
- **Lack of ventilation:** Do not cook in a confined space such as a tent or snow shelter as the carbon monoxide from the cooking fuel can asphyxiate you. It is very risky to cook in any closed shelter.

Tree base shelter

Dig out accumulated snow near the trunk of an evergreen tree with spreading branches. Use the space beneath low branches for shelter. Insulate the sitting area and where your back will rest and line the area with a plastic garbage bag to stay dry when snow melts due to your body heat. It may be advisable to use available materials to create a small lean-to against the trunk to prevent snow dropping onto you.



Figure 8.7: Example of a tree base shelter

Quinzhee (Create your own cave)

Sometimes, only powder snow or very little snow is available. In this situation, you can scrape the snow into a mound and let it settle for several hours. Place your pack where your shelter chamber will be and heap snow on top to create a large mound. Place sticks of equal length into the mound at intervals; they should be a bit longer than the desired thickness of the walls, which must be at least 30 cm thick. After the snow has recrystallized and the snow particles are bonded together, dig a small tunnel into shelter. Remove the pack and equipment and continue to hollow out the chamber. When you encounter a stick you will know the thickness of the wall at that point. The floor should be higher than the entrance opening to retain warm air. Insulate, make an air hole for ventilation and leave an air hole at the entrance. This is a lot of work, but it provides shelter. If you make a very small fire inside for a very short time, ice will form on the ceiling and reflect your body heat.



Figure 8.8: Quinzhee © Jamie Bastedo

Snow tunnel.

Locate a good sized snow drift and dig out a tunnel into it. Make an air hole for ventilation and leave an air hole at the entrance.



Figure 8.9: Creating ventilation in a snow tunnel

Snow or fighter trench

This is the least desirable type of snow shelter. Detailed construction is described and illustrated in *Down but not Out* and involves cutting uniform slabs of snow and stacking them at a 45° angle over the trench from which they were cut. Avoid this form of shelter if you do not have a sleeping bag as it will become a cold tomb. Dig a snow cave or a build a quinzhee instead.

Combine a trench with tree branches: Below tree line, a better solution is to dig a trench and use the snow to form walls. Make a thick insulation layer with boughs and create a roof with branches and/or a tarp.

8.6.4 Fire

Fire provides warmth, boils drinking water, dries wet clothing, signals your location, keeps bugs away, heats food, and lifts your spirits. You should be able to light a fire under any weather conditions you may experience, which takes practice. The section on fire methods in *Down but not Out* contains good tips.

Ignition

Always carry at least three methods to start a fire and some dry tinder (in a waterproof bag) in your pockets. Good fire lighting materials include:

- Regular matches – carry in a waterproof container. You can make your own waterproof matches by dipping regular wooden matches in paraffin wax.
- Waterproof matches – these usually require a special surface to strike on.
- Cigarette lighter – not dependable in very low temperatures. It should have an adjustable flame, which makes lighting easier.
- Magnesium spark rod – this method takes practice to become proficient.
- Magnifying glass, camera lens – focus strong sunlight through the glass or lens onto dry woody tinder to create an ember to light the remaining tinder. This works when there is no wind.
- Vehicle battery: Use two pieces of wire and connect one to each battery terminal. Touch the free ends of the wires together next to your tinder to create a spark. It is safest to remove the battery from the vehicle and use long pieces of uninsulated wire.

Warning: As hydrogen is present, the battery may explode, especially if you use metal tools in place of wire (spanners, knives etc.). Do not allow the wires to touch any other metal (vehicle frame) or a short circuit may occur. Flashlight or radio batteries may have enough power to produce a spark.

Fire Components

Assemble everything before building and lighting the fire. Know what local materials will burn when wet. The fuel should be within reach. Have water available to extinguish the fire.

- Tinder: Good tinder must be dry and easy to light. Use bits of cotton lint, pitch or sap, fir and pine needles, moss, shredded dry birch or cedar bark, powdered wood from insect borings, seed fluff from plants, fine steel wool etc. These catch fire quickly and they can be soaked in fuel oil if available. 100% cotton balls saturated with Vaseline are invaluable for tinder as one ball will burn for several minutes. Pack them tightly in a film canister.

- **Kindling:** It must catch the flame from burning tinder. Use very small twigs, dead leaves or grass, shaved wood bits, fir cones, inner bark of dead trees, dried animal scat etc. Sticks should be no larger than a pencil so they catch fire easily.
- **Fuel:** Start with dry wood. Dead branches on trees are dry and burn easily. Start with finger-sized sticks for fuel and gradually increase the size of the wood. Add fuel slowly so the fire does not smother. Green or wet wood burns slower and creates smoke to help keep insects away. Mixing dry and wet wood helps a fire last longer. If only wet fuel is available, it will require hard work to make the fire go.

Fire Location

Choose a safe place to build a fire.

- Try to locate the fire so it is visible to rescuers.
- Clear a large circle and scrape down to bare mineral soil. Build a fireplace of scraped up earth and rocks. This offers wind protection and diminishes heat loss. The fire area should be at least 2 metres wide – more if it is windy or if vegetation is very dry. Make certain no overhead branches will catch fire or drop snow on your fire and extinguish it.
- Do not build a fire on moss, needles or roots. Do not start a fire in a peat bog, as they are nearly impossible to extinguish and may smoulder for years. **Do not** build a fire at the base of a tree or stump or against a log because it cannot be controlled easily and may continue burning after one thinks it is extinguished – and even start a forest fire.
- Avoid using “river rocks” around the perimeter or as a foundation for a fire, as they may retain moisture inside and explode when heated. Any layered rocks that contain moisture may do the same.

Fire Building Tips

Use materials that will burn easily even when wet.

- Make your fire only as large as necessary; collect enough fuel so you don't run out. Collect some extra fuel so you can quickly increase the size of the fire to attract attention when a plane is heard. One large signal fire is easier to maintain than three smaller fires separated by many metres. It is difficult to gather sufficient fuel, and smaller fires are less visible from a distance or the air than one large fire.
- Do not waste matches trying to light a poorly built fire. Build it well and then light it.
- Light a bundle of twigs and dry grasses off the ground to get it going and then insert it into carefully laid kindling and fuel sticks.
- Windy areas: Dig a trench and build a fire in the trench. Make a fire circle with rocks large enough to offer wind protection.
- Wet areas: Build a platform of green wood and cover it with earth, if possible. In flooded areas, raise this platform on stilts. Build your fire on the platform.
- Stack green or wet logs and sticks at the back of a fire to dry. They will reflect heat as well.
- Pine sap scraped from trees will burn easily. It can be added to tinder and a fire should start even when it is damp or raining. Usually pine sap can be found at the base of trees that have been scarred; it flows down and forms large clumps.
- Practice building and lighting a fire under difficult condition. Consider how much more difficult it would be if you were injured when having the warmth of a fire might be critical.

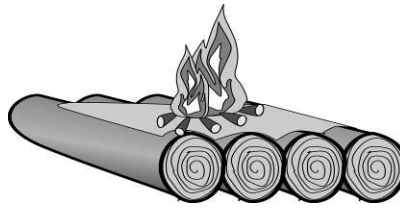


Figure 8.10: Example of a Platform fire

Fires in the Arctic and Alpine Areas

- Wood for fuel is rare in the Arctic except along the coast where driftwood can be found. Carry fuel and stove or improvise with fuel from a vehicle etc. A small fuel canister and stove attachment is useful and lightweight.
- Kerosene or diesel fuel can be drained from aircraft, vehicles, ATVs or drums. Fill cans with dirt or sand, soak with fuel until saturated and then set them alight. Use rags soaked in fuel for starting a fire if wood is available. Do not use gasoline as the vapours are explosive.
- Take care not to cause a tundra fire. Build it on a platform of rocks if necessary.
- Use a platform to prevent a fire melting through deep snow, which will extinguish it.

8.6.5 Water and Food

Water is more important for survival than food. You can live only a few days without water while you can survive a month without food. If you work in areas where water is often not safe to drink, carry water purification equipment (e.g., tablets, filter, a container for boiling). People often forget that dehydration can be a serious problem in the Arctic; do not count on streams carrying water during summer months – even when marked on a map. Never travel in desert terrain without sufficient water for everyone, extra water for emergencies, and equipment to obtain water.

Each person needs *at least* 10 litres (2.5 gallons) a day when working in hot climates. If you become stranded, stop work immediately and make every effort to conserve the drinking water you possess as well as the water within your body – by doing everything possible to prevent the formation and evaporation of sweat. It is better to “ration your sweat, not your drinking water”. Do not reduce your water intake in the first 24 hours of a survival situation because dehydration impairs your ability to think clearly.

To conserve body fluids

- Make every effort to avoid sweating, crying or vomiting. Do not eat anything that might cause diarrhea.
- Drink sufficient water frequently enough to quench your thirst. Don't just sip small amounts; you must drink enough to avoid dehydration.
- Follow the guidelines in this section for clothing, rest and shelter.
- Work to avoid sweating in cold regions or you will waste energy drying yourself and your clothes.

Sources of Water

- The best source of water is that which you carry from the project or camp. Fill up all your containers and drink a lot to pre-hydrate yourself before departing each day. Do not presume that a stream or creek etc., will exist just because it is marked on your map.
- Surface sources such as lakes, streams, pools or watering holes may or may not provide clean safe water. They may contain viruses, bacteria, and numerous parasites including flukes, leeches etc. In dry regions, water sources may be contaminated with mineral salts.
- When searching for ground water, look for areas where plants that require water are growing. Typical plants in temperate areas include willows, rushes, cattails and cottonwoods. In Australia, look for greasewood, casurinas and baobabs.
- Check pockets and depressions in rocky areas, cavities in trees, areas with abundant insects and look for seeps in shady areas at the base of cliffs.
- Filtering water: Filter muddy or scummy water through a handkerchief if you do not have a proper filter. Let sediment settle out, decant the water and then purify it by boiling or chemical treatment, whenever possible.
- Melted ice yields more water than snow. Eating snow lowers your core body temperature unless you are very active so it is best not to eat it. If there is no source of heat, squeeze snow in your hand to liquefy it. Normally water procured by melting ice does not require purification, although it is not particularly clean.
- Lay out black plastic (bag or sheet) so that it drains into a cup. Place a very *thin* layer of snow (snowflakes) on the plastic and the ultraviolet energy absorbed by the black plastic will melt the snow. This method works down to -10°C and under cloud cover so it is not necessary to waste fuel melting snow to obtain water. This is especially useful in Arctic and alpine areas.
- When it rains, spread out plastic sheets, rain gear and extra clothing to catch it. Remember not to wet clothing that you need for warmth. Depending on the situation, hypothermia may be a greater threat than thirst.
- If you cannot remove surface water to filter it, lay a handkerchief on the surface and sip the water through the cloth.
- Sop up dew from vegetation or the surfaces of trees, vehicles, rocks etc. Do this before dawn before dew evaporates.
- Learn which plants in the project area will yield water and how to retrieve it. Some vines yield water when cut and held vertically. Some plants are easily chewed to release water. Be careful, as it may be difficult to correctly identify many plants.
- Never drink water from plants with milky sap or sap that turns black if exposed to air. Cacti may not be a good source of water as some contain toxic water.
- Use clear plastic transpiration bags to obtain water. Select healthy, lush, non-poisonous, broad-leafed plants. Seal a clear, plastic bag around several leafy branches that receive direct full sunlight. A pebble in the bag will weigh it down so water can collect at the bottom. Depending on the source, up to about 125 ml of water can collect before the atmosphere within the bag becomes saturated and the tree stops producing water. Drain the water by making a small hole. Reseal the bag with tape to repeat the process. Place several bags on a tree or shrub at once. This method often yields more water than a solar still, but the water will taste of the plant of origin and may be unpalatable.

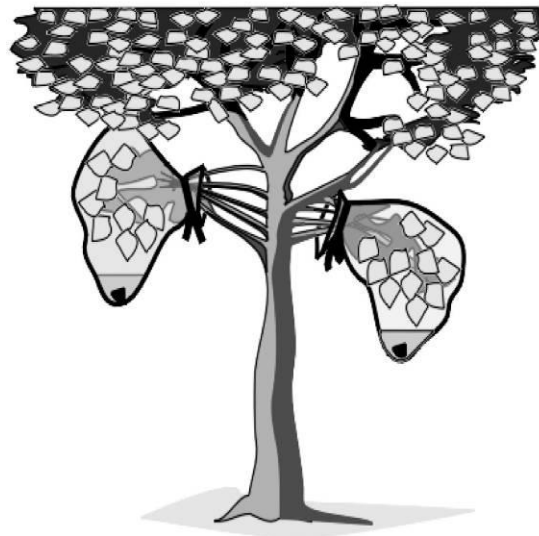


Figure 8.11: Transpiration bags

- Make a solar still: Water can be obtained by distillation by digging a solar still. The best site to make a solar still is where the earth is damp and easy to dig, although dampness is not necessary. Dig a new one when the still no longer produces water. This method requires high energy output for a low yield of water. Water procured by this method does not require purification.
 1. Dig a hole 0.75 m deep and 0.75 to 1 m wide. The sides should slope so they do not cave in.
 2. Place a container in the bottom and cover the hole with a 2x2 m piece of clear or white plastic.
 3. Anchor the plastic around the edge of the hole and weigh it down with a stone to form a cone (about 0.5 m deep) over the container.
 4. As the air warms within the still, water from the ground will condense on the underside of the plastic and drip down into the container. Insert a piece of tubing in order to sip the water without disturbing the still. Add cut vegetation, water from a vehicle radiator or urine to the hole to provide additional moisture for distillation.

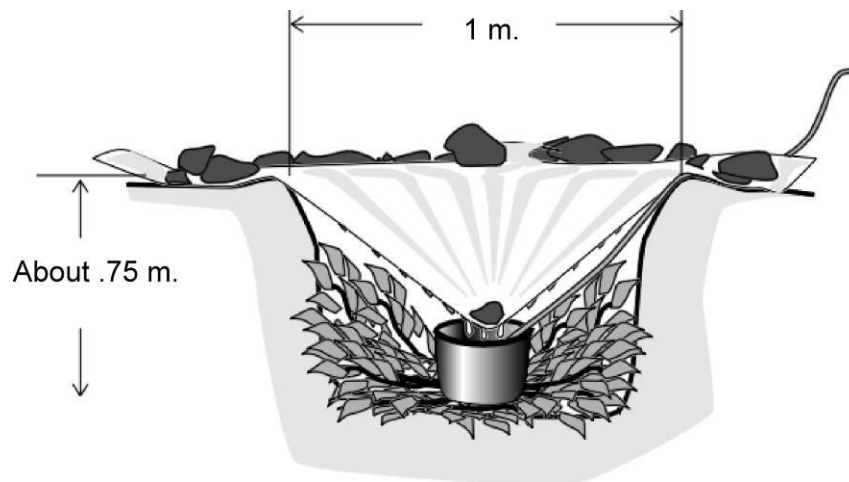


Figure 8.12: Example of a Solar still

- Create a simple desalination unit with two containers and a piece of tubing. Place one container with water over a heat source, preferably a fire, but a hot engine might work. Cover the container but allow the tubing to extend from the top into a second cool container. Steam produced in the first container should condense in the second container after passing through the tubing. Use aluminum foil, leaves etc., for the covering material if a lid is not available. Salt water and non-potable water, including urine, can be turned into potable water by using this distillation process.
- Never drink urine because it forces your kidneys to filter concentrated impurities from your body. Do not drink water from vehicle radiators as it is toxic. However, you can add urine, sea water, polluted water or water from vehicle radiators to the earth of a solar still or to a desalination unit. Then, potable water will be distilled into the container.
- If you are dehydrated and lack water treatment equipment, it is better to drink scummy, dirty water than none at all. Let it settle as long as possible and heat it if possible. It is not advisable to drink water containing alkali salts. Check that the water contains living creatures to indicate it can support life and is not toxic.
- Dark coloured urine is an indication of dehydration.

Sources of Food

The availability of food sources depends in good part on the season of the year, the latitude and elevation of the region.

- Most foods require water to aid digestion. The less water available, the less food you should eat. You can live far longer without food than without water. Do not eat anything if you have no water available at all.
- When you carry freeze-dried food packets and cans of sardines etc., in your pack, you will have better nourishment than what chocolate bars provide.
- Use any food supplies that are already open as they will spoil first.
- Try to consume protein foods first because they require water to digest. Save your carbohydrate foods for later, as they produce water within your body during digestion.
- Eat native plants and animals *only* if you are certain that they are not poisonous. Obtain local knowledge to be certain about which plants and animals are edible.

- In general, avoid any with red, yellow or white berries; those with milky sap; stinging, bitter or acidic tasting plants; and fungi. Just because birds and animals eat a plant or berry does not mean it is safe for humans to eat. If in doubt – do not eat it.
- Many insects, and small animals (e.g., rodents, amphibians, reptiles) are edible, as well as small game and birds. Depending on the region, local knowledge is important because some insects and small animals contain toxins (e.g., tropical tree frogs).
- *Down but not Out* contains information about making snares and traps, fishing methods and cooking procedures.
- Clean and wash all food sources, if possible. Make sure they are as fresh as possible as toxins occasionally develop as plants age. It is advisable to cook most gathered foods so there is less chance of getting sick. All meats, including insects and grubs are best cooked before eating to kill potential parasites, etc. Vomiting and diarrhea, even in cold weather, can quickly cause dehydration that may progress to death.
- In Canada, stinging nettles are edible. Employees working in temperate areas should be familiar with stinging nettles. Harvest them with gloves and boil them like spinach; they do not sting once immersed in hot water. Cattails are edible any time of the year. Peel the roots before cooking them; shoots and immature flowers are edible boiled or steamed.

8.6.6 Signalling

Signals must stand out against the existing background and look man-made. When you are the target of a search make signals as visible and noticeable as possible. Remain in the vicinity of your signals.

- Locate signals where they will be seen by searchers. A ridge top or high point and an open meadow on flat land will be visible from the air; signals on slopes may be seen from below but not necessarily from the air if the searching aircraft approaches from the far side of the ridge. Therefore signals placed at or near the top of a hill/ridge are most likely to be noticed.
- Consider what signals will stand out best, which depends on the season, the weather and the light conditions. Use any and all possible methods that are safe and appropriate for attracting attention.
 - Flashes from a signal mirror can be the most effective as they can be seen for many kilometres.
 - Fluorescent orange helicopter cloth is highly visible. It is most visible when you wave or run with it – so move it to attract attention. Tie several together to make a bigger block of colour. Stake it to the ground if necessary. However, when foliage is highly coloured in the fall, consider carrying fluorescent blue helicopter cloth as the fluorescent orange may blend with the foliage.
 - Fires: Smokey fires are noticeable during the day, especially if the smoke is black. At night, flames of large fires are visible.
 - Flares: Flares are useless in the day except for smoke flares. Red distress flares can be seen for only a short distance. Set flares off at night only when you are certain they will be seen. Flares with dye markers work well on water and leave a bright mark on snow and ice.
 - Three of a signal indicates an emergency (e.g., fires, smoky fires, blasts of a whistle, flashes from a mirror, flashes of headlights, gun shots).
 - Wave with both arms to attract attention. A single arm wave may be regarded as a greeting.

- SOS is the internationally recognized signal for distress. The signal: 3 short – 3 long – 3 short. The sequence can be made with lights, whistle blasts or other noise making devices, or spelled out with letters etc. Stay near your SOS sign – do not leave unless you leave a clear detailed message indicating your direction of travel and date.
- Do not set off an EPIRB (Emergency Position Indicator Radio Beacon) unless you are in a life-threatening emergency situation. EPIRBs tie into international search and rescue organizations and an inconvenient night out in the bush is not a reason to activate an EPIRB. Refer to Chapter 19. Communications.
- Destroy all ground signals when you are rescued.

Signal Mirrors

A flash from a signal mirror can be seen a long distance even in dull weather. Directing the sun's reflection onto a target is quite easy when the sun is high in the sky, but it can be difficult to do when the sun is low. Practice helps.

The best signalling mirrors have a small sighting hole in the centre to use to pinpoint the target. Any mirror will work – a Brunton or Silva compass mirror are excellent – and if necessary, you can improvise with a can lid, aluminum foil, a chrome piece or the side or rear-view mirror from a truck. Use three quick flashes to signal an emergency. Repeat them, but **DO NOT** sustain a flash signal onto a nearby plane or landing aircraft as the signal may momentarily blind the pilot.



Figure 8.13: Using a signal mirror without a sighting hole

To use a signal mirror without a sighting hole:

1. Hold a mirror under your sighting eye.
2. Extend your arm outwards and form a "V" with two fingers.
3. Sight the aircraft or object in the point of the "V".
4. Tilt the mirror under your eye so the sun's reflection also passes through the "V" in the direction of the aircraft. Flash the reflection on your target.

Fire and Smoke Signals

- Prepare signal fires but do not light them until you hear a plane. This preserves fuel and the required energy to keep them going. Stack smoke-producing material near each fire to add when required. Cover prepared fires to keep them dry if necessary.
- Smoke is most visible during the day. Try to create smoke that contrasts with the landscape or vegetation. To produce smoke, add ferns, green leafy branches, green leaves, wet magazines, moss, rubber tires or diesel fuel (carefully). Fuel, rubber and plastic produce dark smoke. Soak fuel into logs and then add the logs to a fire. Do not add fuel directly to the fire. Puncture tires to prevent an explosion.
- Fire is most visible at night, on dull days or in low light conditions. Where possible, make three fires a minimum of 30 m (100 ft) apart to form a triangle. Fires in a straight line are acceptable along a river or restricted area. One good fire is better than three small ones.
- You can set an isolated tree (torch tree) on fire by building a fire in the lower branches. Light it when you see or hear a plane. Make very sure that you will not start a brush or forest fire.

Noise Signals

- Three repeated sounds are recognized as a distress signal. Leave at least 5 seconds between each sound and *at least* 15 seconds between each series of sounds (one minute is a better interval).
- A whistle blast carries much farther than shouting. A whistle is a highly recommended part of a survival kit. Keep it on a cord around your neck or fastened to your field vest.
- Gunfire attracts attention except on an aircraft, as the sound cannot be heard. Never fire in the direction of an aircraft. Gunfire will not attract attention in daylight hours during hunting season. It is wiser to use other signals and preserve ammunition for other uses.
- Other noises to attract attention: banging rocks together, hitting sticks on a tree, firing bear-bangers etc.

Pyrotechnic Signals

Flares designed for marine use are recommended for use on both land and water. These flares are far superior in terms of visibility than the pencil variety that is standard issue for most field work. Carry signal flares that produce enough smoke or light to be seen from a long distance. Small flares fired from pen-like holders are not very effective. Flares fired from pistols are brighter and reach a higher altitude – therefore, they are more useful in a survival situation.

Tips about Flares

- Do not scrimp on flares. Emergency caches should be well equipped with an assortment of flares, especially parachute and meteor flares. Buy the best brand available regardless of cost because your life may depend on the effectiveness of the flares.
- The best flare to buy carries a SOLAS designation (SOLAS is a division of the International Maritime Organization). SOLAS designated flares meet very strict specifications. They are waterproof, easy to fire and extraordinarily bright – all essential requirements of a flare when you want someone to spot it. Cheap ineffective flares will only give you a false sense of security and will fail to perform when really needed (i.e., in a life-threatening situation). The flares and flare gun must be able to propel a flare well above the tree canopy.

- Use red flares to indicate distress and use white flares for illumination.
- To fire flares, hold them at arm’s length above your head. Aim them in a near vertical direction, away from all people. Note: Plastic cases may crack in cold weather; if the case is cracked, a flare may shoot sideways.
- Flares have expiry dates. Make sure to have fresh flares – but you may keep expired flares as backup if they are in good condition. Discard any flares that show signs of leaking or corrosion according to jurisdictional requirements.

Types of Flares

There are two major categories of flares – hand-held and aerial. See the table below to compare various features of flares.

- Hand-held flares are similar to highway flares. They provide a ground signal that burns for a relatively long time, usually one to two minutes. Use them when you want a rescue vehicle or aircraft to home in on you.
- Parachute flares are high altitude signals. They are propelled upwards to 300 m (1,000 ft) in the air so they are visible for a great distance. They burn for 25 seconds with a brightness of 10,000 to 30,000 candlepower. SOLAS parachute flares have a self-contained launcher; other types require a launching pistol and typically burn for a shorter time and with less brightness.
- Meteor flares rise from 75-150 m (250-500 ft) in the air and last 10 seconds. They fall quickly; therefore rescuers must be looking in your general direction to see them. They should be launched in pairs. The first flare attracts attention and the second confirms the first. Meteor flares are launched from either a special flare gun or a launching barrel.
- Smoke flares provide visible signals only in the daytime and are effective for aerial searches. They last a short time but are good for indicating wind direction to a pilot. Their ash will leave a noticeable mark on snow. SOLAS versions can be tossed into water and will not ignite oil or fuel on the water.
- Shell crackers and screamers emit a loud noise and many emit a bright light as well. Refer to section 10.3.9 Bear Deterrents for additional information.

Table 8.1 Flare Comparison Table

TYPE OF FLARE	BURN TIME	INTENSITY	ALTITUDE	COMMENTS
PARACHUTE	25-40 seconds	10,000-30,000 candlepower	300 metres 1,000 feet	Incredibly bright. Use to attract initial attention. SOLAS flares have a self-contained launcher. A 25mm flare gun is required to launch other brands.
METEOR	10 seconds	10,000-30,000 candlepower	60-120 metres 250-500 feet	Use when rescuers are nearby and looking in your direction. Launch in pairs – first to attract attention, second to confirm. Launch from 12-gauge, 25mm flare gun or barrel launcher.

HAND-HELD	120 seconds	500 candlepower	ground level	Long duration, low altitude. Allows rescuers to home in on your location.
SMOKE	50-180 seconds	dense cloud of orange smoke	ground level	Day signal. SOLAS flares will not ignite oil or fuel on water.
DYEMARKER		bright yellow-green dye	ground level	Good for use on water, snow or ice for daytime visual signal to aircraft or boats.
SHELL CRACKERS and SCREAMERS			25-70 metres	Use to scare away bears or other threatening animals. Refer to section 10.3.9 Wildlife regarding additional pyrotechnic devices.
ROAD	5-30 minutes		ground level	All vehicles should carry at least 3.

Aircraft Emergency Locator Transmitters – ELTs

- In most countries, an ELT is mandatory equipment on every aircraft. The device automatically broadcasts a distress signal to the Cospas-Sarsat search and rescue satellite system when an aircraft is involved in a crash. ELTs have a manual switch for testing purposes and emergency use if the automatic switch fails. Pilots should show passengers where the ELT is located before flights. Information regarding Cospas-Sarsat is available at the following website: <http://www.sarsat.noaa.gov/>
- Employees who use charter aircraft should know how to activate an ELT in case it fails to engage after an emergency landing or crash. To broadcast a signal with the best range, remove the ELT and place it as high as possible so that it has a 360° range. Always make sure the ELT is connected to an antenna, which should be in the vertical position.
- If you are forced down and no emergency exists (e.g., bad weather), DO NOT activate the ELT. Notify the project, anyone in charge of the flight plan or itinerary, or an aircraft passing overhead of your situation. This will prevent an unnecessary search and rescue effort. If you cannot contact any of these parties, a search will begin at the agreed upon time in project SOPs and ERP. At this time – when the search begins – turn on your ELT to help rescuers locate you.
- Once started, an ELT signal should not be turned off. Search and rescue efforts need to receive the continuous signal to home in on it. ELTs should transmit a signal for 48 hours at -20°C, if the batteries are properly maintained.

Ground to Air Emergency Signals

The following standardized symbols are used to communicate from the ground to an aircraft when there is an emergency. Be familiar them even though they are not used frequently because people routinely carry satellite phones in the field. Symbols 1 to 5 are internationally accepted; symbols 6 to 9 are for use in Canada only.

Table 8.2 : Standardized ground to air emergency signals

No.	MESSAGE	CORE SYMBOL
1.	REQUIRE ASSISTANCE	V
2.	REQUIRE MEDICAL ASSISTANCE	X
3.	NO or NEGATIVE	N
4.	YES or AFFIRMATIVE	Y
5.	PROCEEDING IN THE DIRECTION	↑
6.	ALL IS WELL	LL
7.	REQUIRE FOOD AND WATER	F
8.	REQUIRE FUEL AND OIL	L
9.	NEED REPAIRS	W

Source: **TP 14371 – SAR-4.0 Aircraft Emergency Assistance**. Transport Canada in December 2009. Reproduced with the permission of the Minister of Public Works and Government Services Canada, 2008.

URL: <http://www.tc.gc.ca/CivilAviation/publications/tp14371/SAR/4-0.htm#4-8-1>

Tips for creating noticeable ground to air signals

- Make the symbols BIG. Symbols should be a minimum of 6 m long, but 15 m long is better. Space them at least 3 m apart. They should be visible from 360° if possible.
- Contrast is the key. Use what will be most visible for the season, light conditions and their location on the ground.
- Letters should be angular with straight lines and square corners so they look man-made and stand out from the natural background.
- Make a trench in snow or sand in the shape of the signal. Pile the snow or sand all on one side of the trench to help maximize a shadow effect.
- Outline letters trampled in snow or sand with brush, dirt, peeled logs, green boughs, rock piles, seaweed etc.
- Scrape away vegetation or turn it upside down to expose soil.
- Cut or trample grass to form signals in a field or meadow. Burn grass only if you can control the fire.
- Destroy the signals when you are rescued to avoid initiating a second search.

8.7 Search and Rescue (SAR)

When you are lost or injured, follow the priorities set out in section 8.6 to keep yourself safe. Maximize your chances of being seen by rescuers by following tips in this section that are appropriate for the climate and terrain. If an employee is missing, alert the project supervisor and follow project SOPs and ERPs.

8.7.1 Guidelines for the Lost or Injured Person

Be aware when small problems are adding up to become a large problem. A bad situation is frequently the end result of a series of small mishaps. When things begin to go wrong or you become lost, disoriented, are injured or are in a crash, do the following:

- Sit down and calmly evaluate your situation. Do not panic. Your greatest resource is your intelligence; do not go anywhere or do anything without carefully thinking through the situation. Mentally review the group discussion scenarios, company SOPs, appropriate ERPs and act accordingly (see below, and section 8.3.2 Knowledge).
- Immediately go into survival mode. *Do not* wait to see if someone shows up. *Do not* expect your situation to suddenly improve.
- Stay at the site if there has been a crash or a breakdown. Otherwise, find a place where you will be easily located by search teams such as a clearing, high spot, or along a grid line; if you are injured, administer first aid. Get organized, get set up and stay there. Use the remaining daylight, warmth of the day, your strength and resources to organize your field crew or yourself and build a shelter and fire. Set out signals to indicate your location. Do not wander off. If it is necessary to hunt for wood or water, leave a detailed message with the date and time, where you have gone and when you will return.
- Consider the means of transportation in terms of what mode of transportation you were last using and what mode of transportation will most likely be used to rescue you. Often it may be a combination so give consider the following options:
 - Vehicle – try to go to a road
 - ATV – go to a track or trail
 - Snowmobile – go to a track, trail or frozen lake
 - Boat – go to river, lake or sea
 - Helicopter – find a place where a helicopter can land
 - Float plane – go to a lake where the plane can land
 - On foot – could be anywhere so find a highly visible location where signals will be seen and heard.
- Make a plan: List your options. List of pros and cons and consider them to arrive at a “best option”. Then, devise a plan and stick to it unless there is a radical change in circumstances. If this occurs, go back to your list of options and start the process again.
- Document what is happening in order to keep an account of details. Record what works and what does not work and keep an inventory of supplies (food, water, batteries etc.). It is easy to lose track of time. Without information it is difficult to plan.
- Avoid panic. Control your anxiety by gathering fuel etc., setting priorities and work at solving immediate challenges.

Potential Scenarios

The following are potential scenarios with general suggestions to handle the emergency.

- If you do not appear at the pick up spot: Do not retrace your route unless there is lots of time. When the pilot (or driver) realizes you are overdue, the first search will be along your planned route from the finish point back to the starting point looking for signals from you. If you are able, go to a conspicuous place, light a fire or make ground signals and wait. If the pilot cannot locate you, a crew will start following your planned traverse on

foot while helicopter searchers try to analyze where you may have gone astray. Attend to the fire, build a shelter, prepare a smoke or signal flare and wait.

- If you are at the correct pick up spot and your transportation does not arrive – stay there. A helicopter or vehicle may have broken down and it may take several hours, or even days, to repair or replace it. Your location is recorded by those in camp so stay at the pick up point. There may be other employees scattered through the area or stranded with the aircraft. If you know of another crew or person and their traverse is close by, you could try to communicate and meet up with them. However, return immediately to your pick up point if you fail to locate them. Leave a prominent signal and a note indicating your plans and direction of travel at your pick up point if you leave for *any* reason, even for a short time.
- Aircraft accident or breakdown: Always follow the pilot's instructions regarding the aircraft and setting up the ELT etc. If this is not possible, the most experienced or most senior person should be in charge to make sure the ELT is functioning and sending signals. It may be difficult to spot the aircraft if it is in water, thick timber, or covered in snow. The ELT signal may not transmit through the body of an aircraft if it is upside down. Follow the priorities in section 8.5 and prepare for a wait – it should be a short wait if the aircraft is on or near the flight plan route. If the aircraft is off the flight plan route or not easily visible, be prepared for a longer wait. Stay with the aircraft and move from the site only if you require a safer or more visible location. Leave a prominent detailed note with the aircraft indicating your plans and leave markers along the trail for searchers to follow. Searches will normally be conducted during daylight hours so prepare signal fires for use.
- Once clear of the aircraft, the most experienced or most senior person should take charge of organizing the survival situation. This person may or may not be the pilot, as many bush pilots today rely heavily on technology and lack relevant survival training and bush experience in the local terrain.
- When a search is conducted by aircraft, it can be very difficult to see a person on the ground, especially if they are in brush or timber or if the person is not moving. Run and wave helicopter signal cloth to create motion, which will catch the eye of the searchers. Searchers will be looking for unusual sights that stand out from the background, so make sure signals contrast with the background. In addition, use a mirror to attract attention when you hear an aircraft in the distance.

8.7.2 Guidelines for the Project or Camp Manager

Anyone who has failed to check in by a predetermined time interval should be reported as “missing” and the appropriate project ERP should immediately be activated. Follow set procedures when a person, vehicle, boat, or aircraft is overdue. Refer to Chapter 3. Emergency Response.

Person In Charge

Contact the employee's supervisor and provide the following details:

- Who is missing: name, age, description, clothing, physical and mental state, equipment being carried
- Length of time the person is overdue
- Location where the person was working: Work site, details of traverse route, grid line etc.
- Last known position, last location seen, last location heard from

- Working alone or with a partner
- Direction person was moving; speed at which the person is capable of moving
- Destination: Where they are suppose to be
- Weather conditions
- Other pertinent facts

Search and Rescue Headquarters

Organization requirements

- One designated person is in charge, which would normally be the project manager or second in command if that person is not present.
- Communications: One person should be in charge. Check that all means of communication are working because good communication is essential. Only one designated person should talk to the media or public.
- Designate who should organize food, water, supplies and fuel for searchers. This may be the expediter.
- First aid assistance should be organized and ready at search headquarters
- Keep a master map at the headquarters.

Search Parties Organization

Follow the company emergency response plan and procedures. If an immediate search or rescue is attempted before engaging officials:

- Go to the place where the person is most likely to be found (i.e., where his or her truck is parked).
- If the missing person is not found right away, notify the organizations in charge of search and rescue. Depending on the jurisdiction, there may be different SAR organizations for land, sea, and air searches (e.g., police, RCMP, military, Coast Guard).
- No other employees must be endangered during search or rescue operations. Searchers should always use the “buddy system” and work in teams. Co-workers must not endanger each other or themselves.
- Searchers must carry their own maps and compass, GPS, survival kit, first aid kit, communication equipment, extra batteries, food and water.
- There can be no unofficial searches. Every team must be fully equipped, names logged and their designated search area recorded on a map before heading out.
- Formal SAR: When formal SAR groups are engaged, it is imperative that only one person coordinates all operations.

8.8 Resources

The Prospectors & Developers Association of Canada (PDAC) thanks the following for granting permission to include material from their publications.

Association for Mineral Exploration British Columbia (AME BC)
National Defence and the Canadian Forces
Transport Canada

Their permission does not imply that they endorse the PDAC Health and Safety Guidelines. The PDAC is solely responsible for the content of these Health and Safety Guidelines.

Note: Numerous books and internet resources are available covering survival information and techniques. Some resources are useful for one particular area and some stress survivalist methods that are beyond the requirements of mineral exploration employees. The PDAC has received permission to reproduce *Down but not Out*, the 1990 Canadian National Defence survival manual, on their website. Although long term survival techniques are the primary focus, it contains valuable information relevant to the Canadian wilderness. The book *Survive!* by Les Stroud, creator of the television show *Survivorman*, is more up-to-date and contains extensive practical information aimed at short term survival in various climates and terrain.

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