



*A Guide to increasing safety awareness  
for field workers in the mineral exploration industry*



PROSPECTORS &  
DEVELOPERS  
ASSOCIATION  
OF CANADA



**A Framework for  
Responsible Exploration**  
Exploration minérale  
responsable



*Please attach your  
emergency contact  
details here*

Prospectors and Developers Association of Canada  
800-170 University Avenue  
Toronto, Ontario, M5h 3B3  
Telephone 416 362 1969  
info@pdac.ca  
<https://www.pdac.ca/priorities/responsible-exploration/health-and-safety>

The Prospectors & Developers Association of Canada is dedicated to putting appropriate information in the hands of field workers to increase field safety. This health and safety guide is intended to be a brief portable handbook that can be easily carried in a pocket or backpack when in the field. It is intended that a copy can be given to all field workers. Companies may individualize the contents for a particular project. However, it does not replace more comprehensive health and safety information that should be made accessible to field workers through training, or the more extensive free download online *e3 Plus: A Framework for Responsible Exploration* – Excellence in Health and Safety e-toolkit – or professional expert advice in specific cases. As an example of the latter, glacier travel should not be undertaken without experts involved, or without professional training in glacier rescue. A copy of the e-toolkit should be made available in the camp.

Everyone in the field is responsible for safety and you will increase your own safety by asking questions of your employer about risk analysis and procedures and, where appropriate, reading the more detailed information in the e-toolkit.

On behalf of PDAC, I would like to thank those who have been involved in the development of this manual, especially its author Courtney Mitchell, and the PDAC Health and Safety Committee members who have assisted by critically reading the manuscript.

Please “have a safe day every day”.



Bill Mercer, Co-Chair  
PDAC Health and Safety Committee



## Table of Contents

<b>1. Safety Responsibilities</b> .....	1
<b>2. Emergency Response</b> .....	5
2.1 Emergency Communications and Contact Lists .....	6
2.2 Emergency Response Procedures for Accidents.....	10
2.3 Accident and Incident Investigations and Reports .....	13
<b>3. First Aid</b> .....	15
3.1 General First Aid Treatment .....	16
3.2 Fluid Replacement Therapy .....	19
3.3 Field Treatment for Mild Hypothermia and Frostbite.....	20
3.4 Field Treatment for Heat Illnesses .....	21
3.5 Stings and Bites .....	22
3.6 Allergic Reactions and Anaphylactic Shock.....	24
<b>4. Survival</b> .....	27
<b>5. General Field Work and Traversing Safety</b> .....	31
5.1 Planning and Preparation for Field Work .....	32
5.2 Weather-Related Topics .....	40
5.3 Working and Traversing in Specific Terrain .....	46
5.4 Abandoned Mine Workings, Trenches, and Pits .....	56
<b>6. Wildlife</b> .....	59
6.1 Bears .....	61
6.2 Insects and Reptiles .....	64
<b>7. Field Transportation</b> .....	69
7.1 Safe Operating Procedures for All Ground Transportation.....	70
7.2 Field Vehicles .....	71
7.3 Utility Vehicles and All-Terrain Vehicles (ATVs) .....	77
7.4 Snowmobiles.....	79
7.5 Aircraft.....	84
7.6 Boats.....	93
<b>8. Field Camp</b> .....	99
8.1 Employee Health .....	100
8.2 Fire Prevention .....	102
8.3 Firearms .....	104

<b>9. Personal Protective Equipment (PPE) and Hand Tools</b> .....	106
9.1 General Recommendations for Personal Protective Equipment (PPE) ....	106
9.2 Hand Tools .....	108
9.3 Power Tools, Chainsaws, and Other Motorized Tools .....	109

## List of Figures

Figure A: Homemade oral rehydration solution .....	20
Figure B: Lean-to, using a tarp or local vegetation .....	29
Figure C: Snow tunnel with air holes .....	29
Figure D: Tarp over trench and logs .....	29
Figure E: Vehicle-anchored shade .....	29
Figure F: Transpiration bags .....	30
Figure G: Ground-Air Emergency Signals .....	30
Figure H: Crouching is the safest position .....	41
Figure I: The Lake Louise Consensus on the Definition of Altitude Illness .....	50
Figure J: Safe ice thickness for moving light loads on clear blue ice .....	83
Figure K: Danger zone on float planes.....	88
Figure L: Approach from the front or side – eye contact with the pilot – crouch – hold on to your hat.....	89
Figure M: Additional helicopter safety .....	90
Figure N: “Marshalling Signals – Helicopters”, TP 9528.....	91
Figure O: Slings Hand Signals .....	92
Figure P: “Safe Boating Guide”, TP 511 (01/2011) .....	94
Figure Q: Classification of fires and the appropriate fire extinguishers to use ....	103
Figure R: Recommended Personal Protective Equipment (PPE) .....	107

## Photo Credits

- Front Cover – Courtesy of Avalon Rare Metals
1. Safety Responsibilities – Courtesy of Selwyn Resources
  2. Emergency Response – Courtesy of Agnico Eagle Mines Ltd
  3. First Aid – Rights from BartCo, istockphoto.com
  4. Survival – Courtesy of Scott Jobin-Bevans
  5. General Field Work and Traversing Safely – Courtesy of Dennis Rousseau
  6. Wildlife – Rights from lamCDN, istockphoto.com
  7. Field Transportation – Courtesy of Alan Taylor
  8. Field Camp – Courtesy of CBR Goldcorp
  9. Personal Protective Equipment (PPE) and Hand Tools – Courtesy of Avalon Rare Metals

## 1. Safety Responsibilities



## 1. Safety Responsibilities

Most accidents and injuries occur when people fail to recognize a potentially hazardous situation and do not take preventive measures. The typical mineral exploration site is remote and first aid and medical treatment may be unavailable for hours or even days. Two noteworthy circumstances also increase the risk of accidents – working alone, and being a new employee at a site. Analysis of incidents in the field shows that the main causes of injuries are slips and falls and improper tool use. The main causes of fatalities are associated with travel, specifically helicopters and vehicles. All field workers should be aware of the risks associated with their activities.

**It is everyone's responsibility to reduce risks associated with field work to the lowest reasonable level.** Carrying out risk assessments, Job Safety Analyses (Job Hazard Analyses), developing Safe Operating Procedures (SOPs), and employee training are the best ways to mitigate risks. The company, managers and supervisors, contractors or service providers, and employees have different responsibilities regarding safety.

Companies are required to adhere to standards, rules and regulations of the Authorities Having Jurisdiction (AHJs). Therefore, it is the responsibility of company management to develop and implement safety policies and procedures and to communicate those policies and procedures to employees through regular safety orientations and safety meetings. It is the company's responsibility to supply appropriate personal protective equipment (PPE), provide adequate safety training and document the training. Employees are responsible for protecting their own health and safety and that of co-workers, which includes the obligation to follow safety policies, legislation, safe work procedures and practices, and wear appropriate PPE. Employees should obtain formal training and practice to improve their work skills. Experienced employees should teach new employees good field work skills and habits. Employees who undertake work at a foreign location should seek advice from locals and get sufficient training to work safely; they should not presume they are familiar with local risks and hazards.

This pocket guide is intended as a personal handbook to encourage safe field work practices by increasing awareness of the risks, hazards and dangerous situations inherent in field work. It is designed to be carried with you in the field.

It is hoped that greater awareness will lead to the implementation of necessary preventive measures to avoid accidents and injuries in the field. Use this pocket guide as a quick reminder of general safety practices prior to commencing work. The equipment checklists should help you be adequately prepared. This pocket guide also aims to provide guidance in the event of an emergency or survival situation. Please take time to evaluate – and frequently re-evaluate – the risks inherent in field work. Also take time to acquire the proper training and knowledge to deal with expected and unexpected risks and hazards of the specific terrain where you work.

**NOTE:** The goal of the PDAC Field Safety Pocket Guide is to increase safety awareness for field workers in the mineral exploration industry. **However, this safety guide does not encompass all potential risks and hazards associated with field exploration.** Additional comprehensive guidelines and safety procedures are available in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.



## 2. Emergency Response



## 2. Emergency Response

Employees and emergency response teams at a local site generally manage and resolve emergencies without the direct involvement of the corporate office. However, outside resources such as fire, police or other emergency services may be required for serious events. Report all emergencies to the corporate office promptly through regular channels (supervisor, project manager, etc). On-site management should carefully monitor emergency situations to assess their potential to develop into a crisis.

A crisis may exist or be developing if:

- The emergency poses a significant threat to the public or employees
- The emergency situation provokes government scrutiny
- The company no longer has full control of the situation, e.g. kidnap and ransom
- The situation has caused significant regional, national or international media interest
- The situation is likely to escalate and there is no immediate resolution in sight
- The corporation's reputation may be damaged or there is a threat to the bottom line or share value.

### 2.1 Emergency Communications and Contact Lists

*Lack of good communication during an emergency can escalate the severity of an emergency.*

It is essential to maintain appropriate fully functioning communication equipment at each camp. Employees need to know how to use communication equipment. Post the equipment user instructions and all emergency contact lists at the communication centre and in other useful and visible places, e.g. kitchen, dining area, drills, core facilities, and any place where exploration takes place. Carry the list in field packs and vehicles, etc. User instructions should accompany each satellite telephone.

**Example Emergency Contact List**

*Include telephone numbers or radio frequency call signs*

List the full telephone number(s) (day/night) and/or radio frequency that is appropriate for the location, region, and country. Develop emergency contact lists for each camp or location as appropriate. It may be advisable to print key contact information on an adhesive sheet that fits inside the front cover of this pocket guide; in this way, the sheets can be easily replaced as needed.

Project Manager

---

Corporate head office (appropriate names and telephone numbers)

---

Company hotline (if applicable)

---

Contractor management (if applicable)

---

**First Response**

Names, full telephone number(s) and/or radio frequency call signs

---

Camp first aid attendant

---

Camp person in charge

---

**Emergency Services**

Fire

---

Police

---

Search and Rescue (SAR) land

---

water (as required)

---

Aircraft contractor at nearest airport

---

Backup rescue team (if applicable)

---

Nearby exploration field camps (remote areas)

---

**General Hospital** (Name and Location)

Emergency

---

Outpatient

---

Nursing station

---

Health centre

---

Poison control

---

**Outside Agencies** (all other AHJs [Authorities Having Jurisdiction]: federal, provincial/territorial/regional/state, local government, other)

Military

---

Workers' Compensation Board (or equivalent) day

---

night

---

Forest Fire Reporting

---

Environmental Agencies

---

Chemtrec (or similar HazMat communication centre)

---

Red Cross/Red Crescent

---

Aviation authority (e.g. Transport Canada Office)

---

---

## Transportation

Transportation companies, including air service (fixed wing, helicopter)

---

---

---

Expeditor

---

If expeditor/office cannot be reached

---

Initial transport to camp and medical facility is by (describe means)

---

---

---

In addition, list the time required to transport a patient from camp to the medical facility by each potential mode of transportation. For example:

Time required by vehicle by road

---

Time required by off-road vehicle

---

Time required by boat

---

Time required by helicopter

---

Time required by fixed wing aircraft

---

## Emergency Contact Information for Field Crews

- Program the satellite phone with every possible number you may require. Keep the user instructions with the satellite phone.
- Program the radio with every frequency you may need. Be sure the radio has the frequencies used by other camp radios and the aircraft, if used.
- Carry fully charged spare batteries.

## 2.2 Emergency Response Procedures for Accidents

### General Procedures

1. Assess the situation and assure the safety of yourself and others.  
**Do not endanger yourself or others during rescue operations.**
2. Get help if necessary.
3. Stop or contain the problem, if possible.
4. If required, immediately contact an ambulance or Medevac.
5. Provide first aid if required.
6. Report the accident to your supervisor as soon as possible.
7. If an accident results in lost time injury, notify the appropriate authority within the specified time limit and the local police (e.g. Workers' Compensation Board authority in Canada or other country's equivalent).
8. Complete and submit the required accident/incident investigation form.

### 2.2.1 Emergency Response Procedures for Vehicle Accidents or Incidents

1. Assess the situation and assure the safety of yourself and others.\*
2. Administer first aid, if practical.
3. Call for an ambulance or air charter if necessary.
4. If there are injuries, or the damage to third party or public property could be more than the jurisdictional minimal limit, call the police and request a police report and call your company contact.
5. Report the accident to your supervisor as soon as possible.
6. Make notes, sketches and/or photos to document the accident. Include what happened and names of witnesses. Complete and submit the required accident/incident investigation form.

\* If possible, set up reflective warning triangle signs or flares both behind and ahead of the accident scene, away from vehicles (beware of fuel spills). If there are no injuries and the vehicles can be driven, move the vehicles off to the side of the road, turn off ignition, and do not smoke.

### 2.2.2 Emergency Response Procedures for Missing Persons

1. Confirm that the person has failed to check in at the predetermined time.
2. Contact the person's supervisor (or next in line for reporting) and provide details, e.g. where the person was working, length of time overdue, and if the person is alone.
3. If you plan to initiate a search, inform a supervisor (or next in line for

reporting) of your plans before heading out.

4. Do not endanger yourself during a rescue.
5. Searchers should always use the buddy system and work in teams. Each team must be fully equipped, names logged, and their designated search area recorded on a map before heading out. Searchers should carry maps and compass, GPS (Global Positioning System) unit, survival kit, first aid kit, communication equipment, extra batteries, and appropriate provisions.
6. Search first where the missing person will most likely be found, e.g. where the person's truck is parked.
7. If the missing person is not found within a specified time (e.g. two hours), notify the appropriate Search and Rescue (SAR) authority and/or local police. When formal SAR groups are engaged, it is imperative that only one person coordinates all operations.
8. Notify ALL authorities when the missing person is found so all search participants are informed and can cease their efforts.
9. Complete and submit the required accident/incident investigation form.

### **2.2.3 Emergency Response Procedures for Survival – Stranded Traverse or Drill Crew**

1. Assemble the crew at the site where the survival cache is located, which is usually at the end of the traverse (air drop or vehicle), or near the drill shack.
2. Contact the camp to inform them of your location and condition.
3. Determine whether it is possible to safely return to the camp by foot. This can only be done if the site is reasonably close, weather conditions are good, the GPS is functioning, extra batteries are available, and everyone is in good physical condition and capable of completing the trip. Carry food, water and shelter, in case the trip cannot be completed. Otherwise, remain at the shelter. If possible, inform the camp of the decision.
4. When it is not feasible to return to camp, the survival cache and personal survival kit materials should provide adequate temporary shelter and supplies.
5. Remain at the site until assistance or transportation arrives.
6. Maintain communication with camp but do not waste battery power.
7. Complete and submit an accident/incident investigation form.

### **2.2.4 Emergency Response Procedures for Aircraft Accident At the Site of an Aircraft Accident**

1. Assess the situation and assure the safety of yourself and others.

2. Provide first aid if required.
3. Activate the ELT (Emergency Locator Transmitter) if it did not automatically begin operation.
4. Build a shelter (and fire) near the accident scene. Make others comfortable. Remain near the scene.
5. Make signals that are visible from the air to aid the search (e.g. fire, large symbols) and use a signal mirror when an aircraft is within range.

### **At the Camp**

1. Attempt to contact the aircraft by normal means when it is 15 minutes overdue. Use local resources when possible, such as camp radio or satellite phone, radio in another aircraft, or cellphone to try to reach the satellite phone on the aircraft if so equipped.
2. Relay contact attempts through other aircraft in the area.
3. Upon confirmation that an aircraft has been in an accident or is missing, contact the relevant government authorities as soon as possible.
4. If required, immediately contact an ambulance, Medevac or equivalent.
5. Report the accident to your supervisor, to the aircraft company concerned, and to relevant government authorities as soon as possible.
6. If there are injuries, notify the relevant authorities within the required time limit (e.g. Workers' Compensation Board authority in Canada or other country's equivalent).
7. Complete and submit the required accident/incident investigation form.

## **2.2.5 Emergency Response Procedures for Fires**

### **Fire in the Camp**

1. Assess the situation and assure the safety of yourself and others.
2. Sound the Fire Alarm or get someone else to sound the alarm.
3. Only if it is safe to do so, try to put out or prevent the spread of the fire.
4. Evacuate all persons to the muster station and hold a roll call. Locate any missing or injured persons and organize a rescue, as required.
5. Provide first aid, if required.
6. If required, immediately contact an ambulance or Medevac (or equivalent).
7. If necessary, arrange for camp evacuation.
8. Call the 24-hour local Forest Fire number.
9. Report the fire to the appropriate supervisor as soon as possible.
10. Arrange for temporary shelter once all persons are accounted for, as required.

11. If there are injuries, notify the relevant authorities within the specified time limit (e.g. Workers' Compensation Board authority in Canada or other country's equivalent).
12. Complete and submit the required accident/incident investigation form.

### **Forest or Brush Fire**

1. Assess the situation and assure the safety of yourself and others.
2. If safe, return to camp as soon as possible.
3. Arrange for camp evacuation, if necessary.
4. Provide first aid, if required.
5. If required, immediately contact an ambulance or Medevac (or equivalent).
6. Call the 24-hour local Forest Fire number.
7. Report the fire to the appropriate supervisor and the relevant forest company as soon as possible.
8. If injuries involve lost time, notify the relevant authorities within the specified time limit (e.g. Workers' Compensation Board authority in Canada or other country's equivalent).
9. Complete and submit the required accident/incident investigation form.

## **2.3 Accident and Incident Investigations and Reports**

The purpose of investigations is to gather factual information, rather than interpretations of what might have happened, in order to find the root causes for the accident or incident and thereby prevent future recurrence.

### **Procedures**

1. Assess the situation and assure the safety of yourself and others. Determine if it is safe to enter the accident area and provide first aid.
2. Get help if necessary. Follow steps outlined in the Emergency Response Plan (ERP). Immediately contact an ambulance or Medevac and the local police, as necessary.
3. Stop the process or cause of problem if applicable or practical, but at the same time do not disturb the area, except in order to prevent further damage or injury.
4. Provide first aid if required.
5. Secure the site.
6. Take mental pictures. Who was involved? What actually happened? Where and

when did it happen?

7. Report accidents/incidents to your supervisor immediately. Provide the details of the accident. Report what has been done since the accident.
8. In some emergency situations, local police and the government agency dealing with industrial or transportation accidents should also be notified.
9. Cooperate with the authorities and accident investigators. If you are required to conduct an accident or incident investigation, complete the required accident investigation form. Be sure to fill out the form as completely and accurately as possible. What happened? What actions resulted? Take photographs and make sketches to clarify the investigation and add to the form.

### 3. First Aid



## 3. First Aid

*The text below is not an alternative for first aid training or for a detailed first aid manual. Instead, what follows are reminder notes, intended for easy reference. It is advisable to carry a small first aid booklet in your pack for more complete information.*

All field employees should be certified in standard first aid and CPR (cardio-pulmonary resuscitation) and, if possible, wilderness first aid. Field personnel should carry an adequate first aid kit at all times. Every campsite, truck, drill, ATV, snowmobile, etc. should be equipped with an appropriate first aid kit. Complete first aid kits and equipment (e.g. backboard, stretcher), first aid facilities and records of each use should be maintained as required by local regulations. Refer any condition serious enough to impair a worker's ability to do his/her job to a first aid attendant or physician.

### 3.1 General First Aid Treatment

Make sure everyone is safe, including you, prior to taking action with respect to the injured person. Attend to minor cuts, abrasions, and scratches to prevent them developing into major problems. If first aid is required and expert medical help is not immediately available, designate a leader to help prevent confusion. Maintain a record of the patient's condition. Note the time and make detailed observations, including the vital signs, the degree and description of injury, and any changes.

#### 3.1.1 Patient Assessment

**Primary Survey: The main steps in assessing an injured person's condition are:**

Follow the **UABC** sequence:

- **Unconscious:** Is the person conscious or unconscious?
- **Airway:** Is the airway obstructed? Make sure the airway is open.
- **Breathing:** Is the person breathing and is the breathing normal and efficient? Start rescue breathing if necessary.
- **Circulation:** Is the person's blood circulation operating and normal? Start CPR if there is no pulse. If there is significant bleeding, attempt to stop it by applying direct pressure.

**Secondary Survey: Evaluate injuries and severity of condition**

**Vital Signs:** Evaluate level of consciousness using AVPU (**A**lert, **V**erbal, **P**ain, **U**nresponsive), pulse and respiration, skin color, temperature and moisture. Evaluate blood pressure if possible.

**Physical Examination:** Evaluate patient from head to toe in order to locate injuries.

**Medical History (SAMPLE):** Evaluate **S**ymptoms, known **A**llergies, whether the patient is taking any **M**edication, has any **P**ast medical conditions, when was their **L**ast meal, and what **E**vents led to the injury.

- Record findings in order to organize and communicate victim data.
- Re-evaluate frequently and note change in condition. Check all dressings and splints; ensure that they are not too tight or too loose. Ensure bleeding is controlled and check extremities for circulation. Keep victim hydrated and nourished if appropriate.
- As necessary, seek medical help as soon as possible and follow Emergency Response Plans for any required medical evacuation.

### 3.1.2 Shock

Shock is an insidious condition in which the body cannot sustain normal function. It can lead to multiple organ failure and death if not recognized and treated promptly. Major causes of shock are severe bleeding, infectious diseases, heart and lung problems, severe allergic reactions, and brain and spinal cord injury. The signs of shock are pale and clammy skin, rapid pulse, and rapid, shallow or irregular breathing. Mental status may be disoriented or agitated. Address mild shock symptoms as soon as possible to prevent severe shock.

**General treatment:** Treat the cause of shock if possible and initiate transport to a medical facility or qualified medical personnel. Stop any bleeding. Keep the victim warm, covered and insulated from the ground. Elevate the legs if bleeding is the cause, unless the patient has a suspected heart attack (chest pain), or is paralyzed. Reassure and keep the patient calm. Give small drinks if the victim is alert, coherent, and not vomiting. Give oxygen if available.

### 3.1.3 Blisters

When you first notice pain, apply moleskin, adhesive gel pads, or self-adhering wraps to relieve or prevent pressure on any red spot, which helps prevent a blister from developing. Follow directions for the specific product. Protect existing blisters by cutting a hole in a foam pad the size of the blister and apply the pad so it surrounds the blister. If necessary, apply a dressing over the pad. The main concern with blisters is to try keeping the roof skin intact to cover the wound. If the blister is likely to break inside a boot, disinfect the skin and puncture the blister with one or two small holes at the edge near the intact skin. For open blisters, wash and clean off the skin, then cover with an appropriate dressing.

### 3.1.4 Lacerations and Abrasions

First, control bleeding by applying direct pressure with a gauze or pad in order to prevent infection; clean and disinfect the area with water and a povidone-iodine solution or another antibacterial cleanser. Apply antibacterial ointment and cover with a sterile dressing. If bandaging is required, use the appropriate type and size. Change the dressing daily. Clean and monitor the wound for signs of infection (redness, oozing pus, etc.).

### 3.1.5 Burns

Remove the body part from the heat source and remove clothing in contact with skin to prevent further damage to the skin. Cool the wound with cold water if it is small. Minor burns (redness but no blistering) can be treated by covering with a sterile gauze or plaster/band aid to protect the skin. For second degree burns (redness and blistering), gently clean the wound with water or disinfectant solution, express fluid from the blister by puncturing the edge with a sterile needle or safety pin, apply antibacterial ointment and cover with a sterile dressing to prevent exposure to bacteria.

Any burn area more than 7 cm in diameter is a major burn and requires medical treatment and evacuation.

### 3.1.6 Foreign Matter in the Eye

Try to remove matter with a damp tissue or handkerchief. Gently pull the upper eyelashes out over the lower lashes to flush the matter out. Gently roll the upper eyelid up over a match stick to remove matter inside the eyelid. Flush eye by streaming from the inside to the outside with contact lens solution (if available) or with clean water. Do not try to remove anything embedded in the eye; protect it with a plastic cup. Avoid applying direct pressure when there is penetrating trauma to the eye.

### 3.1.7 Dental Emergencies

**Toothache:** Take pain medicine; soak a cotton ball in oil of cloves and bite down on it; use a lukewarm salt water rinse to reduce swelling.

**Loose tooth:** Clean the mouth using a lukewarm salt water rinse. Align the tooth properly. Place sterile gauze over the tooth and gently close teeth together and maintain light pressure. Do not bite using the tooth until assessed by a dentist.

**Broken tooth:** Clean the mouth using a lukewarm salt water rinse. Bite on a wet tea bag if bleeding does not stop quickly. Cover tooth by making a cap of warm

wax or a commercially available instant filling material. Treat for pain. Rinse mouth every two hours.

**Missing tooth:** Locate the missing tooth and minimize contact with air – ideally less than 30 minutes for best results. Try to save the tooth by gently washing it in cold saline or clean water; do not clean off, rub, or destroy loose tissue. Transport the tooth in milk, saline or saliva (not dry) to a dentist for implanting as soon as possible. If victim is alert, attempt to reinsert the tooth. Rinse the mouth to remove blood clots from the socket and then insert the tooth with slow steady pressure. Splinting is generally required to prevent chocking or swallowing it. If splinting the tooth is not possible, and only for a short period, have the victim bite gently on a gauze pad. Seek medical attention as antibiotics and anti-tetanus medication is required.

### 3.1.8 Skin Irritations

After contact with irritating plants such as poison ivy, poison oak, or poison sumac, wash exposed skin with soap and water within 30 minutes of contact to remove oils, which will penetrate the skin. The oils remain active for months, so wash all clothing and equipment that may have touched the plants. Applying rubbing alcohol or hydrogen peroxide may help prevent a rash. Treat rashes with calamine lotion or ointments containing zinc oxide or hydrocortisone. Seek medical attention for severe cases and if the rash does not improve. Do not burn toxic plant materials; if smoke or oils are inhaled, they may cause a severe internal allergic reaction.

## 3.2 Fluid Replacement Therapy

Whatever the cause of dehydration (e.g., working at high altitude, heat illness, diarrhea), it may be advisable to use fluid replacement therapy.

**Diarrhea:** When diarrhea starts, maintain or increase fluid intake and restrict food intake. Limit food to dry biscuits and bread. For relief, Pepto-Bismol may be used (2 tablets or 30 ml liquid every 30-60 minutes: Maximum 16 tablets or 8 doses/ 24hrs). Seek urgent medical attention if you have blood or mucous in your stool, fever over 38.5 °C, severe stomach or abdominal pain lasting beyond eight hours, jaundice (yellow skin), or diarrhea lasting beyond five days. If diarrhea (or vomiting) is severe, consider using an oral rehydration solution (ORS) to prevent dehydration.

Pre-packaged ORS mixes are commercially available. Follow the instructions carefully and use purified water to mix them. Consume room temperature oral rehydration solutions within 12 hours and refrigerated ORS within 24 hours. Sports drinks can be used, but it is best to dilute a full strength sports drink by adding 50% more water to the solution. Do not use a high caffeine “energy drink” for rehydration purposes. In an emergency, an adequate rehydration mixture can be made using this World Health Organization recipe.

### FIGURE A

Ingredients	Amount
Purified Water	1 Litre (4 ½ cups)
Salt	2.5 mL (1/2 teaspoon)
Sugar	30 mL (6 teaspoons)

#### Homemade oral rehydration solution

Source: Foreign Affairs, Trade and Development Canada website:

<http://travel.gc.ca/travelling/health-safety/rehydration>

### 3.3 Field Treatment for Mild Hypothermia and Frostbite

While mild hypothermia and frostbite can be treated in the field, moderate and severe hypothermia and frostbite require treatment in a medical center. Handle victims gently.

1. Prevent the victim from losing more body heat. Insulate the victim from the ground.
2. Get the victim into shelter – create one if necessary.
3. Gently remove the victim’s wet clothes without exposing bare skin to wind or rain, if possible. Do not rub the skin.
4. **Warm the victim** by placing wrapped warmed objects next to the victim under the armpits and at the sides of the chest, e.g. chemical hot-packs, hot water bottles, or heated rocks. Do not warm the limbs initially, as this can cause the peripheral blood vessels to dilate and cause the core temperature to drop further – a condition known as “afterdrop”. Gently place the victim in a **hypothermic wrap** as follows:
  - Insulate the victim including the head and neck
  - Insulate extremities (hat, gloves and socks) but do not apply external heat to limbs

- Cover the head, as about 50% of body heat can be lost through the head of a hypothermic person
  - Wrap a survival blanket or other vapour barrier around the clothed victim (wet or dry) to prevent evaporation
  - Add more insulation by wrapping with blankets or sleeping bags, etc.
5. If a hypothermic wrap is not possible, warm the victim by placing him/her, stripped, in a warmed sleeping bag next to or between one or two other stripped people not affected with hypothermia. Their body heat will slowly warm the victim.

**Frostbite:** Address frostnip and superficial frostbite quickly to prevent more tissue damage. Warm the frozen part(s) against a warm part of the body (e.g. armpits). Do not rub affected areas or thaw a frostbitten area with direct heat (e.g. fire, heating pad, chemical hot packs). Do not break blisters. Never thaw severely frostbitten tissue if it is likely to refreeze, as this causes permanent tissue damage. Transport the victim to a medical center for thawing procedures.

### 3.4 Field Treatment for Heat Illnesses

Treat heat cramps with rehydration and electrolyte replacement. Relieve pain by gentle stretching.

**Field treatment for heat exhaustion:** Lay the victim in a cool area, elevate the legs and pelvis, and give fluids to drink when conscious. Do not carry out heavy activity for the rest of the day. Although victims of heat exhaustion may feel better almost immediately, they should not return to work, as fluid and electrolyte replacement takes about 24 hours. Transport the person to a medical center if their core body temperature remains high, as heat exhaustion can quickly develop into heat stroke. If someone has been sweating excessively or vomiting, an oral rehydration solution may be advisable. See section 3.2 Fluid Replacement Therapy.

**Heat Stroke** should be considered in anyone performing exertion in a hot environment who exhibits changes in mental status. Symptoms can vary but will generally include profuse sweating. Core temperature will generally be above 40°C. Heat stroke is a life-threatening medical emergency that requires immediate medical attention and evacuation to a medical center. The main objective of treatment is rapid cooling of the victim and should be initiated promptly.

### **Interim treatment for heat stroke – prior to evacuation to a medical center:**

1. Move the victim out of the sun into the coolest possible location.
2. Remove any heavy clothing, loosen any tight clothing, and elevate the feet.
3. Cool the victim as quickly as possible, particularly the head, armpits, back of the neck, and groin. Drape with cool wet sheets or towels to conduct heat away for the best cooling effect. If near a cool water source such as a lake or pond, spray the victim with water or consider brief immersion if the victim's overall condition allows for it to be done safely.
4. Fan the body with electric or handheld fans. Place the victim on a screen or hammock to maximize evaporation without chilling the victim. Increased blood circulation is the objective, so massage the victim's arms and legs so cooler blood circulates to the core organs.
5. Have a conscious victim drink cool water – about 1 cup (250 ml) – every 15 minutes, unless nauseous or vomiting. Add a little salt to water, but do not give full strength fruit juice, soft drinks, alcoholic, or caffeinated beverages.
6. **Transport a heat stroke victim to a medical center as soon as possible.**  
Cool the victim efficiently by dousing the victim with cool water or covering with wet clothing. Open all windows in the vehicle so the victim is exposed to moving air. Use air conditioning as long as the victim does not start shivering.

## **3.5 Stings and Bites**

The best method of treatment is prevention through

- Habitat avoidance
- Physical protection (appropriate clothing, accessories, nets, etc.)
- Use of repellents (DEET)

**Bees and wasps:** Remove stingers as soon as possible (scrape them off). Apply a paste of baking soda or ice water after removing the stinger and any venom on the skin.

**Fire ants:** Wash with soap and water to remove venom as soon as possible. Disinfect with alcohol and do not break blisters that form. Apply cool compresses. Apply an antibiotic if infection occurs.

**Spider bites:** Obtain local knowledge regarding which spider bites require medical attention. An ice pack may relieve pain for black widow spider bites (*Latrodectus* sp). Recluse spider bites (*Loxosceles* sp) are relatively painless, but require immediate medical treatment, as the necrotic toxin destroys tissue.

For funnel-web spider bites (*Atrax* sp), immediately apply a pressure immobilization bandage (see below) and seek urgent medical attention.

**If a systemic reaction develops soon after being stung or bitten, immediately administer or take an oral antihistamine (e.g. Benadryl). Seek immediate medical attention in case the reaction progresses to anaphylactic shock.**

### Snakebite

Know the correct way to manage snakebite for local venomous snakes. Know which medical center has antivenin in order to transport a victim to the correct place as soon as possible.

**Viper or pit viper bites (hemotoxic venom):** Gently wash the bitten area with lots of water and soap. Immobilize the bitten limb and keep it slightly below the heart.

**Elapid snakes (neurotoxic venom) and all Australian snakebites:** In Australia, do not wash off venom. Take any cloth used to wipe the bite for venom analysis.

**Wrap the bitten area using the Australian pressure-immobilization technique:** this technique involves immediately wrapping the entire bitten extremity with an elastic wrap or crepe bandage as tightly as would be done for a sprain, beginning at the extremity and going as high as possible up the limb. Apply a splint and immobilize the limb.

**Spitting cobra:** If venom enters the eyes, flush them immediately with large quantities of water or any fluids available. Seek medical attention as soon as possible.

**Do not** cut or suck the bite. Do not apply ice. Do not apply electric shock. Do not apply or drink alcohol. Do not apply a tourniquet.

### If someone is bitten:

1. Get the victim to back away carefully and do not try to kill the snake to prevent further bites.
2. Reassure the victim. The victim should lie down and remain so.
3. Remove rings, jewellery, and any constricting clothing, as snake-bitten areas will swell.
4. Wash the area gently, if appropriate (if in Australia, do not wash off venom). Apply a pressure-immobilization bandage, if appropriate.
5. Bring transportation to the victim, or transport the victim by stretcher if possible. The victim may be carried, but should not walk and should never run.

6. Monitor vital signs. If swelling develops, mark its progress on the skin every ten minutes and note changes in physical symptoms and mental state, including quality of vision, respiration rate, emotional changes, and nausea. Maintain the victim in a horizontal position.
7. Leave all dressings and any splint in place. Only a doctor at a medical center should remove them once appropriate required medications are assembled. If venom was injected, it will quickly move into the bloodstream once the dressings and splint are removed.

**NOTE: If the victim is unconscious and near death**, apply a tourniquet between the bite area and the heart. The victim may lose the bitten limb, which is preferable to death. If the victim stops breathing, begin CPR (cardiopulmonary resuscitation).

### Tick Removal

Find and remove ticks quickly to prevent transmission of disease bearing bacteria. Know what tick borne diseases are endemic in the area that you are working in or visiting. **Do not** apply a hot match or wrench out a tick, as the head may remain embedded and cause infection. Once removed, cleanse and apply antiseptic. Two methods of removal:

1. Use sharp pointed tweezers to grasp the tick as close as possible to the mouth parts; pull gently for one or two minutes.
2. Slide a straw over the tick so the body is inside the straw. Tie a thread in a loose knot around the straw and slide it down the straw. Slide the knot off the straw and tighten it around the tick's mouth parts. Pull upwards slowly.

## 3.6 Allergic Reactions and Anaphylactic Shock

People with severe allergies (bee stings, peanuts) should carry medication (epinephrine, as in an EpiPen auto-injector, plus an oral antihistamine such as Benadryl). Consider carrying several EpiPens, as one injection may not be sufficient. Before an emergency, instruct co-workers to recognize signs of an allergic reaction and how to administer the medication.

- **Symptoms of a local reaction** (e.g. sting) include redness, minor swelling, and itching or pain, but no changes in breathing or blood pressure.
- **Symptoms of a systemic reaction** include itchy red skin, hives on the body, runny nose, and watery eyes. Treat with oral antihistamine (Benadryl 50 mg) immediately; monitor for signs of a severe reaction.

- **Symptoms of a severe reaction and anaphylactic shock** may appear within minutes or up to one hour. Generally the more rapidly the symptoms appear, the more severe the reaction will be.
- **Symptoms** include (one or more):
  - Skin turns red within minutes
  - Swelling in the face, lips, tongue, eyes and eyelids, and neck
  - Itchy hives develop
  - Wheezing, difficulty breathing and/or tightness in the chest, which gets worse
  - Increased heart rate and respiratory rate
  - Change in consciousness and drop in blood pressure, cardiac arrest
- **Anaphylactic shock is a true medical emergency** and requires immediate treatment. If a patient shows signs of developing anaphylactic shock, an auto-injection of epinephrine should be prepared. Administer 50 mg (2 tablets) Benadryl immediately, if not previously given. **Unfortunately, once a victim develops swelling and muscle spasm in the airway and has difficulty breathing, the only treatment is epinephrine.** CPR also may be necessary. Once the epinephrine has been administered, evacuate the patient to a medical center for further evaluation even if condition rapidly improves because of the risk of bi-phasic or secondary reaction. If symptoms reappear, a second injection of epinephrine may be required.
- **Note:** Benadryl does not take effect for 30 to 40 minutes. Include Benadryl in a personal first aid kit when working where stings are a risk.
- **Note:** The EpiPen and Twinject are the only auto-injectors available in North America. Know the expiry date and storage requirements.



## 4. Survival



## 4. Survival

Ultimately, you are responsible for your own safety and survival. Be as self-reliant as possible. A successful outcome depends on prior training, knowledge and preparation.

- **Equipment:** Always carry your fully equipped day pack to jobs, even on short traverses or when working near camp. Conditions may change or transportation may fail to arrive.
- **Emergency caches:** Set out an emergency cache in a convenient location when weather or other factors may cause stranding. See section 5.1.1 Field Equipment.
- Follow the site specific emergency response procedures, including action plans if weather closes in, you become disoriented, and/or if transportation or communication breaks down. Consider the factors of hypothermia, hyperthermia, and traversing risks should you try to return to camp. It is usually safer to stay put and seek shelter rather than attempt to walk back. Do not risk getting lost in poor or reduced visibility conditions. Do not cross barriers you would not normally cross (e.g. streams, cliffs).
- Keep up your safety awareness on traverses. Watch for developing storms, suitable sites for shelter, safe trees or safe routes to avoid threatening wildlife.

### If you become lost, disoriented, or have an accident:

- **Do Not Panic!** Your greatest resource is your intelligence. If part of a group, avert panic with careful organization, good leadership, and teamwork. If alone, sit down and calmly evaluate the situation. You need to maintain a positive attitude and strong will to live, so try to control your emotions. If lost, be aware that panic will gradually replace reasonable anxiety. If you start to travel blindly, **stop!** You are dangerously close to panic.
- **Go into survival mode immediately.** Do not wait for the situation to improve – it won't. Take immediate action. Improvise to solve problems. Think your way through challenges. If you lack something, find an alternative or create a substitute. Keep trying, as success will probably not come with the first effort.
- **Priorities in a survival situation:**
  - **Attend to any necessary first aid.**
  - Location: Let others know where you are, if possible. Consider what rescue transportation will be used to find you. Find a spot where you are **visible and easily located** and remain there (e.g. a clearing, a high spot, along a grid line, a gravel bar, a beach).
  - **Shelter:** Create shade or shelter from wind, rain, heat, or cold, as required.

Avoid windy ridges and ravines, unless attempting to avoid insects like mosquitoes or canyon bottoms where cold air settles. A slope facing the sun is often warmest. Space blankets, a tarp, or garbage bags can create shelters (e.g. Figure B: a lean-to, or Figure D: a trench or hollow between logs or rocks). Create a mound of branches and vegetation to block rain and wind. Snow shelters require an air hole; see Figure C. Insulate yourself from the ground with boughs, grasses, moss, cattails, etc. In deserts, seek or create (e.g. Figure E). Avoid wind and direct sunlight; try to stay 1-2m above the desert floor (tree limb, sheltered ledge). Build a windbreak and cover skin to prevent dehydration and sunburn.

FIGURE B:



Lean-to, using a tarp or local vegetation

FIGURE C:



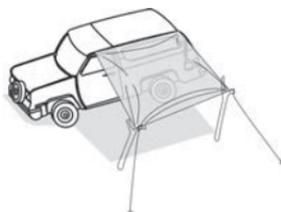
Snow tunnel with air holes

FIGURE D:



Tarp over a trench and logs

FIGURE E:



Vehicle-anchored shade

- **Fire:** Build a fire for warmth, signalling, or to boil water. Carry foolproof means to light a fire. Assemble tinder, kindling, and sufficient fuel. Light a twig bundle in the air and insert it into a well prepared fire. If a vehicle is disabled and there is no wood for a fire, drain the oil into a can of sand or dirt, insert a strip of rag for a wick, and light the wick.
- **Water:** Purify water if possible. Boil for one minute. Follow product directions when using iodine and filters. Lacking a filter, you can filter muddy or scummy water using clean sand, a bandana or shirt fabric before boiling or treating. Collect rainwater using plastic sheets etc. Black plastic

(e.g. garbage bag) can be used to melt snow if spread out with a very thin covering of snow. In hot climates, ration your sweat, not your drinking water; use transpiration bags on vegetation to obtain water.

**FIGURE F:**



Transpiration bags

- **Signals:** Make signals using a mirror, flares, helicopter cloth, fire, and smoke – do not cause a forest fire! Build large ground signals (>6m long with straight lines, square corners) that contrast with the background, so they are visible from the air. Use “SOS” ground letters or the “three long-three short-three long” sequence, using vehicle lights or sound signals – (e.g. horn or whistle). Stay with the SOS sign until rescued. Destroy ground signals when rescued.

**FIGURE G: Ground – Air Emergency Signals**

<b>V</b> Need Help	<b>X</b> Need Medical Help	<b>N</b> No	<b>Y</b> Yes
⋯ Going This Way	<b>LL</b> All Well	<b>F</b> Need Food and Water	<b>L</b> Need Fuel and Oil

(The first 5 symbols are International Signals; LL, F, and L are Canadian only)

- **Vehicle breakdown or stranding:** It is usually best to remain with the vehicle. If it is necessary to move, leave a visible, concise explanatory message (windproof and waterproof) to avert a full-scale search. When using the vehicle for shelter in cold weather, periodically clear the tail pipe of snow/mud. Open a window slightly to maintain ventilation, but prevent exhaust from entering when the engine/heater is turned on. Carbon monoxide is odourless and deadly.

## 5. General Field Work and Traversing Safety



## 5. General Field Work and Traversing Safety

*It is everyone's responsibility to reduce risks inherent in field work and traversing to the lowest level. Carrying out risk assessments, developing Safe Operating Procedures (SOPs), and employee training are the best ways to mitigate risks. It is an employee's responsibility to follow Standard Operating Procedures and be as self-reliant as possible.*

### Significant Risks and Hazards

- Injuries: Slips and falls and the misuse of tools and equipment are the primary causes of field injuries! Other common injuries: back (lifting, carrying heavy loads) and impact from flying rock chips or falling rocks from above.
- Hypothermia, hyperthermia, dehydration, altitude illness
- Wildlife: bears and other large mammals, crocodiles, venomous snakes, insects
- Stranding caused by transportation breakdown, communication breakdown, injuries, adverse weather, getting lost

### 5.1 Planning and Preparation for Field Work

Plan traverse routes using the best available maps, air photos, and local knowledge for safety – no route or sample is worth an accident. Traversing should be guided by operating procedures. Be prepared for potential emergencies by being familiar with site specific emergency response plans.

- **Safe Operating Procedures:** Address site-specific risks and hazards. Include weather, altitude, dangerous terrain such as cliffs, canyons, specific unstable ground, jungle, potential technical mountaineering with glaciers and avalanches, crossing water bodies, use of field vehicles or aircraft, firearms, dangerous wildlife, potential security risks, and the use of audio entertainment equipment.
- **Emergency Response Plans:** Have emergency response plans that address potential injuries and emergencies including evacuation from the most remote and difficult terrain in the area. See section 2. Emergency Response.
- **Physical fitness:** Build up fitness and endurance before starting field work. Work within your physical limitations and do not take chances. Plan easier traverses early in the season and difficult traverses when crews are in the best physical condition, extra help or technical support is available, and weather conditions are good.
- **Communication schedules:** Set up and adhere to a communication schedule between traverse crews and camp or office. Notify the contact person when plans change, problems develop, or there are delays – make sure changes are

recorded. Schedule more frequent contact between crews and base camp when risks are higher (e.g. working on ice, very rough ground, locations with potential wild animal attack).

- **Tracking system:** In the main camp or base, keep track of traverse and work crews at a central location. Record on a whiteboard or maps all work sites, traverse routes, drop-off and pickup points and alternatives, estimated times of arrival and return, potential emergency pickup locations, and other pertinent information. Update the whiteboard/maps as changes are called in. **Leave a copy of your itinerary or traverse route with your transportation (e.g. vehicle, ATV, boat).** Employees working out of an office or hotel should leave the same information with a responsible person who knows what to do if they do not return.
- **Health issues:** Understand the risks of hypothermia, hyperthermia, altitude illness, etc. Get acclimatized before starting heavy field work after flying from low elevation or temperate conditions to extreme altitude, heat, or cold. Know the local health risks (e.g. diseases).

### 5.1.1 Field Equipment

Carry sufficient equipment, gear, and emergency supplies for the terrain, weather, and degree of risk. This includes appropriate communication equipment, compass and maps, GPS unit, Personal Locator Beacon (PLB) as required, extra batteries, a personal survival kit, first aid kit, and enough food, water (and/or portable water purifier), and clothing to cope with an emergency overnight stranding or injury. Consider daily what equipment is required ( e.g. chainsaw, ice axe, crampons, ropes). Drop off emergency caches along difficult routes.

### Equipment Checklists

Use the lists to identify appropriate equipment. Requirements will vary according to the season, terrain, local risks and hazards. Use good quality personal equipment.

- **Day packs** should be durable, with strong zippers and wide, comfortable shoulder straps and waist belt. A bright colour aids visibility and a waterproof pack cover is essential in rain or snow.
- **Boots** should be appropriate for the work and terrain, soles in good condition, and good ankle and foot support. Insulated boots provide extra warmth. Break in boots before the field season. Gaiters help prevent pebbles, soil, or snow from entering the tops of boots.

- **Field clothing** should be durable and appropriate for the activity. Dress in layers and carry adequate extra clothing. Your outer layer should be windproof and waterproof.

*See the appendices at the back for sample equipment lists.*

## **Daypack Contents**

The following items are considered essential:

- Satellite phone, two-way radio or mobile/cell phone, emergency call list, PLB as required
- Maps, compass, GPS unit, air photos
- Extra batteries for GPS and communication equipment
- Knife or “Leatherman” type multi-tool
- Fire-starting equipment (waterproof matches, lighter, magnesium flint striker)
- 10-15m paracord or light strong rope
- Light mountaineering tarp or space blanket
- First aid kit – plus three-day supply of personal medications, including epinephrine, as required
- Survival kit – select appropriate items from these lists
- Helicopter signal cloth
- Signal mirror
- Rain gear
- Hat(s) – sun, cold
- Large orange garbage bags (tent, keep gear dry, signal)

## **Additional Items (as appropriate for the work environment)**

- Flares and flare gun (good quality)
- Whistle
- Insect repellent
- Mosquito head net, jacket (depending on region)
- Bear bangers and pepper spray, as appropriate
- Altimeter (depending on region)
- Sunscreen
- Sunglasses
- Spare glasses (if needed to read a map)
- Small gas cylinder and stove burner attachment
- Water (two litres minimum)
- Water purification tablets and/or iodine or portable water purifier
- High energy food packets

- Extra warm clothing and socks in waterproof bag
- Sample bags and sampling tools
- Axe or folding saw, wire saw
- Toilet paper
- Duct tape
- Wrist watch
- Metal cup
- Flashlight or head lamp, extra batteries, bulb
- Light sticks
- Fishing line and hook
- Water treatment filter
- Siphon (length of plastic tubing)
- Lip balm
- High visibility clothing (hunting season, working around helicopters)
- Firearm in high risk areas
- Walking stick
- Lightweight nylon rope
- Soap

### **Survival Cache or Vehicle Emergency Contents**

Consider the season, terrain and wildlife. Use animal-proof and waterproof containers.

- First aid kit, first aid book
- Survival book appropriate for region
- Sleeping bags – one per person – appropriate for climate
- Tent or similar shelter (“bivisack”)
- Small gas cylinder and stove burner attachment
- Fire-starting equipment (waterproof matches, lighters, other)
- Candles
- Flashlights
- Satellite phone or radio with extra batteries, emergency call list
- GPS unit with extra batteries
- Compass
- Water
- Water purification tablets, filter, siphon tube
- Food
- Insect repellent
- Head nets
- Signal flares and flare gun

- Bear spray, bear bangers
- Fishing kit
- Snare wire
- Duct tape
- Paracord or light rope
- Chemical heat packs

### **Personal First Aid Kits**

First aid kits should meet required government regulations (e.g. regional Workers' Compensation Board specifications in Canada) rather than the arbitrary list of a private supply company. If necessary, supplement with:

- Small first aid booklet
- Six sterile wound cleansing towelettes, individual packets
- Six or more waterproof adhesive dressings, assorted sizes
- One pressure bandage – especially for chainsaw work
- A few large dressings
- Triangular bandage
- Roll of tape
- Ace bandage (crepe, elastic)
- Several pre-packaged tablets of pain medication (ibuprofen or acetaminophen), antihistamine for insect bites or stings
- Vinyl gloves

### **Hypothermia Kit**

- Chemical heat packs
- Sleeping bag
- Space blanket or mountaineering tarp
- Spare clothes
- Waterproof matches, lighter, magnesium flint striker
- Stove or small gas cylinder and stove burner attachment
- Food and drink mixes

### **5.1.2 General Traverse Preparations**

Most traversing is carried out by small parties of a few individuals or in pairs. Risks increase when employees traverse alone.

- **Be aware of specific known hazards** when planning each day's route, the drop-off and pickup points, and alternates. Avoid impassable terrain and areas that are potentially very hazardous. For long traverses, have a backup plan in case they cannot be completed.

- **Perform a check routine before field parties leave camp.** Crew members should verify they have recorded: (1) the planned traverse route; (2) the drop-off and pickup points; (3) the estimated time of return; and (4) have all essential gear and supplies in their day pack – use a checklist. Know the location of emergency caches and emergency pickups and drop-offs.
- **Weather:** Know the weather forecast and carry appropriate clothing and gear. Develop a thorough understanding of local weather patterns. Be aware of how marginal weather conditions increase traverse risks. For example, clouds or fog may obscure cliffs, crevasses, or avalanche slopes, and you may be unaware of them until it is too late.
- **Be prepared for changing conditions that may impact progress,** e.g. lightning storms, inversion or ice fog layers in mountains, descending cloud cover, strong winds, heavy or torrential rains, snow squalls, whiteouts, or rapid temperature changes. They may limit visibility and affect communications. You may not be able to establish your location and you risk becoming lost. Because of changing weather conditions, you may not be able to arrive at the pickup place on time, or your pickup transportation may be delayed.
- Plan to complete traverses in daylight and allow plenty of time to return to camp before dark. Be careful late in the day when you are tired and less agile. Many slips, trips, and falls occur at this time.
- Allow extra time for adverse weather or through rough areas, e.g. dense brush, slash areas, old burned areas, jungle, or boulder terrain.
- Be vigilant where bears or other wildlife may be surprised by your presence, e.g. along creeks, dense brush. Make plenty of noise.
- Do not use audio entertainment equipment; focus on traversing and your surroundings.
- **Working along roads, highways and railway cuts:** Park vehicles in a safe place well off the road; do not park on a curve. Walk facing oncoming traffic. Place traffic warning cones or reflective signs to indicate work is in progress. Wear safety glasses and a reflective safety vest.

### 5.1.3 Traversing Alone Versus the Buddy System

Traversing alone is strongly discouraged. It is safer to traverse with a partner using the buddy system. Each partner should be fully equipped and remain in sight of each other in high risk areas (e.g. very rough terrain or where wildlife is a major threat). When working in low risk areas at some distance from each other, partners should make radio or visual contact at regular intervals.

Occupational Health and Safety regulations usually require that special procedures are in place when employees work alone, which include a job safety analysis (JSA), special communication provisions, and specific check-in procedures.

**When you are asked to work alone:** It is imperative to: (1) realistically evaluate your level of experience and capabilities; (2) be informed about and carefully evaluate all risks and hazards; (3) ask advice from experienced workers; and (4) work with extra caution. If it is absolutely necessary to work alone:

- Confirm all equipment is in good working order. Verify that communication equipment functions by initiating communication at the onset of the job.
- Strictly adhere to tracking and check-in procedures. Immediately notify the contact person of changes in plans.
- Remember, you have the right to refuse work that you perceive to be unsafe or for which you feel inadequately trained.

#### 5.1.4 Field Communications and Routines

Carry two-way radios, mobile/cell phones or a satellite phone – whatever provides appropriate coverage. Establish and follow a systematic call-in schedule for field crews and camp. Inform the camp and your field partner if you encounter problems or change plans.

- **Satellite telephones:** Know procedures for using the satellite phones. Post user instructions with the list of emergency contact numbers at the communication centre. Keep user instructions with each satellite phone.
- **Radios:** When using two-way radios, confirm which channel everyone is using. When using a two-way HF radio to communicate with a pilot, make sure the radio has the correct aircraft frequencies. Some radios include a GPS device (preferred type if traversing alone).
- Program all contact numbers that may possibly be required into satellite phones and/or cellphones.
- Each day before leaving camp, check that your communication equipment functions correctly, is fully charged, and you have fully charged spare batteries.
- When dropped off by air support, make radio contact with the pilot to confirm that radios are functioning correctly. As this requires the pilot to tune the aircraft radio to your radio frequency, conduct the frequency check prior to takeoff.
- When a planned drop-off point is changed, notify the camp and ensure they record it at the tracking centre. The driver or pilot may forget to relay the information.

- **Signalling:** Pilots have difficulty locating people on the ground when they are in shadow, dark brush, mist, rain, or low light conditions. Carry extra signalling devices in addition to electronic devices. Use the following signal methods to attract a pilot's attention, especially when you are not at the designated pickup spot, or you lack radio communication:
  - Use a signal mirror to flash a signal when the aircraft is in the right position.
  - RUN or MOVE or wave bright clothing or fluorescent signal cloth. Tie several signal cloths together for a larger visual target. It is much easier to spot a moving object.
  - Flares work when correctly used, but they will not be seen if fired behind the aircraft.
- **Distress Radio Beacons, Personal Locator Beacons (PLBs)**
  - There is a variety of Distress Radio Beacons (also known as Personal Locator Beacons – PLB, Emergency Position Indicating Radio Beacon – EPIRB). If you have one of these, make sure you are familiar with how it works, and its strengths and weaknesses before going in the field. The technology is constantly changing.
  - Some PLBs transmit to a standard 406 MHz frequency of the Cospas-Sarsat international search and rescue satellite.
  - SPOT, IMREACH and some other devices use satellite phone systems such as Globalstar (SPOT) and Iridium (IMREACH, Yellowbrick, Spidertracks).
  - **All of these systems have advantages and disadvantages. Know the limitations of yours before going in to the field.**

### 5.1.5 Keeping Track of Your Location

Each field employee is responsible for keeping track of his/her location while traversing. Use up-to-date maps, air photos, satellite images, and dependable navigational equipment.

- Good map reading skills allow you to estimate the ruggedness of topography, changes in altitude, and to more accurately estimate the time required to complete traverses.
- Know how to use a compass. Do not rely solely on a GPS unit, as they sometimes fail to work. Heavy foliage or topography may cause interference with the satellite signal or the batteries may fail. Check the topographic map legend and set the GPS to match the datum and coordinate system on the map.
- Use several methods to keep track – pacing, compass sightings, as well as GPS waypoints.
- When possible, fly the route before the traverse. Confirm the drop-off, pickup

and alternate pickup points with the pilot. Look out for wildlife (bears) and other potential hazards (cliffs, deep or rough water).

- At the drop-off point, make sure you know exactly where you are on the map before your transportation departs.
- Estimate the time, distance, and altitude to be covered and decide on a “go/no go” point. If this point is not reached by a specific time, it may be better to return rather than continue and not reach the pickup point by the designated time or nightfall.
- Keep track of all landmarks and be aware of the relative location of roads in the area.
- Wear a watch. Keep track of “time vs. distance”, as it is easy to lose track of time while crossing difficult terrain, sampling, or examining outcrops.
- When you must return along the same route, mark the route adequately (flagging tape, blazes) so it is visible from multiple directions.
- STOP whenever there is any doubt about where you are and backtrack as necessary to confirm your location. If you get lost or disoriented, it is unsettling and can be very dangerous if you panic. STOP if you become truly lost.

## 5.2 Weather-Related Topics

Understand the prevailing local weather patterns, especially when to expect storms, thunderstorms, strong winds, or whiteouts. Keep track of weather changes throughout the day.

### 5.2.1 Lightning

The overall risk of being struck by lightning is small, but if you work or take shelter in the wrong place during a lightning storm, your chances of being struck are much higher than average.

- **The 30-30 rule.** Seek shelter immediately when thunder is heard within 30 seconds of seeing lightning; remain in the shelter for at least 30 minutes following the last thunder. Hearing thunder within 30 seconds means the lightning strike is less than 10km away. Lightning can travel great horizontal distances before reaching the ground.
- **Shelter:** Find a safe building or a vehicle with a metal body if no building is near. In a forest, go to a stand of young trees of uniform height.
- **DESCEND to a lower elevation from a ridge or peak.** When sheltering below a peak or cliff, it should be at least five to ten times your height. Crouch >2m but <15m away from the cliff base.

- **Do not shelter in, near, or under conductive objects** (e.g. isolated tree, power lines, cliff face, shed, open vehicle). Do not contact geophysical survey wires or wire fence lines. Do not stand in open spaces where you are the tallest object. Do not shelter in small gullies, shallow caves, or under rock overhangs. If in a boat, get off the water.
- **Camps:** Immediately disconnect radio antennas and ground them. Crews should move well away from drill rigs, as masts may act as lightning rods.
- **The safest position:** Crouch low with feet together and knees drawn up. Minimize contact with the ground. Discard metal objects. Parties should spread out at least 20m apart.

FIGURE H:



Crouching is the safest position

- Victims struck by lightning cannot give rescuers a shock. Begin CPR if the victim is not breathing and has no pulse. Extended rescue breathing may be required after a pulse is regained.

### 5.2.2 Whiteouts

Whiteout conditions occur when blowing snow or sand severely obscures visibility. Flat light conditions may develop during overcast or foggy conditions and make it hard to distinguish changes in topography.

Camps should designate someone to call a whiteout alert in time for people to return safely.

- Mark regularly travelled routes near camps with pickets painted fluorescent orange every 10-20m. Label each picket with the GPS location. Stay on established routes.
- If whiteout conditions are likely, in addition to survival equipment, you should carry (and be trained how to use) a GPS unit, a satellite phone or radio, and extra batteries, and have each item readily accessible. Carry extra fuel.

- If caught out in a whiteout, go to a nearby shelter unless camp is very near. Build a snow shelter – make sure you have air to breathe. Notify camp and give your GPS coordinates. Maintain hourly contact.
- If whiteout conditions develop while driving on public roads, slow down and increase your distance between vehicles. Avoid passing and changing lanes. Make sure headlights and taillights are on. Find a safe place and pull off the highway as far as possible and turn off your lights. Wait for conditions to improve. Start with a full fuel tank, especially when weather conditions are marginal. To prevent running out of fuel if stranded, maintain the fuel tank at least half full.

### 5.2.3 Flash Floods

Be familiar with local weather patterns, especially during the wet season. Most flash floods are caused by heavy rainfall or thunderstorms, but some occur when a debris jam bursts, a dam fails, or water is suddenly released from a lake blocked by a glacier or terminal moraine (glacial outburst flood or “jökulhlaup”). Flash floods are local in extent, almost impossible to predict, and warning time is minimal. Flash floods commonly occur in small streams or dry stream beds in or near mountains, deserts, or the tropics. Desert dry washes near mountains are particularly susceptible and may become raging torrents after rainstorms far upstream. There is a high risk of drowning if caught in a flash flood; undertow conditions create extremely lethal hazards for persons trying to traverse through flash floods. In North America, about half of all flood-related deaths are occupants of vehicles swept away by moving water.

#### **Signs of an impending flash flood:**

- Water level suddenly increases
- Water suddenly becomes muddier and/or debris appears
- Loud noises of rushing water from the upstream direction
- A thunderstorm or rainstorm nearby, especially within the drainage system.

If you encounter a flash flood, immediately move to higher ground and wait for the floodwaters to recede – this may take 24 hours – or find another route. Flash floods sometimes come in quick succession. Once one has passed use extreme caution.

#### **Prevention and Preparation**

Listen to local radio stations and heed flash flood warnings. Keep essential survival equipment in your pockets in case you must abandon your vehicle or pack.

- Be aware of your surroundings and changing weather. When working in washes near mountains, leave the drainage area immediately when you see rain or storm clouds.
- In some tropical areas, flash floods may occur daily. Be cautious if using a dry stream bed for a helicopter landing site.
- Do not walk through flowing water. Quick flowing water 15cm deep can sweep you off your feet, especially on unstable ground. Check out a road bed by walking where water is not moving and use a stick to probe for firmness and washouts.
- Do not set up camp in a dry stream bed, a valley bottom subject to flooding, or downstream from glaciers that can release large quantities of water.
- **Vehicles:** Never drive in a dry stream bed or dry wash unless there is an obvious escape route.
  - Do not overestimate a vehicle's ability to drive through floodwaters. Water 15cm deep can reach the bottom of most cars and cause loss of control or stalling. Water 30cm deep will float most cars. Flowing water 60cm deep has sufficient lateral force to float and sweep away larger vehicles, including pickup trucks.
  - Do not drive through partially flooded underpasses, even in urban areas. It is usually impossible to estimate water depth and underpasses can fill rapidly.
  - In urban areas where rescue is probable, occupants statistically have a better chance of survival if they stay with the vehicle after it is stranded. Climb on the roof to avoid rising water if it is unsafe to leave the vehicle.
  - If your vehicle stalls in floodwaters and help is unavailable, leave it immediately if you can do so safely. Do not waste time trying to restart the vehicle. Many people drown when their vehicle is swept away as they are attempting to restart it.

### 5.2.4 Cold Weather Safety

Field work in cold and/or wet weather conditions requires adequate clothing to prevent hypothermia and frostbite. Hypothermia is a leading cause of death in the outdoors; deaths generally occur when temperatures are 10°C and below. Frostbite, wind chill, and being wet (rain or sweat) contribute to developing hypothermia.

## Clothing

Wear several loose layers made of appropriate fabrics:

- Long underwear made of wool, wool blend, or polyester is warmest. Cotton dries too slowly.
- Middle layers should be warm, loose, and dry easily. Air between layers increases insulation.
- A windproof outer layer and good quality rain gear are essential. The jacket should be long enough so rain does not leak into your pants. Put rain gear on before you get wet.
- Mittens are warmer than gloves. Consider light gloves inside mitts, especially if frostbite is a risk.
- Prevent heat loss with a warm hat (toque) with ear protection. Wear a scarf or face mask when working in cold wind.
- Arctic clothing should be appropriate for the temperature range and type of activity.
- Wear sufficient clothing when working at altitude in the tropics, especially in the rainy season.

## Footwear

- To prevent frostbite and hypothermia, keep feet dry and warm.
- Boots must not constrict blood flow. Gaiters keep snow and water out of boots.
- Felt-lined boots with a spare set of liners are recommended.
- Woollen socks are warmest. Carry extra socks in case they get wet.

**Hypothermia** develops when a body loses heat faster than it can be produced through metabolism and exercise. Consequently, the core body temperature falls and internal organs – including the brain – cease to function effectively. It is essential to identify mild hypothermia, which can be treated in the field. The risk of death increases as the severity of hypothermia increases – evacuation to a medical center is required for moderate or severe hypothermia. See section 3.3 Field Treatment for Mild Hypothermia and Frostbite.

## Prevention and Preparation

- **Stay warm and dry.** Try not to work up a sweat, as wet clothing may chill you.
- Avoid fatigue, dehydration and hunger. Take adequate warm-up breaks; build a fire if necessary.
- Use the buddy system to monitor signs of hypothermia in yourself and others.
- **Never leave a potential hypothermic patient alone** as their condition may deteriorate rapidly.

## Symptoms and Signs of Mild Hypothermia

(i.e. body core temperature between 35°C and 32°C)

- Cold extremities – feeling cold and numb is the first symptom
- Shivering may be intermittent or constant and uncontrolled
- Rapid heart rate and/or rapid breathing
- Loss of coordination (i.e. some difficulty performing tasks with the fingers and hands)

The following mnemonic is helpful to remember the signs of mild hypothermia: *“The hypothermic subject mumbles and grumbles (personality changes) and fumbles, stumbles, and tumbles (loss of coordination).”*

Source: James A. Wilkerson (2001) *Medicine for Mountaineering & Other Wilderness Activities*  
Mountaineer Books

### 5.2.5 Hot Weather Safety

Heat illnesses can develop when the air temperature exceeds 23°C and the humidity exceeds 50%. The higher the temperature and humidity, the greater is the risk of developing heat illnesses. While heat illnesses are normally associated with deserts and the tropics, they may develop anywhere during periods of hot weather or hot working conditions, including when working in clear cuts or on the tundra.

#### Heat Illnesses (Hyperthermia)

Heat cramps, heat exhaustion, and heat stroke are progressive forms of heat illnesses. The combination of high temperature, high humidity, strenuous activities, dehydration, and lack of acclimatization all contribute to developing heat illnesses. Preventing dehydration is most important in order to maintain the correct body temperature and correct volume of blood flow to produce sweat. Sweat must evaporate from the skin for maximum cooling effect; sweat that pools and runs off the body has little cooling effect. Almost all cases of hyperthermia can be prevented by drinking enough water. Maintain your electrolyte balance by eating salty snacks and lightly salted meals. **Heat stroke is a life-threatening condition and requires immediate medical attention and evacuation to a medical center.** See section 3.4 Field Treatment for Heat Illnesses.

#### Prevention and Preparation

- **Prevent dehydration:** Drink plenty of water (0.5-1.0 litre/hr). Do not rely on thirst. Water is best, as carbonated drinks are less effective. Sports drinks are acceptable but do not drink high caffeine energy drinks. Carry enough fluids on traverses and do not count on finding water.

- **Clothing:** Wear a broad-brimmed hat and light-coloured, loose-fitting clothing that covers the skin. Cotton fabrics are a good choice.
- **Acclimatization:** Become acclimatized when you are new to a hot climate or returning from a break, sickness, or annual leave. Full acclimatization may take a week or more.
- Perform the heaviest work during the coolest part of the day and take frequent short breaks in the shade. Pace yourself.
- Use the buddy system to watch for signs of heat stress in co-workers.
- Pregnant women should be very careful to avoid heat illness, as it may affect the fetus.

Symptoms of Heat Exhaustion	Symptoms of Heat Stroke
<p><b>Pale, cool clammy skin</b>            Normal mental state            Weakness or fatigue            Dizziness and/or fainting            Headache            Nausea and/or vomiting            Muscle cramps            Decreased and/or dark-coloured urine</p>	<p><b>Pale, cool clammy skin or hot, dry red skin</b>  <b>Irrational, hostile behaviour, confusion</b>  <b>Headache, dizziness</b>            Nausea, vomiting            Rapid, shallow breathing            Irregular pulse            Possible seizures            Collapse and coma</p>

## 5.3 Working and Traversing in Specific Terrain

Exploration personnel who are skilled and competent working in one specific terrain are not automatically competent when working in another terrain. It is advisable when beginning work in new terrain (or a new country) to seek advice from knowledgeable local people or experts and get sufficient training to carry out work safely.

### 5.3.1 Mountains

**Significant risks:** Slips, trips, falls, adverse weather, hypothermia, altitude illness, rough steep terrain, stranding, avalanches, transportation-related risks, isolation.

#### Preparation and Prevention

Companies planning field work in mountains should provide field crews with relevant specialized training. Work in high mountains or on glaciers requires

special skills, equipment, and training and, if necessary, should be carried out with the help of mountaineering experts. Refer to sections 6.4.1 Mountainous Terrain and 6.4.2 Snowfields and Glacier Terrain in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.

Working conditions in mountains are challenging because of isolation, terrain, altitude and cold temperatures; even mountains in tropical regions can be cold, especially in the wet season. Weather and unexpected storms may cause poor visibility that obscures hazards or increases the risk of becoming lost. Warm clothing, rain gear and high quality boots are essential. Polarizing sunglasses and sunscreen (>SPF 30) should be used, as needed, to reduce exposure to ultraviolet radiation. Be prepared and carry adequate equipment.

- Steep slopes are more difficult to climb down than climb up. They seem less steep when viewed from above (including from aircraft). Steep, wet, or icy slopes are particularly treacherous if you fall. It may be impossible to arrest your fall and you may slide over a cliff. Do not descend a slope that you cannot see the bottom of, as it may end in a cliff. Do not descend a slope that you cannot see the bottom of, as it may end in a cliff. Do not glissade down snow slopes; if you lose control you may be injured.
- Gullies may appear to be the easiest access route up or down a slope. Be aware of the hazards of loose rock, rock falling from above, unstable sides, and sudden changes in the degree of slope. Gullies may end in a cliff or a cornice and may be particularly dangerous to descend.
- Be wary of narrow ridges, especially ones with snow, as there may be cornices (overhanging snow and ice) that appear solid but are, in fact, unsupported and may collapse.
- Do not work beneath ice cliffs and hanging glaciers, especially near recently fallen debris. Avoid traversing above cliffs on snow covered terrain where a fall can send you sliding over the edge.
- Don't locate fly camps in the path of a potential avalanche, in a narrow valley, near a cliff, or on a ridge exposed to high winds, or on game trails.
- When traverses are very long or difficult, consider setting out a survival cache at a strategic location.

### 5.3.1.1 Altitude Illness

When you rapidly ascend to elevations above 2,500m, one or more forms of altitude illness may develop unless you become acclimatized. Acclimatization is the process when your body progressively adapts to the reduced available oxygen

(“thin air”). Anyone can be affected by altitude illness. It does not depend on fitness, age, gender, or the number of previous trips to altitude with no ill effects.

## Forms of Altitude Illness

**Acute Mountain Sickness (AMS)** is a progressive disorder with symptoms that develop before acclimatization. There is no precise altitude when symptoms develop; it depends on the individual. AMS may develop gradually or very rapidly.

**High Altitude Pulmonary Edema (HAPE)** is a severe form of AMS when fluid builds up in the lungs. Symptoms usually develop two to four days after reaching altitudes over 2,500m. HAPE kills more people than any other form of AMS.

**High Altitude Cerebral Edema (HACE)** is a severe form of AMS when fluid builds up and brain tissue swells. Symptoms usually develop two to four days after reaching altitudes over 3,600m, but it can develop as low as 2,500m. HACE can cause permanent brain damage or death.

## Preparation and Prevention

- **AMS is preventable by gradually ascending to high altitude over several days so the body acclimatizes to the reduced oxygen available at the specific elevation.** Become acclimatized whether you are new to a site, returning from a break, sickness, or annual leave. Full acclimatization can take at least ten days. Avoid flying to high altitude camps when you can drive, but be aware that a driving ascent may also be too rapid.
- Have a medical check-up before working at high altitude, especially if you have asthma, sickle cell disease, or are pregnant. Discuss whether to use the medication Acetazolamide (Diamox). Take sufficient medication for the trip.
- Oxygen therapy should be available in all camps 2,500m and higher.
- Do not overexert by starting heavy work upon arrival at high altitude.
- Try to camp at the lowest elevation possible. It is advisable to “work high and sleep low”.
- Drink lots of water and juices, do not consume alcohol, and limit consumption of caffeinated drinks. Do not smoke.
- Use the buddy system and watch each other for symptoms of AMS, HAPE and HACE.
- Never take sleeping pills; they limit deep breathing efforts to gain oxygen.

## Symptoms and Signs of Altitude Illnesses

Symptoms and signs of altitude illnesses are progressive. Mild AMS is uncomfortable and feels like a hangover. Moderate AMS requires monitoring as it

can quickly develop into HAPE and HACE, which may be fatal. Monitor persistent symptoms and take appropriate action, which is usually descent to a lower altitude. Recognizing the onset and progression of AMS symptoms is critical to prevent developing HACE or HAPE.

**A persistent headache** aggravated by exercise: A mild headache becomes severe and is not relieved by medicine.

**Insomnia:** Difficulty sleeping is normal until acclimatized. Loss of appetite and mild nausea are common; vomiting is a sign of advancing AMS.

**Shortness of breath:** Normal breathing should resume after 15 minutes at rest. Increasing breathing difficulties are serious signs that indicate HAPE.

**Fatigue or lassitude:** Fatigue does not diminish with a good night's sleep. Fatigue may progress to lassitude when a person does not get out of bed to eat, drink, or urinate.

**A persistent dry cough** that progresses to a watery cough and finally to a bloody cough: This indicates HAPE.

**A crackling sound** (crackles or rales) that can be heard when listening to the victim's chest: Rales sound like hair rubbed between fingers when held next to the ear.

**Fluid retention, decreased urine output and dark yellow urine** indicate dehydration.

**Rapid pulse** at rest, >110 beats per minute.

**Cyanosis:** Pale or bluish colour on the lips and fingertips indicates HAPE.

**Loss of balance and muscle coordination (ataxia):** This serious sign indicates HACE.

**Disorientation, poor judgment and poor coordination:** These symptoms indicate severe AMS.

**Mental confusion and hallucinations:** These symptoms indicate HACE.

**Confusion, delirium, and coma:** These symptoms are followed within a few hours by death.

### **To determine the forms of altitude illness:**

Referring to the *Lake Louise Consensus on the Definition of Altitude of Altitude Illness* (see Figure I next page) can help determine the form(s) of altitude illness experienced by a patient.

**FIGURE I: The Lake Louise Consensus on the Definition of Altitude Illness**

<b>AMS</b>	<p>In the setting of a recent gain in altitude, the presence of headache and at least one of the following symptoms:</p> <ul style="list-style-type: none"><li>• gastrointestinal (anorexia, nausea or vomiting)</li><li>• fatigue or weakness</li><li>• dizziness or light-headedness</li><li>• difficulty sleeping</li></ul>
<b>HACE</b>	<p>Can be considered “end stage” or severe AMS.</p> <p>In the setting of a recent gain in altitude, either:</p> <ul style="list-style-type: none"><li>• the presence of a change in mental status and/or ataxia in a person with AMS [inability to walk a straight line]</li><li>• or, the presence of both mental status changes and ataxia in a person without AMS</li></ul>
<b>HAPE</b>	<p>In the setting of a recent gain in altitude, the presence of the following:</p> <p><b>Symptoms</b> – at least two of:</p> <ul style="list-style-type: none"><li>• dyspnea at rest [difficult, laboured breathing]</li><li>• cough</li><li>• weakness or decreased exercise performance</li><li>• chest tightness or congestion</li></ul> <p><b>Signs</b> – at least two of:</p> <ul style="list-style-type: none"><li>• crackles or wheezing in at least one lung field</li><li>• central cyanosis [bluish coloured skin, lips, fingernails]</li><li>• tachypnea [abnormally rapid respiratory rate]</li><li>• tachycardia [abnormally rapid heartbeat]</li></ul>

Source: Reproduced with the permission of Charles S. Houston M.D. from: “The Lake Louise Consensus on the Definition and Quantification of Altitude Illness” in Hypoxia and Mountain Medicine, by J. R. Sutton, G. Coates, and C. S. Houston (eds). 1992.

**Test for HACE that demonstrates the loss of muscle coordination (ataxia):**

Have the patient walk a straight line for 5m in a heel-to-toe manner. If the patient staggers or cannot return along the line without falling, he/she is probably suffering from HACE and must descend to lower altitude immediately.

**Treatment for AMS**

It is advisable to insist that a person receives medical attention when AMS is a possibility, as the person affected can easily disguise some symptoms

if he/she does not wish to descend.

- **Mild AMS:** The person affected should eat foods high in carbohydrates and low in fat, take acetaminophen for pain, and minimize activity. They should not ascend to higher altitude until they have acclimatized and symptoms have disappeared. They should descend to a lower altitude if symptoms worsen.
- Anyone with symptoms of moderate or severe AMS, HACE, or HAPE must not go to higher altitude, even for a brief time (e.g. a day's work). Descend at least 600-1200m to a lower altitude where symptoms disappear. While oxygen therapy may be administered, it is essential to remove the patient to lower altitude immediately. Never leave a person with AMS, HACE or HAPE alone, as their condition can deteriorate very rapidly, even during descent.

### **Thrombophlebitis**

Blood may clot more easily at high altitude, especially in the legs. This may be due to restrictive clothing and/or dehydration, or as a result of sitting for extended periods on long airline flights or long vehicle trips. Wear loose clothing, keep well hydrated, and exercise legs and feet frequently. Women with increased estrogen levels (contraceptive medication, pregnancy) are at increased risk.

### **5.3.2 Cliffs and Steep Terrain**

**Significant risks:** Slips, trips, falls, objects in eyes, falling rock causing injuries.

#### **Prevention and Preparation**

- **Personal Protective Equipment (PPE):** Wear eye protection and a hard hat. Make sure no one is below you or close enough to be injured by falling or flying rock. Do not work directly above or below anyone.
- Stay back from cliff edges, as they may break off and collapse. Avoid working for extended periods below a cliff face, especially below frozen cliffs in sunlight. Be alert for rock falls; falling pebbles often precede a larger fall of rock.
- Use parallel routes spaced well apart to climb steep terrain to avoid knocking loose debris onto anyone else. Otherwise, wait until the leader reaches the top and then follow in the same path.
- Shout "Rock!!!" if you dislodge a stone or boulder. When you hear the warning "Rock!!!" do not look up; get as close as possible to the rock face.
- Select traverse routes carefully to avoid impassable terrain, especially when there are numerous dissected canyons or badlands.

### 5.3.3 High Arctic Latitudes

**Significant risks:** Keeping track of location, adverse weather, wind, hypothermia, slips and falls.

#### Prevention and Preparation

- **Location:** Use good maps, air photos, a compass, a GPS, extra batteries, and carry them at all times. Depending on the location in relation to the magnetic north pole, a compass may be of little use. Also, it is difficult to determine location on nearly featureless terrain. Clear Arctic air makes it difficult to estimate distances; people more commonly underestimate rather than overestimate distances.
- **Communication:** Identify and confirm the GPS coordinates for drop-off and pickup points. Several methods of communication may be necessary, in addition to handheld radios. Carry extra signalling devices (flares, mirror, and helicopter cloth). It may be hard for a pilot to locate you, so RUN and MOVE and wave a helicopter cloth.
- **Wind:** Most high latitudes are cold deserts. Wind is a serious problem and can contribute to dehydration and hypothermia, so drink plenty of water. Select rugged personal equipment.
- **Hypothermia:** Take all precautions to prevent hypothermia. Wind and near freezing temperatures are normal, especially in the Arctic Islands. Wear sufficient clothing and stay warm, dry, hydrated, and well fed.
- **Survival:** Carry a comprehensive personal survival kit suited to extremely harsh conditions. Survival caches should contain a minimum of that list in 5.1.1 Field Equipment. Consider the potential need to place several survival caches in strategic locations. Everyone must know the precise GPS coordinates of all caches, as they can be difficult to find in fog, snow, or darkness when everything looks the same. Caches must be bear-proof, rodent-proof, and as visible as possible.
- When working on ice, each team should carry a waterproof hypothermia kit. See section 5.1.1 Field Equipment.
- In cold weather, keep all electronic equipment inside many layers of clothing rather than in a pack. Use this equipment sparingly and quickly and replace it inside your clothing.
- **Bears:** See section 6.1. Bears.

### 5.3.4 Lakes, Rivers, Streams, and Coastal Waters

When boats are used, they should be large enough for the job, the weather risks, and be fully equipped. Wear a lifejacket or other personal flotation device at all times when using boats or traversing on steep shorelines. See sections 7.6 Boats and 7.6.1 Cold Water Immersion.

**Significant risks:** Drowning, cold water immersion hypothermia, slips and falls.

#### Prevention and Preparation

Plan traverses to avoid crossing dangerous streams or rivers. If you must cross, search for the safest place, plan the crossing carefully, and do not rush. Find the shallowest depth and slowest current. Make sure there are no hazards downstream, e.g. rapids, snags, sweepers, waterfalls, ice dams, log jams. Carry survival and emergency gear in your pockets in case you lose your pack. Consider the depth of water and how to keep essentials dry (e.g. matches, batteries, electronics).

- Many lakes and streams encountered during exploration work are classified as “cold waters” (less than 21°C or 70°F). Storms may generate large waves on large or long lakes. Be familiar with the treatment for cold water immersion hypothermia. See sections 3.3 Field Treatment for Mild Hypothermia and Frostbite and 7.6.1 Cold Water Immersion.
- **When dropped off on an island or bar, a helicopter must wait until everyone reaches safe ground.**
- Be cautious in tidal zones (green zone), as rocks covered in algae and seaweed are very slippery.
- Wear a lifejacket or other personal flotation device as required when collecting sediment or water samples. Do not collect samples while wearing a back pack; if you fall in, it can push or pull you under water.
- Due to heavier stream flow as a result of increased snowmelt or heavy rains, mountain streams may be easy to cross in the morning and too dangerous to cross late in the day.
- To cross an outlet stream below a glacier, it may be safest to cross the glacier rather than the stream. Glacial meltwater is cloudy and extremely cold.
- Slow-moving and meandering streams are frequently muddy with a shallow shelf at each edge of a deep main channel. There may be a drop-off, so use a long, strong stick to probe ahead. Tropical rainstorms can turn a slow-moving stream into a raging torrent. It is better to be stranded for a night than to attempt a dangerous crossing.
- Do not use fences, especially wire and barbed wire, to cross streams.

- Be wary of waterborne diseases and parasites.

### **Stream-Crossing Techniques**

The best method to cross streams depends on the width, depth, composition of the stream bed, water temperature, current, etc. Make certain that everyone crosses safely before the party continues.

Some suggestions:

- Release the pack waist strap and loosen shoulder straps in order to discard it immediately, if necessary. For heavy packs, consider dividing the load into two trips. Take dry clothes and matches in each load.
- Face upstream for the best balance. Use one or two heavy sticks for support. Keep one stationary while probing ahead. Aim upstream and cross at a diagonal.
- Link arms with a partner and alternately lift only one foot at a time. Use shuffling steps without crossing one leg in front of the other.
- Fast-flowing water only as deep as the knees can sweep you off your feet. If you fall in, try to get into a sitting position; point your feet downstream and work your way to the stream bank.
- For frequent crossings: Carry inexpensive, lightweight athletic shoes or rubber boots. Rig a rope between banks for a hand line. Anchor the rope to a tree or a large boulder rather than a co-worker. A person acting as an anchor can easily be dragged in.
- Use caution when jumping from rock to rock. Rocks can be unbalanced, slippery, algae-covered, and can tip over.

### **5.3.5 Deserts**

**Significant risks:** Dehydration, sunburn, heat illnesses, hypothermia, rough dissected terrain.

#### **Prevention and Preparation**

- Traverse with a partner and do not travel long distances from transportation without careful planning, equipment, and extra water. When using air support, consider dropping off a survival cache at the midpoint and/or at the end of the traverse route.
- Prevent dehydration. Start work well-hydrated and consume water throughout the day. Carry at least 7.5 litres of water per person per day in the vehicle, plus sufficient for traversing needs in your pack.

- Wear appropriate protective clothing: long trousers, long-sleeved shirt, a broad-brimmed hat, and sunglasses. Use sunscreen (SPF 30+) frequently. Protect your neck. Carry extra clothing for cold nights. Boots should have thick soles and rise up well over the ankles to provide protection from sharp vegetation and potential snakebite.
- Consider working during the cooler times of the day.
- Carry several methods of signalling; dust and wind-blown sand may interfere with radio transmissions.
- Watch where you step to avoid snakes. Inspect the area before sitting down (scorpions, ants); bare rock is safest. Shake out shoes, clothing, and utensils before use.
- Traversing in hot deserts is usually carried out with a vehicle. Vehicles should be fully equipped with maps, GPS unit, extra batteries, survival kit, first aid kit, food and lots of extra water, as well as a radio, satellite phone or mobile/cellphone, as appropriate. See section 7.2 Field Vehicles.
  - Always carry a survival kit, compass, signal mirror, and extra water when you leave the vehicle.
  - Do not use dry creek beds for a road or drive in them, unless there is a means of escape. Stop and get out of the vehicle before driving across dry creek beds, streams, or wet areas on a road. Check for sharp rocks, water, potholes, ditches, soft spots, or washouts. Check upstream and downstream for the safest place to cross. See section 5.2.3 Flash Floods.
  - Stay with the vehicle if it breaks down.

### 5.3.6 Tropics

**Significant risks:** Malaria and other diseases, sunburn, heat illnesses, dehydration.

#### Prevention and Preparation

- Plan for the wet and dry seasons, especially regarding transportation and health issues. It is important that immunizations are up-to-date.
- Protect against sunburn and heat stroke – use sunscreen (SPF 30+), protective clothing, sunglasses, and cloth extension on hat. Avoid direct sun at midday if possible.
- **Stay hydrated – consume at least four to five litres of water per day.** Do not drink water from streams and rivers without following appropriate purification procedures.
- When working at altitude, be prepared for hypothermia, especially during the wet season.

- Wear gloves when sampling; avoid excessive handling of soil and forest debris. Attend to cuts and abrasions promptly to avoid infections.
- Use care when passing through thick foliage to avoid dangerous animals, reptiles, insects, and sharp vegetation.
- Where malaria is a risk, follow preventive measures, and use insect repellent containing DEET. See the malaria section in 8.1 Employee Health.

### 5.3.7 Heavy Vegetation or Jungle

**Significant risks:** Finding your location, slips, trips and falls, eye injuries, poor visibility, wildlife.

#### Prevention and Preparation

- Useful Personal Protective Equipment (PPE) and general equipment: eye protection, caulked boots, machete.
- Consider hiring local people experienced in bush clearing and familiar with the fauna and flora.
- It may be difficult to establish your location. Heavy foliage may interfere with GPS satellite reception.
- Follow your partner at a safe distance to prevent branches whipping back into your face.
- Slips, trips, and falls: Be vigilant in very heavy underbrush to avoid holes, sharp rocks, slippery rotting logs, or stream banks obscured by vegetation. Wet ground increases the risks.
- Mark trails with flagging tape as it is easier to find the route on the return trip.
- Where venomous snakes are present, watch for them on paths, in grasses, bushes and trees, and around rocks and logs. See 6.2 Insects and Reptiles.
- Where malaria is a risk, follow preventive measures and use insect repellent containing DEET. See section 8.1 Employee Health.

### 5.4 Abandoned Mine Workings, Trenches, and Pits

Due to the high risks and hazards associated with abandoned surface and old underground workings, field employees should not enter any such workings – especially underground workings – without expert advice. Refer to section 22. Abandoned Surface and Old Underground Mine Workings in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.

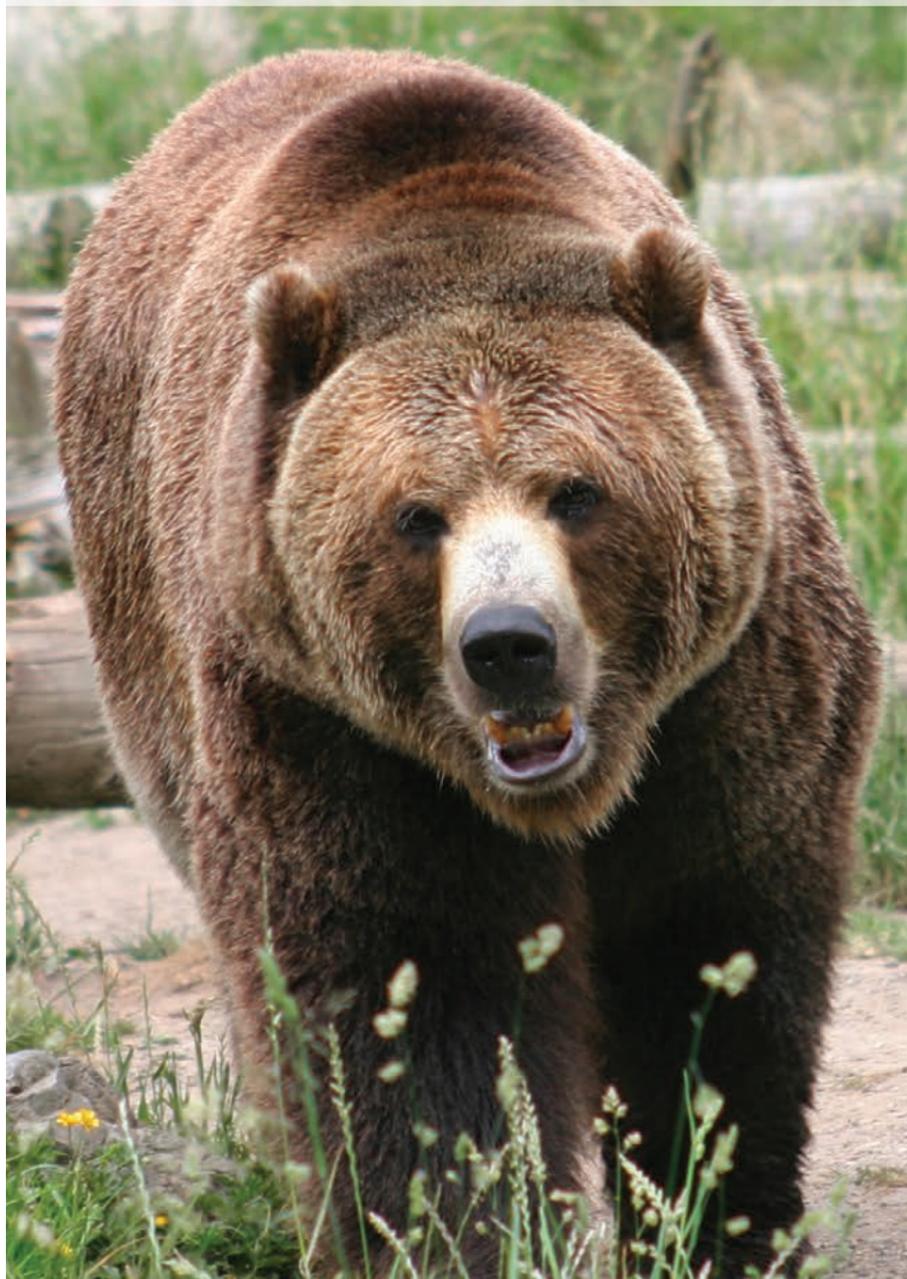
## Trenches and Pits

**Significant risks:** Burial by collapsing walls, being struck by falling rock or heavy equipment, falls, contact with buried cables or pipes.

- Refer to section 21.5 Trenches and Pits in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration* before undertaking trenching or pitting.
- Obtain all required permits (work, cutting) from authorities having jurisdiction (AHJs). Plan work to comply with jurisdictional regulations. Verify there are no underground pipelines or buried cables.
- Accurately assess the soil type and calculate the required depth, cut back, slope, and wall support to prevent collapse.
- Do not enter any trench or pit:
  1. Deeper than 1m, unless it is in solid rock, widened, benched, or sloped (1m horizontal run for each 1m of vertical rise)
  2. Unless there is someone on the surface monitoring you
  3. That you feel is unsafe
  4. With unstable walls.
- Use caution near edges to prevent falling in. One end must slope gently to permit easy egress.
- Locate excavated material at least 1m back from the face; for deeper excavations, the set back should equal the depth of the trench.
- The heavy equipment operator must know where you are working. Never approach from the operator's blind side. Establish a method of communication with the operator.
- Post warning signs and erect barriers where trenches remain open.
- Wear a high visibility vest plus PPE recommended in section 9. Personal Protective Equipment (PPE) and Hand Tools.
- Be aware of your surroundings. Do not sample above or below another person.
- Keep generators or combustion engines at least 10m away – and preferably downwind and downslope from a trench. Never locate them in a trench, as exhaust may cause asphyxiation.
- Fill in trenches and pits and reclaim as soon as possible.



## 6. Wildlife



## 6. Wildlife

Usually, larger animals are the main threat to traverse crews. However, disease-carrying insects and animals (of all sizes) may present potential health risks (e.g. malaria, rabies, dengue, Chagas disease). When starting work in a new region, ask knowledgeable people about local wildlife risks. To reduce wildlife encounters:

- Be alert and make noise on traverses to avoid startling animals. Most will leave the area.
- Avoid female animals with their young. Do not corner animals. Do not provoke animals in any way.
- Minimize animal attractants. Animals become food conditioned and human habituated very quickly. Do not feed animals or leave food in accessible places. Sloppy camp hygiene attracts animals and insects, so dispose of garbage regularly and properly.
- A group should stay together during a threatening wildlife encounter.
- Report problem animals (bears, wolves) to local authorities without delay.
- Know the dates for hunting season and avoid fieldwork at that time. Otherwise, wear an orange hunter cap and vest and post “Men Working” signs to indicate your presence.
- Never touch a dead animal carcass. Wear gloves and use a shovel for disposal.
- If possible, do not sleep or sit on the ground to avoid insect/reptile bites and stings.

**Cougars and jaguars:** Make noise, carry a big stick and bear spray for deterrents. Appear as large as possible. Face the animal and back away – never run, crouch, or turn your back. Cougars rarely attack humans, but if attack is imminent, be aggressive, shout, and appear threatening. If attacked, inflict pain; protect your head and neck. If knocked down, try to get back up.

**Moose and elk:** Males are dangerous during rutting season and when food is scarce. Females actively defend their young by charging and stomping. Back away slowly and use trees as a decoy. If a vehicle collision with one is unavoidable, aim for the hindquarters, as the animal is less likely to be flipped up and crash through the windshield.

**Wolves and coyotes:** They fear humans, but are difficult to scare off once they become human habituated and food conditioned. Appear as large as possible and try to intimidate them. Noises scare them. Back away. Do not run, crouch, or turn your back. Bear spray works.

**Hippos:** Never camp near their grazing areas. When threatened on land, they will attack anything between them and the safety of water. In a boat, avoid waters with hippos, as the hippos may overturn a boat without provocation. Use extreme caution and leave the area quietly.

## 6.1 Bears

Due to the widespread ranges of black, grizzly and polar bears, with few exceptions, most mineral exploration field employees working in North America will be working in bear country. Black bears are the most common and widely distributed species; their range includes boreal forest in Alaska and Canada (occasionally on the tundra), the Cordilleran, Rocky Mountain, and Appalachian mountain ranges, other thickly forested areas of the USA, remote mountainous areas of Mexico. Grizzly bears, also known as brown bears, prefer open country; their range includes tundra of Alaska and Canada, Canadian and U.S. Rocky Mountains, parts of the coastal mountains of Alaska, Yukon, and British Columbia. Polar bears live on sea ice, especially active ice; their range includes coastal arctic mainland and islands, some subarctic regions. While usually found near the coast, polar bears may range up to 150km inland before the pack ice freezes in the fall.

**Note:** The ranges of black and grizzly bears overlap in many areas. The ranges of grizzly and polar bears overlap in the arctic. The ranges of polar bears and black bears overlap in subarctic eastern Canada.

Employees working in bear country should receive relevant bear safety training, including how to prevent encounters. Site-specific bear response plans should address when a bear is sighted on traverse, near camp, when a bear enters camp, and if a bear attacks. Immediately notify wildlife officials about problem bears so they can be removed. It may be advisable to hire qualified local people as trained bear guards to protect the camp and traverse crews, especially in polar bear country. The following information is abridged from section 10.3 Bears in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*, where additional bear information can be found.

### Preparation and Prevention

Minimize bear attractants in camps and while traversing. Good camp cleanliness, food handling, and waste management practices are essential.

### Traversing:

- **Recognize bear signs**, e.g. tracks, scat, dug up areas, marked trees, and day beds.
- Make plenty of noise, especially near rushing streams, and before entering heavy bush. Shake a can of rocks, bang on a metal clipboard, shout and clap, or sound an air horn, etc.
- **Never approach bears.** Never come between a female bear and her cubs.
- Arctic: Take breaks in high open areas where the surrounding area is visible, especially in polar bear country.
- Helicopter support: Scan the drop-off area before landing. If possible, fly the traverse route to check for wildlife, but remember that bears may be present even though they are not visible.

### Fly camps:

- A site should have good visibility to see approaching bears. Consider setting up electric fencing or a tripwire fence with an alarm surrounding camp.
- Suspend food stores (caches) from a tree when possible. Hang food at least 4m high and 100m away from sleeping tents.
- Never sleep in the open without a tent; always use a flashlight at night.

### Deterrents

Carry at least two types of bear deterrents, including pepper spray. Know the capabilities and limitations of each deterrent. Calmly prepare the appropriate deterrent as soon as an encounter occurs.

- **Bear Spray:** Keep it immediately accessible – not buried in your pack. Use bear spray only in the path and face of a charging bear
- Know the appropriate distances to use various explosive bear deterrents. There are several types of launchers, so make sure your deterrent works with your launcher.
- Transport deterrents as dangerous goods and never carry them in the cabin of an aircraft.
- **Firearms:** Only qualified and authorized employees should be permitted to handle firearms. Follow local regulations. Canada requires anyone using a firearm to hold a Possession and Acquisition Licence (PAL). Refer to sections 10.3.9.3 Firearms and 18.2.2 Firearms Regulations and Policies in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration* for additional information regarding firearms.

## Bear Encounters

**In the field:** Remember that bears usually leave and avoid an encounter when they detect humans. A bear standing on its hind legs will not charge in this position – it is assessing the situation.

- **If a bear is unaware of your presence,** move away without attracting attention and try to leave undetected. If a bear is aware of your presence, speak calmly and slowly wave your arms to identify yourself as human, and move away slowly. Do not shout and do not run.
- The closer the encounter when a bear discovers you, the more likely it will charge or attack – especially grizzlies and polar bears.
- Bear behaviour reflects the bear's level of stress during the encounter. Subtle signs of stress include yawning or a change in body posture. Obvious signs of stress include huffing and teeth-popping noises. Signs of high stress or aggression include paw swatting, roaring, open-mouthed jawing, or charging.
- **If a bear approaches:** Stay calm and stand your ground. Prepare deterrents and try to determine whether the approach is defensive or non-defensive. A defensive bear perceives you as a threat (to its cubs or food). A non-defensive bear may be curious and approach slowly, or it may be after your food or be testing you. Predaceous bears (non-defensive) see you as food and approach with confidence and persistence.

**In camp:** When present, trained bear guards should respond to face a bear and attempt to isolate it away from people.

- Verify the bear is sighted approaching or within camp. Sound the alarm. The alarm must sound distinctly different from the fire alarm.
- People in shelters should shout or use radios to confirm their location. Do not go to a muster point.
- Attempt to scare away the animal using noise and appropriate deterrents.

**Black and Grizzly Bears:** Play dead if it is a defensive attack. Fight if it is a non-defensive or predatory attack.

**Polar Bears:** Always fight if attacked.

**To play dead:** When the bear contacts you, drop to the ground and lie face down. Keep your pack on. Clasp your hands over the back of your neck. Stick elbows out, spread legs apart, and dig your toes into the ground to help maintain this position. Do not struggle or make noise. Use the strength of your legs to resist attempts by the bear to flip you over. If the bear flips you, continue rolling onto

your stomach so you are face down again. Play dead until the bear departs.

**If you must fight a bear:** Inflict as much pain as possible to the bear's face and nose. Fight for your life.

## 6.2 Insects and Reptiles

Follow preventive procedures below to discourage insect bites, especially where disease-bearing mosquitoes are present. Avoid using scented products and cosmetics.

### To Prevent Insect Bites

- Wear appropriate protective clothing, which includes light-coloured long pants and long sleeves made of heavy, tightly woven fabric. Wear permethrin-treated bug-jackets and head-nets as required.
- Do not camp in a damp area. Eliminate standing water around camps when possible.
- **Use appropriate insect repellent and insecticides:**
  1. Use insect repellent containing 15% to 30% DEET (N, N-diethyl meta-toluamide) on skin. Higher concentrations of DEET provide longer protection, but are generally not recommended by health authorities. Read the label and follow application instructions. Wash DEET off when protection is no longer needed.
  2. Treat clothing with DEET or permethrin products (insecticide) to repel or kill mosquitoes (and flies, ticks, leeches). Follow the product instructions.

Additionally, to reduce risks of bites from disease-bearing insects, avoid exposure at times when they are most likely to bite. It is also very important to:

3. Sleep under insecticide-treated bed nets.
  4. Use knock-down insecticide sprays in living quarters and inside bed nets before bedtime.
- Sleeping quarters, including tents: It is preferable to spray a knockdown insecticide 30 minutes before bedtime rather than burn mosquito coils (which should be placed in metal containers). Do not inhale the spray or smoke. Avoid using coils made in Asia, as they may contain highly carcinogenic chemicals.

### Mosquitoes

Mosquitoes in high latitudes are a serious nuisance, although they generally do not carry diseases. Mosquito-borne diseases are a major hazard in the tropics and some temperate regions (malaria, dengue fever, yellow fever, encephalitis).

Know when bite protection is important, e.g. dengue-bearing *Aedes* mosquitoes bite during the day and twilight, while malaria-bearing *Anopheles* mosquitoes bite mostly at twilight and at night. Prevent bites! See the malaria section in 8.1 Employee Health.

### **Triatomine Bugs**

Infected triatomine bugs (kissing bug, assassin bug, or vinchuca) cause Chagas disease. The endemic areas include rural Mexico, Central and South America. The bugs inhabit palm trees, thatched roofs, and the roofs and walls of mud, adobe, or cane dwellings. Triatomine bugs generally bite at night. Prevent bites, as there is no cure for Chagas disease.

- Fumigate the buildings before occupying an uninhabited camp.
- Use a knockdown spray indoors. Sleep under a treated mosquito net and spray inside it before bed.
- Search your bed and living area for insects; the beetles are large (2.5cm) and easy to spot.

### **Ticks**

Wear long sleeves and light-coloured long pants tucked into socks. Check frequently on clothing and your body. Spray insect repellent on wrists, boots, and socks to deter ticks. Insecticide (permethrin) designated for ticks works best on clothes. Remove attached ticks immediately and carefully, see section 3.5 Stings and Bites.

### **Bees, Wasps, and Ants**

Look out for bees, wasps, and ant nests. Bees and wasps may nest in cliff faces or old mine entrances, as well as trees, underground crevices, and buildings. Reactions to stings range from minor irritations through moderate reactions to severe reactions, including anaphylactic shock causing death to people with venom allergies. Carry an EpiPen if you are allergic to bee or ant stings. See section 3.5 Stings and Bites for treatment.

- Do not swat or crush bees and wasps, as this excites them and attracts more. Do not use scented products or cosmetics.
- If you encounter large numbers of bees or wasps, cover your face and eyes. Leave immediately and seek an enclosed shelter. Heavy vegetation does not offer sufficient protection. Jumping into water may work, but Africanized bees will hover and wait until you emerge.
- Africanized bees: Obtain local knowledge regarding Africanized bees. Be vigilant and avoid swarms and nests. They are aggressive, very territorial, and

attack for little reason. While Africanized bee venom is no more toxic, they attack in greater numbers. Consult a physician if stung multiple times.

- Fire ants: Fire ants attack rather than flee. They crawl onto the victim, bite or pinch the skin to anchor their body, and then repeatedly sting. Immediately brush off loose ants and kill the ants attached to your skin.

## Reptiles, Scorpions, and Spiders

General Precautions:

- Vigorously shake out sleeping bags, clothing, and boots, etc. before use, including items left in vehicles or hung outside.
- Wear boots or shoes – not sandals. Do not go barefoot.
- Keep tents tightly closed. Sleep up off the ground.
- Check carefully before reaching into cracks or crevices or under logs or rocks.
- Wear gloves to collect firewood. Always use a flashlight at night.
- For treatment, see section 3.5 Stings and Bites.

**Snakes:** Be familiar with the types of snakes in your field area. Train your eyes to recognize the shapes, colour patterns, and distinctive signs of local venomous snakes, as they are well camouflaged. Most snakes are quite timid, sensitive to noise, and usually leave before you see them. Use common sense and do not handle snakes (dead or alive).

- Wear loose, long trousers over boots and socks. Boots should cover the ankles or higher; wear gaiters over boots. Clothing can absorb venom, deflect fangs, and reduce the severity of snakebite.
- Snakes often shelter under logs or rocks. To avoid potential snakebites, step up onto rocks/logs rather than stepping over them; check that there are no snakes on the other side of the rock or log before you step down.
- When it is necessary to move a rock or log, use a rock hammer or long stick (not your hands or feet). Roll it toward yourself to keep the object between you and any snake that might be present.
- Stamp on the ground and use a walking stick to sweep ahead in tall grasses or dense foliage.
- **Encounters at close range:** Do not move suddenly, as snakes strike at moving objects. It is usually best to remain motionless until you locate the snake (e.g. rattlesnake) and then back away slowly. Give the snake lots of space and look out for more snakes.
- Do not keep food in tents. Food attracts rodents and snakes eat rodents.

**Crocodiles:** Heed posted warning signs. Be aware of potential dangers near water holes and sloping river banks. Stay away from water between dusk and dawn, when they are most active. Although you cannot see crocodiles, they may be present. Crocodiles lunge very quickly. Watch for slide marks.

- Do not go to one place for water. Use at least three or four places with shallow flowing water in random order. Crocodiles quickly learn when and where to expect potential food.
- If you must cross a waterway, do so where it is narrow, shallow, and rocky. Avoid water more than knee-deep, especially if it is murky.
- Locate temporary camps >50m from the water's edge and >2m above the high water mark
- **If attacked, fight for your life.** Hit the nose repeatedly and gouge the eyes.

**Scorpions:** All scorpions have venomous stings and a few species are very venomous. They are not aggressive, but will sting when trapped or threatened. Avoid sitting in loose, dry vegetation. Scorpions travel up and down walls at night. Try to sleep in the centre of a tent; pull your bed away from the walls of a room.

**Spiders:** Obtain local knowledge regarding which spiders require medical attention following a bite. Do not put unprotected hands in places where spiders may be present, e.g. under rocks, in crevices, rock storage shelves, and core boxes. Some spiders have very toxic bites, so always seek medical attention for:

- *Latrodectus* sp. (black widow, red-back spider): Range – worldwide
- *Loxosceles* sp. (brown recluse, Chilean recluse): Range – North and South America
- *Phoneutria* sp. (Brazilian wandering spider): Range – South America
- *Atrax* (funnel-web spider): Range – eastern Australia.



## 7. Field Transportation



## 7. Field Transportation

Mineral exploration requires various means of transportation to access remote areas. Most exploration-related fatalities occur as a result of transportation accidents. While helicopter accidents kill the most people per accident, many deaths and serious injuries result from vehicle and all-terrain vehicle (ATV) crashes.

**Significant risks and hazards:** Injury or death caused by crashes, adverse weather, running out of fuel, mechanical breakdown, stranding, difficult and dangerous roads or terrain, operator fatigue, inattention, excessive speed.

### 7.1 Safe Operating Procedures for All Ground Transportation

Driver error or negligence is a major cause of transportation-related safety incidents. Practice good driving and riding techniques:

1. Obey the rules of the road. Carry required documentation, e.g. driver's licence, registration, insurance. Only drivers specified on agreements should drive leased or rental vehicles.
2. Only properly trained and licensed employees should drive company vehicles/equipment.
3. Be familiar with the manufacturer's operator manual and adhere to the safe operating procedures, inspection, and maintenance schedules.
4. Be familiar with emergency response procedures and leave an itinerary. Someone must know the planned route, estimated time of return, and what to do if a person does not return. Establish and follow check-in schedules; call in changes.
5. Do not drive while using a handheld mobile/cellphone, radio, or satellite phone. Pull over and stop.
6. Do not drive any vehicle or equipment if you have consumed alcohol or taken medication or drugs that might affect your ability to drive.
7. Do not drive any vehicle or equipment if you are fatigued or sleepy. Change drivers or stop for a rest.

#### 7.1.1 Travel Planning

Plan the route and time of travel with safety in mind. While it is only a guideline, the list below can be used to develop a specific journey management plan. It includes, but is not limited to the following:

- Names of driver(s) and passengers
- Vehicle/ATV/snowmobile details as appropriate: registration, licence plate, make/model, colour, rental agency

- Emergency plan and contact numbers
- Travelling dates and times
- Estimated arrival and departure times.
- Route details: Provide a map for long and non-routine journeys that includes relevant roads and highways. For remote field work, carry maps that include adjacent areas
- Planned rest periods: The driver(s) and supervisor should plan for fatigue management
- Carry appropriate equipment: safety, survival, first aid, spare parts, etc.
- Plan and carry out required appropriate non-routine inspections (e.g. towing a trailer, working on ice)
- Check weather conditions and predictions
- Arrival and check-in schedule

### 7.1.2 Fuelling Procedures

- Use the correct fuel. Fuel in an open, well-ventilated area with the engine stopped. Do not overfill the tank. Clean up spills using spill kit materials.
- No smoking, and no open flames or sparks are permitted in fuelling area.
- Do not fill portable fuel containers, chainsaws, ATVs, or snowmobiles on a vinyl bed liner; static electricity build-up may cause an explosion. Fuel them on the ground.
- **Portable fuel containers:** Use approved containers. Helpful to colour code according to fuel type (e.g. red = gasoline, yellow = diesel). Fill to no more than 95% capacity (mark level on container). Check frequently for spills/leakage when transporting them.

## 7.2 Field Vehicles

While underway, consider road quality, and hazards and drive according to present conditions – not how you remember them. Minimize night travel to avoid known risks (wildlife, pedestrian, violence). **Four-wheel drive vehicles offer increased surface traction, but no increased braking ability.**

### 7.2.1 Equipment

Carry appropriate equipment. Consider the degree of remoteness, climate, potential time for rescue, and whether travelling alone. Keep the following in a storage compartment:

- Contact telephone numbers for the camp, local office, manager, garage, police, etc.
- Operating instructions for the vehicle radio or satellite phone, if present

- Copy of the emergency response plan
- Manufacturer's operator manual, log book

**Essential Equipment (See Survival Cache or Vehicle Emergency Contents in 5.1.1 Field Equipment)**

- First aid kit
- Communication: radio, mobile/cellphone or satellite phone, Personal Locator Beacon (PLB), as required
- Maps, compass, GPS (Global Positioning System) and extra batteries
- One or two spare wheels with fully inflated tires, tire pump, tire gauge, tire repair kit (tire sealant for punctures)
- Jacks: axle jack and/or Hi-Lift jack, strong base plate for stability, lug wrench (cross-type). Note: Some companies prohibit the use of Hi-Lift jacks
- Tool kit, heavy duty jumper cables
- Extra fluids: oil, coolant, transmission, brake, windshield washer fluids
- Spare parts: e.g. fan or serpentine belt, hoses, filters, fuses, headlight and taillight bulbs
- Flares/reflective hazard signs
- Spare keys (hidden)
- Drinking water (quantity depending on region), food
- Fire extinguisher: Class ABC – mounted near driver, readily accessible
- Shovel, axe, and small saw
- High visibility vest(s)

**Recommended Supplemental Equipment**

- Large flashlight and extra batteries
- Matches (waterproof), additional fire lighting equipment
- Survival kit (suitable for region)
- 10m rope or straps (cargo, shelter support)
- Duct tape
- Recovery strap or Kinetic Energy Recovery Rope (KERR) – tow chains or cables are more dangerous

**Additional Equipment** (depending on location)

- Extra fuel in certified containers
- Hand operated winch (Hi-Lift jacks can be used as a winch)
- Extra battery mounted under hood (side opposite the exhaust manifold) or portable power system
- Latex or vinyl gloves and face shield in first aid kit where AIDS is endemic

For Cold Climates (essential)	For Hot Climates (essential)
<ul style="list-style-type: none"> <li><input type="checkbox"/> Windshield ice scraper, brush</li> <li><input type="checkbox"/> Tire chains, traction aids, or sand bags</li> <li><input type="checkbox"/> Gas line anti-freeze</li> <li><input type="checkbox"/> Extra mitts and wool hats</li> <li><input type="checkbox"/> Sleeping bags/blankets (one per person)</li> <li><input type="checkbox"/> Space blankets (three minimum to make shelter)</li> <li><input type="checkbox"/> Emergency candles, sterno cans</li> <li><input type="checkbox"/> Food (high calorie)</li> <li><input type="checkbox"/> Small stove and fuel</li> <li><input type="checkbox"/> Window punch tool (ice roads)</li> </ul>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Large plastic bag, transpiration bags</li> <li><input type="checkbox"/> White/clear plastic sheets (shelter, catch water)</li> <li><input type="checkbox"/> Space blankets</li> <li><input type="checkbox"/> Extra drinking water (at least 7.5 litres per day per person in very hot climates)</li> <li><input type="checkbox"/> Extra water for radiator</li> <li><input type="checkbox"/> Extra coolant</li> <li><input type="checkbox"/> Food (carbohydrates)</li> <li><input type="checkbox"/> Machete (tropics)</li> </ul>

## 7.2.2 Safe Operations and Preparations

### • Daily pre-operation check

- Walk around check: Note pressure/condition of tires, windows clear and wipers in good condition, lights clean and working, no oil leaks, loads are secure, and no debris underneath.
- Under-hood check: Check oil, coolant, washer fluid levels.
- Equipment check: Radio/antenna working, jack, spare tire, booster cables, tool kit, first aid kit, survival kit, fire extinguisher, spare key
- Start engine and check: Gauges (fuel, oil, temperature, voltage), brakes working, turn signal, mirror adjustments, and if there are any unusual sounds from engine

### • Periodic inspection

- Battery: Acid level (use flashlight – no smoking or flames), connections
- Fluid levels: Coolant, brakes, power steering fluid, hydraulic clutch (manual), use the correct viscosity of engine oil
- Hoses and lines
- Maintain tires and spares at the correct pressure.

- **Logbook:** Record mileage, mechanical problems, routine service/repairs; report problems to supervisor so repairs are completed as soon as possible.
- **Use of contactors' vehicles:** Carry out a roadworthiness test or safety inspection before use. Don't assume they are in good condition.
- **Loads:** Balance and securely anchor all internal and external loads. **Do not overload** and do not exceed GVWR (Gross Vehicle Weight Rating). Only light loads are permitted on roof racks. Do not obscure the driver's vision. Do not transport passengers in the back of pickup trucks.
- **Towing a trailer:**
  - Use the correct hitch for the size and weight. The ball hitch and socket must match (check stamps). Safety chains should cross under the tongue and only be long enough to permit proper turning.
  - Inspect trailer for structural damage, hitch condition, signal lights, brakes, and tires before loading. Load and unload on a level surface. Wedge or block wheels.
  - **Keep vehicle/trailer under control. Reduce speed** when a trailer sways or fishtails, in crosswinds, in poor weather, and on steep or slippery roads or slopes (gear down as well). Allow at least five seconds between vehicles when towing on roads.

### 7.2.3 Safe Driving Procedures

- **Wear a seat belt** except on ice roads, fording streams, and when entering/exiting ferries.
- **Brakes:** ABS brakes require a steady firm foot action – do not pump brakes. Downshift gears when descending long or steep hills to avoid overheating the brakes.
- **Reduce speed** for heavy traffic, bad weather, poor light/visibility, and hazardous road surfaces (water, sand, oil, ice, snow, wet leaves, potholes, mud, and ruts). Allow at least two seconds between vehicles.
- **Gravel roads:** Leave extra distance between vehicles to let dust settle. Never overtake in a cloud of dust; slow down when being overtaken. Use headlights; sound horn when approaching blind corners and hill crests. Beware of washboard surfaces and soft shoulders.
- **Private roads:** Know the local rules and obtain any required permissions. Logging/mining trucks have right of way and may use the wrong side of the road. When possible, maintain radio contact with these vehicles. Use headlights; sound horn when approaching blind corners and hill crests.

- **Crossing streams:** Check entry and exit points, water depth, firmness of stream bed, currents, and hidden hazards. Use low range gears; go fast enough to create a small bow wave and prevent water entering the exhaust pipe. If water is deep, place a sheet of plastic in front of the radiator to prevent water being sprayed over the ignition system. Do not drive through flash floods. If in doubt, do not cross.
- **Wildlife:** Use caution whenever animals may be encountered, especially near dawn and dusk.
- **Be visible:** Drive with daytime running lights or headlights on.
- **Avoid fatigue:** Take a break about every two hours when driving long distances.
- In cold weather, maintain the gas tank at least half full in case you become stranded.

### Off-Road Slopes

- Drive straight up and down the slope. Do not spin wheels. Use the correct gear and try not to change gears.
- Downslopes: Use low range and lowest gear possible so engine compression does the braking.
- Never turn around on a slope. Back down slowly in low gear.
- Avoid driving horizontally or at an angle across slopes. Avoid ruts, bumps, and rocks that increase downhill tilt and may cause rollover.

### Obstacles, Mud, Soft Ground, Sand

- **Inspect difficult terrain on foot.** Use a spotter to direct the driver. Maintain maximum clearance by steering toward high spots. Let one wheel ride over rocks. Straddle ruts.
- If wheels spin, reverse and try again with more speed or find an alternate route.
- If mired in mud, dig out sides and in front of wheels to release suction. Place rocks or logs under tires, as required.
- **Tire deflation to increase traction on sand:** Follow directions in the operator's manual. If not available, deflate by no more than ten psi for hard sand and 15 psi for soft sand. Carry a good tire gauge and air pump. Deflate for the minimum time and then re-inflate tires. Reduce speed to avoid damaging and overheating tire. Do not drive on rocks with deflated tires.

## To Change a Tire

Never crawl under a jacked-up vehicle unless it is supported on blocks. Never start the engine while a vehicle is on a jack.

1. Work on a level, firm surface in a safe area well off the road.
2. Set hand brake firmly.
3. Remove all necessary tools, equipment, and spare tire prior to jacking.
4. Set a wedge or block ahead and behind the remaining wheels.
5. Follow instructions for the type of jack. Make sure the base supporting the jack is stable.
6. Jack up the vehicle the minimum necessary height.
7. Remove wheel nuts (topmost nut last). Remove wheel and replace with spare. Use gentle force so the vehicle does not fall off the jack.
8. Hand tighten wheel nuts snugly, then lower the vehicle so the tire just touches the ground.
9. Fully tighten wheel nuts with a lug wrench. Use a criss-cross sequence (top-bottom-left-right) to get even tension.
10. Lower vehicle, remove jack, and replace all equipment.

**NOTE:** When using High-Lift jack, **never** move the reversing latch unless the jack handle is in the upright position against the steel bar. Keep your head/body away from of the jack handle, as uncontrolled movement can cause serious injury.

## To Use Booster Cables

Remove rings and wrist watch to prevent accidental contact with battery terminals. Vehicles should be close but not touching.

1. Clamp red (+) onto positive terminal of good battery.
2. Clamp other red (+) onto positive terminal of “dead” battery.
3. Clamp black (-) onto negative terminal of good battery.
4. Clamp other black (-) onto negative terminal of “dead” battery.
5. Start good engine and rev slightly; start engine with “dead” battery; let idle.
6. Turn off ignition of vehicle with good battery.
7. Remove cables in reverse order – 4,3,2,1.

## Winches

- Follow directions in the winch operator’s manual and/or on the decals on the winch.
- Plan the pull. Keep the action straight – as close to 180° as possible. Use remote control.
- Never overload a winch. Use genuine shear pins (not over-strength).

- Never stand within range of a cable. Drape something over the cable to dampen any whipping action. Don't wind the drape onto the drum.
- Leave enough cable on drum (at least five turns). Wind on the cable to avoid kinks.

### 7.3 Utility Vehicles and All-Terrain Vehicles (ATVs)

Use utility vehicles rather than ATVs whenever possible, as they are safer. Know the limitations of utility vehicles and ATVs and keep them under control at all times.

Only use ATVs and utility vehicles in good mechanical condition and operate them according to the manufacturer's instructions. ATVs have unique handling and control characteristics and are designed for off-road use.

**Significant risks and hazards:** Crashes with stationary objects, flips, injuries (back, head, eye, burns).

#### Prevention and Preparation

- **Use only 4-wheel ATVs (also known as quads); never use 3-wheel ATVs.**
- **Training:** Riders should receive adequate instruction from a certified or experienced instructor and be competent to operate all controls (brakes, engine stop switch, throttle, gear shifter, clutch) and carry out required manoeuvres.
- **Pre-ride inspection:** Check fluid levels, switches, brakes, mechanical parts, tire pressure, lights, load stability.
- **Carry sufficient equipment:** Consider the terrain, weather, remoteness, and distance of trip. Carry an appropriate tire repair kit and pump, tool kit with spare parts (spark plugs, belts, wrench, screwdriver, etc.), wire, and the ATV manual. See section 7.2.1 Equipment for additional recommendations.
- **PPE:** Wear approved safety helmet, eye protection, boots, long pants, long-sleeved shirt, and gloves.
- **Loads:** Do not overload racks or trailers or place sharp objects on front racks. Ride with backpacks on a rack, not on your back.
- Shut off fuel line when transporting ATVs.

#### Safe Riding Techniques

- Ride at a speed appropriate for the skill level, visibility, terrain, weather, and potential oncoming traffic. Be able to stop within the distance you can see. Remember, it is possible to ride farther in one hour than a person can walk in a day.

- Ride with a buddy. Team experienced and inexperienced riders together. Carry a passenger only if the ATV is designed for two people. Don't tailgate.
- Scan ahead and watch out for sharp bumps, holes, ruts, and obstacles. Avoid terrain with dangerous slopes, impassable swamps, etc. Approach unknown terrain cautiously. Identify unsafe topography. Watch out for branches and places where hands or handlebars might wedge against trees or rocks.
- Slow down and brake before entering a turn; move your body weight forward and lean toward the inside of the turn.
- Ride on established trails. ATV handling characteristics are very different on paved surfaces and require extra care.
- Cross roads, railroad tracks, obstacles, and ruts, etc. as close to 90° as possible.
- Park on flat ground; set shifter in park or low gear; wedge or block wheels if necessary.
- No racing, chasing, jumping, or reckless behaviour.

## Ascending Hills

- **Use the hill climbing techniques recommended in the ATV operator manual.** Not all ATVs can carry out the same manoeuvres. Analyze a slope carefully before proceeding. Check that rear racks are not overloaded.
- Keep feet firmly on footrests. Use a low gear and increase speed before ascending.
- Shift body weight forward. For steep hills, stand on footrests and lean over the front wheels.
- When downshifting to prevent a stall, release the throttle, shift quickly and smoothly, and keep your weight forward. Do not allow the front wheels to lift or the ATV may flip over backwards.
- If all forward momentum is lost, apply the parking brake before you roll backwards. Dismount on the uphill side (or to one side if heading straight uphill). Only attempt a "3-point turn" on a slope if the operator manual approves this move.
- **Never attempt to ride downhill backwards.** The ATV may flip over backwards onto you.

## Descending Hills

- Ride directly downhill but avoid obstacles.
- Keep feet firmly on footrests. Shift body weight toward the rear.
- Use low gear – do not use neutral. Ride with the throttle closed. Apply brakes gradually to reduce speed.

## Traversing Slopes

- **Avoid traversing slopes whenever possible**, especially when they are slippery, excessively rough, or with loose terrain.
- Lean your upper body uphill. Keep feet firmly on footrests. If necessary, steer slightly uphill to keep moving in a straight line and/or put weight on the downhill footrest to increase traction.
- If the ATV begins to tip, dismount on the uphill side immediately.

## Riding through Water

- Choose a known, safe ford, where both banks slope gradually. Do not damage the banks, the stream, or fish spawning grounds. Walk through the stream, if necessary, to check depth and hazards.
- Keep feet firmly on footrests. Proceed at a slow, steady speed to avoid submerged obstacles, holes, and slippery rocks. Anticipate shifting your weight to prevent overturning.
- To dry the brakes, apply light pressure several times while underway until they return to normal.

## 7.4 Snowmobiles

Snowmobiles are also referred to as “snow machines”, “Ski-Doos™” or “sleds”. Operate snowmobiles according to the manufacturer’s instructions. Riders must receive adequate instruction from a certified or experienced instructor. If you have not had it, ask for it from your supervisor. Only use machines in good mechanical condition; test drive an unfamiliar machine. Keep machines under control at all times. Ride at a speed appropriate for your skill level, visibility, terrain, weather, light conditions, and potential oncoming traffic.

**Significant risks and hazards:** Breaking through ice, adverse weather conditions, hypothermia and frostbite, overflow and slush, slips and falls, back injuries, and avalanches.

- Collisions with stationary objects or other snowmobiles are the #1 cause of death of riders.
- Breaking through ice is the #2 cause of death of riders.

### Prevention and Preparation

**Pre-ride inspection:** Remove snow and ice. Check fuel and fluid levels, switches, brakes, condition of mechanical parts, tracks and lights. Warm up the machine.

**Carry sufficient equipment:** Consider the terrain, weather, remoteness, and distance

of trip. See section Hypothermia Kit in section 5.1.1 Field Equipment and 7.2.1 Equipment. In addition, **always carry snowshoes and keep survival essentials in pockets** (e.g. knife, waterproof matches, ice picks, whistle, signal device).

**PPE:** Wear an approved helmet, face visor, and/or goggles (sunglasses for sun protection or yellow for flat lighting required), boots, gloves or mitts, and winter protective clothing. When working on ice – especially when ice conditions may be unreliable – wear a floater jacket, flotation snowmobile suit, or lifejacket or other personal flotation device (PFD). Dress for the weather conditions..

**Emergency procedures and itinerary:** Someone must know the planned route, estimated time of return, and what to do if you don't return. Follow check-in schedules and call in changes to plans.

**Training:** Be competent to operate all controls. Be trained for the specific terrain and work conditions. Know how to recognize and treat frostbite and hypothermia. Be familiar with potential hazards in the work area:

- Land: Hidden rocks, logs and tree stumps, fence posts, telephone poles, barbed wire, guy wires and cables. Flag dangerous wires and objects.
- Shoreline: Docks, rocks, pressure ridges, submerged objects, inlets and outlets.
- Lake ice: Pressure ridges, sloping shoreline ice, protruding rocks, open water, springs, fast-flowing water, narrows, bridges.

**Barrens and tundra:** Mark trails and mark predetermined GPS way points on routes. Operators should always carry maps marked with way points, a GPS, and extra batteries. See section 5.2.2 Whiteouts.

**Mountains:** Be trained to recognize avalanche terrain, test snow stability, and correctly use safety and rescue equipment. Check daily weather/avalanche warning reports. Heed warnings and postpone trips; don't take chances. Carry avalanche safety equipment and travel in groups with beacons "on". Only one snowmobile at a time crosses an area with potential avalanche danger.

**Retrieval methods:** Turn off engine; dig out with a snowshoe or ski – avoid lifting. Pack down snow in front of the machine to make a trail. Build a crib under a stranded machine to prevent freezing solidly in slush if it must be left overnight.

**Fuel lines:** Shut off fuel lines when transporting snowmobiles.

## Safe Riding Techniques

- Use the buddy system. Team inexperienced and experienced riders together.
- Carry two people only when the snowmobile is designed to carry a passenger.
- Use your body for balance and control. Lean into turns. Shift your weight to the uphill side. Keep feet on footrests.
- Travel up and down hills with caution. Do not try to prevent a rollover towards the downhill side. Dismount on the uphill side.
- Wear appropriate coloured lenses for flat light or bright sunlight.
- Be able to stop within the distance you can see.
- Know current and forecast weather conditions. Be prepared for worse conditions.
  - Clean headlights, reduce speed, and avoid unfamiliar terrain if it is necessary to ride at night. Use headlights on low beam for fog, heavy snow, or near whiteout conditions.
  - Do not travel in whiteout conditions. See section 5.2.2 Whiteouts.
- Do not ride along paved roads or on railroad tracks. Cross carefully at 90°.
- Snowmobiles lose traction and manoeuvrability on ice, so allow extra distance between machines.
- No racing, chasing, jumping, or reckless behaviour.

### 7.4.1 Working on Ice

Ice is never 100% safe; it is only as safe as the thinnest measurement. Ice strength characteristics may change rapidly – day to day, or throughout the day. Pay attention to what is happening to the ice around you, while crossing or working on it. Follow company procedures and use required safety equipment for working on ice. **Avoid thin ice.**

- **Measure ice thickness and prove it safe** before crossing or working on ice. Ice must support the total weight of the worker, plus all equipment.
- **Comply with the regulatory guidelines for working on ice.** Use the most stringent standards. Remember that tables and charts are only guidelines for “safe” ice thickness under ideal conditions. Currents below the ice surface can erode the ice thickness and create localized zones of thin ice.
- Test ice at regular intervals (e.g. every 50m for uniform ice, every 25m for variable ice or ice that may be thin).
- Reduce allowable loads for: snow ice, slush ice, river ice, salt water ice, presence of wet cracks and some dry cracks, pressure ridges, etc. Extreme temperature changes affect ice strength.

- Be trained in the following procedures: self-rescue, rescue of a crew member who has fallen through ice, treatment for cold water immersion hypothermia, and the safe use of ice thickness measuring equipment (chisels, ice augers).
- In addition to regular PPE, wear a floater suit or lifejacket over snowmobile suit during initial crossings and ice thickness testing procedures.
- Carry a written emergency response plan and a radio or satellite phone. Maintain frequent contact with a supervisor.
- Maintain up-to-date records of ice thickness. Test ice at regular distances and time intervals and whenever ice or temperature conditions change.
- Restrict travel to established safe routes. Mark routes every 15m with pickets or branches, etc.
- For comprehensive information regarding working safely on ice, refer to:
  - *Best Practices for Building and Working Safely on Ice Covers in Alberta* [http://employment.alberta.ca/documents/WHS/WHS-PUB\\_sho10.pdf](http://employment.alberta.ca/documents/WHS/WHS-PUB_sho10.pdf)
  - Section 15.10 Working on Ice in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.
  - There are numerous YOUTUBE videos of ice rescue methods.

## Testing Ice Thickness on Foot

**Work in pairs or crew of three – never alone.** Wear PPE and carry safety equipment. Keep bindings on skis or snowshoes loose enough to remove quickly.

- Lead tester should wear a full body harness and an attached safety line over a floater suit.
- Second crew member should hold the safety line taut, stay on shore until first hole is safely drilled, follow in the path of the lead tester where ice is proven safe, and maintain regular contact with the supervisor if no third crew member is present.
- Third crew member should remain on shore to monitor and call for help if needed.

## Testing Ice Using a Snowmobile

- **Never attempt ice crossings during freeze-up and breakup.**
- Test ice thickness on foot before initial crossing and when there is *any* doubt about the thickness and/or load the ice must bear.
- Use two machines spaced 150m apart for initial crossings and trail breaking.
- **PPE:** Riders should wear flotation suits or lifejackets.
- Each machine should carry an axe, a buoyant throw rope, and a hypothermia kit (see section 5.1.1 Field Equipment).

**FIGURE J. Safe ice thickness for moving light loads on clear blue ice**

Safe ice thickness for moving light loads on clear blue ice (Measurements do not apply to stationary loads)		
Minimum Ice Thickness (centimetres)	Minimum Ice Thickness (inches)	Minimum Load (clear blue ice)
10cm	4 inches	One Person on foot, total load less than 120 kg
18cm	7 inches	Snowmobiles: One rider, single file, well-spaced, total load less than 500 kg
38cm	15 inches	$\frac{3}{4}$ ton 4x4 vehicle, total load less than 5,000 kg
<b>Reduce load by at least 15% for clear blue river ice</b> <b>Reduce load by at least 50% for slush ice</b>		

Source: Best Practices for Building and Working Safely on Ice Covers in Alberta  
[http://employment.alberta.ca/documents/WHS/WHS-PUB\\_sho10.pdf](http://employment.alberta.ca/documents/WHS/WHS-PUB_sho10.pdf)

### 7.4.2 Ice Rescue

Rescue a victim as safely and as quickly as possible. **Rescuers must not endanger themselves or bystanders.** Treat a victim for cold water immersion hypothermia. The self-rescue information below is abridged from *Hypothermia, Frostbite and other Cold Injuries: Prevention, Survival, Rescue, and Treatment*© 2006.

Source: Text quoted with permission from *Hypothermia, Frostbite and Other Cold Injuries* by Gordon G. Giesbrecht, Ph.D. and James Wilkerson, M.D., published by Mountaineers Books, Seattle.

#### **Self-rescue: “One Minute – Ten Minutes – One Hour”**

This slogan helps you remember the average time available for self-rescue if you break through ice. If you fall in cold water – don’t panic and remember you have: **one** minute to get your breathing under control, **ten** minutes of meaningful movement, and **one** hour until you become unconscious due to hypothermia.

**One Minute:** Control your breathing. Try to take slow deep breaths.

**Ten Minutes:** Try to get out of ice water as quickly as possible. Do essential work:

1. Move to the edge of the ice that last supported you.
2. Remove snowshoes and skis before hands become numb.
3. Extend arms onto ice; kick your legs (this will bring your body horizontal near the water surface) to get your upper body onto the ice.
4. Kick vigorously and pull yourself along the surface of the ice and roll to firm ice.

**One Hour:** If you cannot get out within 15 minutes:

1. Stop struggling and preserve your energy.
2. Extend arms and body onto ice. Remain still so you freeze to the ice.
3. Even if you become incapacitated and unconscious, you will not drown.
4. This will increase your survival time and opportunity to be found and rescued.

**After rescue: The victim needs to combat cold water immersion hypothermia.**

- Summon help, if possible, and find or create shelter. Once the victim is in a sheltered area, change the victim into dry clothing, if possible.
- Remove clothing one item at a time, wring out, and put it back on.
- Build a fire. Concentrate on warming the victim's trunk area without burning the victim. The victim should eat/drink available food/liquids, especially if they are calorie rich.
- Treat the victim for hypothermia and shock. Use a hypothermic wrap. See sections 3.1 General First Aid Treatment, 3.3 Field Treatment for Mild Hypothermia and Frostbite, and 7.6.1 Cold Water Immersion.

## 7.5 Aircraft

Aircraft crashes and incidents, particularly involving helicopters, account for more exploration-related fatalities than any other cause. About 75% of aircraft incidents are due to pilot error and 20% to equipment malfunction. For details on chartering aircraft refer to Section 16.3 Aircraft Charters in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.

**Significant risks and hazards:**

- Crashes caused by pilot error, adverse weather, overloading, inadequate maintenance
- Incidents related to pilot fatigue brought on by difficult working conditions, client pressures
- Crashes in water resulting in drowning (inability to escape from a submerged or overturned aircraft)

- Serious injury or death from accidental contact with moving parts (e.g. rotor blades or propellers)
- Stranding caused by crashes, adverse weather, mechanical and/or communication breakdown.

**To reduce the risk of aircraft related incidents and potential fatalities:**

1. Do not accept unsafe practices by pilots or pressure pilots toward unsafe practices. Learn to recognize pilot fatigue.
2. You should be thoroughly trained to work safely in and around aircraft. Aircraft safety procedures should be reviewed at the initial safety induction meeting at camps using air support. The pilot should provide a full safety briefing at the aircraft. Aircraft safety briefings should be repeated at least monthly, when a new pilot is hired, when a new aircraft is chartered, and when new field personnel come on-site.
3. Have periodic refresher training, especially after any incident, and for those who use charter aircraft on a casual basis.

**Note: Anyone has the right to refuse to fly if they feel the situation is unsafe or they need more training to do a job safely.**

### 7.5.1 Aircraft Operations

All operations involving aircraft should have written procedures that address work in and around aircraft. Some terrain and special operations require specific procedures, e.g. mountains, glaciers, jungles, and slinging and hovering manoeuvres. Ask your supervisor about your company's formal procedures for working with aircraft. There should also be written Emergency Response Procedures for overdue or missing aircraft.

#### Pilot Responsibilities

Pilots are required to instruct personnel regarding safety practices around aircraft, while on board and in emergency situations. This is a regulation in most countries (e.g. Transport Canada).

- The pilot is in charge of the aircraft. It is the pilot's responsibility to:
  1. File written flight plans.
  2. Adhere to check-in schedules.
  3. Hold general passenger briefings that include safe approach and departure routes, aircraft danger zones, seat belts, doors, cargo/cabin baggage, safety equipment location, communication with pilot, emergency procedures.
  4. Hold special briefings for slinging operations, hover and toe-in operations,

and where any special hazards are present (e.g. power lines, mountains, glaciers, or small landing pads).

- The pilot/co-pilot must supervise the boarding and disembarking of passengers. The pilot should direct passengers to exit the aircraft during refuelling operations.
- The pilot/co-pilot is in charge of loading procedures and must know the content and weight of cargo and comply with dangerous goods regulations.
- Transport passengers only in anchored seats with seat belts fastened.
- **Required safety and survival equipment on aircraft** should include a survival kit, axe, first aid kit, fire extinguisher, and the Emergency Locator Transmitter (ELT). Float planes are required to carry one life jacket per person on board.
- The pilot should inspect the landing area to detect any steep slope or other potential problems.

### **Passenger Responsibilities**

- Obey the pilot at all times and do nothing to jeopardize the safety of a flight. Comply with and do not pressure pilots to exceed allowable flight and duty limits. Plan flights during daylight hours to begin no earlier than 45 minutes after sunrise and terminate 45 minutes before sunset.
- Follow the pilot's safety briefing instructions.
- Never exit/walk towards the aircraft propeller or helicopter tail rotor.
- **PPE:** Passengers should wear hearing protection. Wear headsets as necessary for communication with the pilot; otherwise wear disposable earplugs.
- Notify the pilot of any hazard observed prior to or during the flight – do not assume the pilot has seen it.
- On the ground, stand well back in sight of the pilot during landing or docking procedures.
- Maintain vigilant, safe behaviour, and refrain from horseplay in and around aircraft. Never ride on the skids or a sling line of a helicopter.
- Wear clothing appropriate for the climate and terrain in case you have to survive an emergency stranding.
- In the event of a crash or stranding **stay in the vicinity of the aircraft.** Follow the pilot's instructions.

### **Aircraft Loads**

Never overload any aircraft. Make another trip.

- Know the weight of all cargo, samples, personnel (plus hand-carried items). A scale should be available at remote airstrips to weigh packs, samples, equipment, and personnel as required.

- Inform the pilot about all dangerous goods cargo. Before stowing a gun, show the pilot that the chamber and magazine are empty.
- Before loading a float plane, make sure the dock is firmly secured to the shore and the plane is firmly secured to the dock.
- When loading or unloading fuel drums, roll them on secured planks with ropes around them for control.
- When ferrying crews, distribute food, equipment, and survival kits between flights to reduce the risk of any group being stranded without food, water, and shelter.

### Remote Landing Sites

Pilots should verify a landing strip is long enough and in adequate condition. Ground personnel should inspect infrequently used airstrips for obstructions and wild animals before flight arrivals and departures. Designate parking areas well back from all landing sites.

**Smoking and open fires:** No smoking within 15m of fuelling areas. Locate open fires at least 100m away to prevent blowing embers that could start a brush fire.

**In snowy conditions or on frozen lakes:** Use evergreen trees to mark a runway and provide a horizon reference in flat light or near whiteout conditions.

**On ice:** Check for other traffic, snow and ice conditions, wind direction and strength, cracks, obstacles, pressure ridges, wildlife, and trees.

### 7.5.2 Fixed Wing Aircraft

**Propellers are invisible when engines are running.** The location of danger zones varies depending on the type of aircraft. Do not touch hot cowlings or the rudder, elevators, ailerons, or connecting wires on the aircraft.

#### Float Planes

Additional safety guidelines apply to float planes.

- **Danger zone:** Propellers extend across the front of the floats (see Figure K below). Always watch out for the propeller overhang on twin engine aircraft at a dock.
- The pilot should brief at least one passenger to familiarize them with float plane mooring procedures. Only trained people should assist to tie up a float plane. Use a strut for initial tie-up. Wait until the engine is fully stopped before securing the front of a float.
- **Remote landings:** Before landing, the pilot should verify the float plane will be able to take off again, as takeoff requirements change with load, elevation,

wind conditions, etc. Overfly the landing and takeoff areas to check for floating obstacles, submerged or semi-submerged logs or rocks, wind direction and strength, trees, structures (e.g. buildings), wires that may connect islands and the mainland, and other traffic.

- In a crash, float planes tend to come to rest upside down, so situational awareness is very important. See section 7.5.4 Aircraft Emergencies.

**FIGURE K:**



Danger zone on float planes

### 7.5.3 Helicopters

If helicopters are used for field work, the safety induction briefing by pilots is especially important. Make sure site visitors are briefed as well. Significant risks and hazards specific to helicopters include impact by rotors, flying objects due to rotor downwash, and damage caused by improperly carried equipment.

#### Safe Operating Procedures for Helicopters

- **Briefings:** The pilot is responsible for the safety of the flight. Briefings should cover: approach and exit routines, safe loading and unloading cargo, use of communication equipment and hand signals, survival, and search routines. Hold special briefings and practices before carrying out hover and toe-in landings or pickups.
- **Never approach or exit without the pilot's direct permission.** Wait until visibility is clear or until the helicopter has shut down before approaching.
- **Approach a helicopter by moving toward the front or side and in full view of the pilot.** Make eye contact with the pilot. Always approach or exit in a crouching position (see Figure L below).
- **Never walk in the direction of the tail rotor.**

FIGURE L:



Approach from the front or side – eye contact with the pilot – crouch – hold on to your hat.

- **Do not approach or exit when the rotors are moving slowly.** Rotors dip as the engine slows or idles, especially when it is windy. Clearance is greatly reduced when the ground is uneven or hummocky. If the helicopter is on a slope, crouch very low and use the downhill side to approach or exit.
- When exiting (and the helicopter will take off immediately), refasten the seat belt behind you, step down smoothly and close the door carefully. Move at least 10m away with your gear to a place where the pilot can see you. Crouch down and remain until the helicopter has gone. Establish a signal protocol with the pilot to indicate that everyone is clear during unloading and prior to takeoff.
- Do not distract the pilot or upset the helicopter balance with sudden or unpredictable movements during takeoff, landing or other manoeuvres.
- Never throw anything out of the helicopter.
- Be able to find and open the exits (situational awareness). In a crash, helicopters may come to rest upside down, especially in water. See section 7.5.4 Aircraft Emergencies.
- Stand back at least 15m during arrival or departure, preferably upwind and in view of the pilot. Protect your eyes. Remember that helicopters can move in any direction, including backwards.
- When directing a helicopter while on the ground, stand with your back to the wind, arms outstretched in the direction of the landing pad (see Figure N for additional hand signals).
- Due to rotor downwash, weigh down loose materials at or near the landing site (e.g. plywood, styrofoam, tarps), and any loose items in the back of pickup trucks. Put away personal gear (hats, maps, hammers) before the helicopter arrives.
- For temporary landing sites construction, field crews must know the required dimensions and carry an axe to clear vegetation.

- **Loads:** Use extra caution. Plan who will do each job, remain calm, and do not rush.
  - Load and unload with the engine shut down whenever possible. Loading is dangerous when helicopters are under power.
  - Carry long items (poles, guns, tools) horizontally and low to avoid contact with rotor blades.
  - Stow field gear, samples, and packs carefully in the cargo compartment and make sure the cargo door is firmly latched. Plan for the increased load at the end of the day due to sample weight.
  - Restrain all cabin baggage. Make sure no loose items can interfere with controls.

### FIGURE M:

Don't smoke in or around the helicopter

Don't touch the bubble (it's only plastic), or any moving parts

Ensure your seat belt is inside before closing the door



Don't slam the doors but close them gently and don't let them swing in the wind

Additional helicopter safety

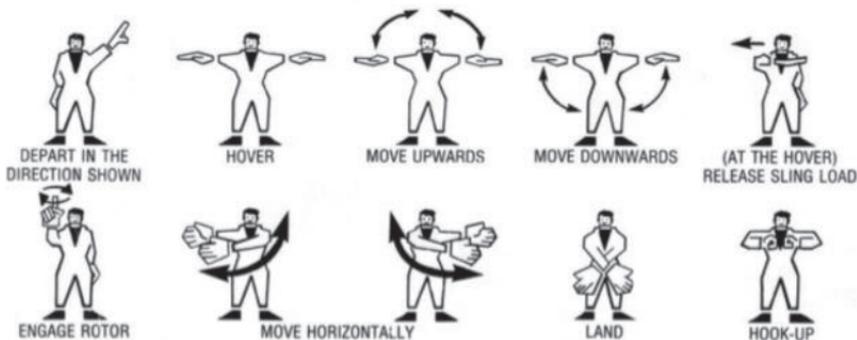
**Tracking and communication:** Base camps should keep track of flight plans and schedules. It is recommended that, at all times, one person in camp, the pilot, and any other persons travelling separately should be familiar with flight plans and schedules. Certain work situations may require that each person post their work location on a map before departure. Ground-to-air radio communication between a pilot and field crews is absolutely necessary to facilitate locating a field crew and to carry out safer slinging operations. See section 5.1.4 Field Communications and Routines.

**Survival and Search and Rescue:** Field personnel should be trained to know relevant survival techniques, standard search and rescue procedures, and how to aid in the search if they become lost. Carry the most essential survival equipment

in your pockets, in case you lose your day pack. See sections 4. Survival and 5.1.1 Field Equipment.

- Fluorescent orange helicopter cloth and a signal mirror should attract a pilot's attention if radio communication fails. Use the cloth to indicate wind direction, but stow it well before landing.
- In remote areas, the field supervisor should make sure all employees and contractors (alone or in crews) that work away from the base camp beyond a specific distance (5 km recommended – depending on terrain, climate) have a survival cache containing appropriate equipment as listed in section 5.1.1 Field Equipment. Usually, this bag should be left at the pickup point, but on particularly difficult traverses, it may be set out midway on the traverse. The bag should be highly visible, waterproof, sealed, able to float for a while, and easy to handle. Inspect the bag regularly and use the survival bag only for survival purposes.

**FIGURE N:** *Always confirm hand signals with your pilot.*



“Marshalling Signals – Helicopters” TP 9528

Source: Transport Canada

### 7.5.4 Aircraft Emergencies

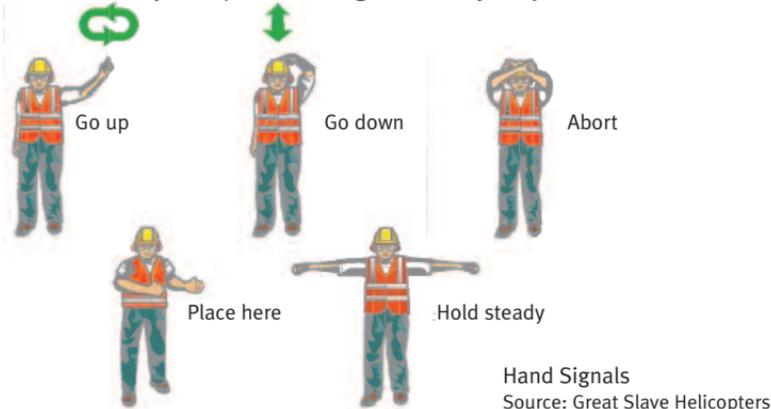
**Follow the pilot's instructions during an emergency situation.** Be familiar with procedures on the aircraft emergency information card; know the correct “brace” position to assume. All passengers should know how to set up and start the ELT (Emergency Locator Transmitter) in case it does not start transmitting automatically.

- **Land:** Do not attempt to leave the aircraft until the aircraft and its rotors or propellers stop moving. Exit safely but as quickly as possible and move to a safe position. Aircraft often catch fire within one minute of a crash.
- **Water:** Aircraft often settle upside down. It is essential to gain situational awareness immediately after boarding. Locate the exit relative to your right or left knee – it will be in the same place regardless whether the aircraft is right side up or upside down. Know the location of your life jacket, how to retrieve it, and how and when to put it on. Normally, you do not inflate it until outside or you may block the exit. Exit as quickly as possible.
- **Stay in the vicinity of the aircraft whenever possible** after a crash or when stranded.

### 7.5.5 Slinging Operations

Drill moves and airborne geophysics are skilled slinging operations for which pilots must have specialized training. Slinging is very stressful and pilot fatigue is the root cause of many incidents. To minimize the hazards and dangers, slinging should only be undertaken by appropriately trained personnel. Refer to section 16.12 Slinging in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.

**FIGURE 0: Always confirm hand signals with your pilot.**



## 7.6 Boats

Small boat operators should have training in safe boating techniques and follow the manufacturer's safe operating instructions. In Canada, federal law requires all boat operators to be licenced. Contract experienced, trained, and licensed pilots when using large boats. **Always wear a lifejacket or other personal flotation device** when working in open boats and be prepared for cold water immersion hypothermia and treatment. Seek local knowledge to minimize risks (e.g. difficult navigational hazards, extreme weather, ice, or tides). Operate boats at night only in familiar waters and with full navigation lights. Limit the speed and maintain control of the boat at all times.

**Significant risks and hazards:** Drowning, capsizing or sinking, rough waters, insufficient fuel, motor breakdown, fire, stranding, adverse weather, running aground.

### Boat Selection

Select the appropriate boat and motor for the specific body of water. Do not exceed the recommended ratings on the boat's specification plate for loads, occupants, and power. Avoid using canoes when possible. Rigid inflatable boats with keels are often the best choice for large bodies of water, coastal waters, and cold lakes. Inflatables require extra attention; inflate them properly and load them carefully. Select beaches that will not damage the hull (e.g., sandy beaches). Before storing, dry inflatable boats thoroughly; complete repairs according to the manufacturer's instructions.

### Required Equipment

Carry equipment required by regulatory authorities. For example, Transport Canada requires the equipment listed below on any power boat <6m in length (including canoes with outboard motors). This list is reproduced from the "*Safe Boating Guide*", TP 511 (01/2011). It is also available on the following Transport Canada website: <http://www.tc.gc.ca/eng/marinesafety/debs-obs-equipment-size-less6m-1791.htm>

**FIGURE P:**

<p><b>Personal Lifesaving Appliances</b></p> <ol style="list-style-type: none"><li>1. One (1) lifejacket or PFD for each person on board</li><li>2. One (1) buoyant heaving line at least 15m (49 ft 3 in) long</li><li>3. *One (1) reboarding device [ladder]</li></ol>
<p><b>Vessel Safety Equipment</b></p> <ol style="list-style-type: none"><li>4. One (1) manual propelling device [oars or paddle] OR One (1) anchor and at least 15m (49 ft 3 in) of cable, rope, or chain in any combination</li><li>5. One (1) bailer or manual bilge pump</li></ol>
<p><b>Visual Signals</b></p> <p>Only required if boat is equipped with a motor:</p> <ol style="list-style-type: none"><li>6. One (1) watertight flashlight OR Three (3) flares of Type A, B or C</li></ol>
<p><b>Navigation Equipment</b></p> <ol style="list-style-type: none"><li>7. One (1) sound-signalling device or appliance</li><li>8. **Navigation lights</li><li>9. *** One (1) magnetic compass</li><li>10. One (1) radar reflector (See Note 3,) [below]</li></ol>
<p><b>Fire-fighting Equipment</b></p> <ol style="list-style-type: none"><li>11. One (1) Class 5-BC fire extinguisher, if equipped with an inboard engine, a fixed fuel tank of any size, or a fuel-burning cooking, heating or refrigerating appliance.</li></ol>
<p>* Only required if the vertical height that must be climbed to reboard the boat from the water is over 0.5m (1'8").</p> <p>** Only required if the boat is operated after sunset, before sunrise or in periods of restricted visibility (fog, falling snow, etc.).</p> <p>*** Not required if the boat is 8m (26'3") or less and operated within sight of navigation marks.</p> <p><b>Note 3 — Radar Reflectors</b></p> <p>Radar reflectors are required for boats under 20m (65'7") and boats that are built of mostly non-metallic materials. A radar reflector is not required if:</p> <ul style="list-style-type: none"><li>• the boat operates in limited traffic conditions, daylight, and favourable environmental conditions, and where having a radar reflector is not essential to the boat's safety, or</li><li>• The small size of the boat or its operation away from radar navigation makes having a radar reflector impractical.</li></ul>

"Safe Boating Guide", TP 511 (01/2011)

Source: Transport Canada website: [http://www.tc.gc.ca/eng/marinesafety/tp-tp511-equipment-1140.htm#minimum\\_safety\\_equipment\\_requirements](http://www.tc.gc.ca/eng/marinesafety/tp-tp511-equipment-1140.htm#minimum_safety_equipment_requirements)

In places where there are no regulations, minimal emergency equipment would include a lifejacket for each person, a buoyant line with float and handle, and paddles or oars for manually propelling a boat with a motor. Other equipment may be required depending on conditions and location.

### **Additional Equipment**

Take into account the boat size, location, time of year, length of trip, weather, and crew size.

#### **Essential Items:**

- First aid kit
- Communications equipment (radio, satellite phone)
- Navigation equipment (compass, GPS unit and extra batteries, up-to-date charts)
- Emergency Position Indicating Radio Beacon (EPIRB) (depending on location)
- Survival kit
- Tool kit (appropriate for boat and motor)
- Water/Food
- Ditch bag (waterproof) containing survival and communication equipment. It should float and have a line and clip to permit quick removal from the boat and reattachment to a lifejacket.

#### **Items for Consideration:**

- Additional fire extinguisher
- Sea anchor
- Axe or bow saw
- Extra clothing

### **Fuelling Procedures for Boats and Motors**

Strictly follow safe fuelling procedures. Boats should be on shore or docked.

- Shut off the motor.
- No smoking or open flames permitted. Keep a fire extinguisher nearby.
- No passengers are permitted on board while fuelling.
- Do not overfill the tank. Clean up any spills and dispose of the contaminants correctly.
- Ventilate the bilges and/or engine compartment before starting the motor.

## Preparation and Prevention

- **Training:** Employees should be:
  1. Trained in safe boat handling and navigation skills
  2. Trained to carry out minor motor repairs
  3. Competent swimmers
  4. Familiar with water survival tactics
  5. Familiar with local boating regulations and safety guides (e.g. in Canada, the *Safe Boating Guide* and the *Small Commercial Vessel Safety Guide*).
- **Wear** a government-approved lifejacket or other personal flotation device (PFD) suitable for your body size and weight at all times when working in open boats.
- **Weather:** Plan ahead and obtain current weather forecasts. Do not boat in inclement weather, including fog. Get off water when storms threaten. In rough weather, head into waves at a 45° angle.
- **Before departure:**
  - Check hull for damage or leaks.
  - Perform maintenance according to the manufacturer’s operator manual. Check that the motor is securely mounted and the safety cable is joined to the linchpin. Backup motors should use the same hose linkage. Use an automatic shut-off device.
  - File daily trip plan with the appropriate person. Include: date, time and point of departure, date and estimated time of arrival/destination, names and number of persons on board, proposed route including all known stopping points.
  - On board: Check that all required and appropriate recommended equipment, emergency supplies, sufficient fuel, and required documentation, e.g. registration, licenses, PCOC (Pleasure Craft Operators Card) are present.
  - Fuel: Check the fuel level and start with a full tank. Monitor fuel en route and keep more than half for the return trip. Carry extra fuel in certified containers.
  - Loads: Keep loads centred and low; stow to prevent shifting. Place heavy items on the bottom and light items on top. Cover cargo with tarps and secure. Do not overload – consider the weather and waves and leave sufficient freeboard. Distribute cargo between boats, so that the loss of one boat does not leave the entire group at risk. Keep essentials in your pockets.

## Boat Operations for Various Waters

- **Shallow water:** Watch out for weeds and protruding or semi-submerged rocks, logs, and shoals. Travel through narrows or a tidal bore at slack tides.
- **Open water, coastlines, and ocean shores:** Carry a GPS to aid navigation. Use current tide tables and charts. Avoid camping on islands subject to high tides, as they may become submerged.
- **Lakes:** Stay as close to shore as possible. Watch for squalls and shoreline effect (unexpected winds and waves). Cross large lakes when winds and weather conditions are most stable (early in day or evening). Don't cross lakes during high winds or when a thunderstorm threatens.
- **Rivers:** Use sequenced aerial photos to predict hazards (e.g. rapids, waterfalls, fallen trees, or logjams) and use them to track your progress. Whenever possible, fly over a traverse route along rivers to check out hazards. Scout rapids from shore. Portage boats and supplies or "line" the boats through rapids from shore. Watch out for strong currents near shore.
- **Ice:** Make sure the wind is low before departure. Watch out for winds and currents that could cause ice to block your return.

### 7.6.1 Cold Water Immersion

Falling into cold water (<20°C) is an urgent and potentially life-threatening incident. A body loses heat 25 times faster in cold water than when exposed to cold air of the same temperature. There are four stages of cold water immersion: (1) cold shock; (2) cold incapacitation; (3) hypothermia; and (4) circumrescue collapse (refer to *Hypothermia, Frostbite and other Cold Injuries, Prevention, Survival, Rescue, and Treatment* by Gordon G. Giesbrecht, Ph.D. and James A. Wilkerson, M.D. Published by Mountaineers Books ©2006.) Drowning or death may occur at any stage, while genuine hypothermia will not begin for about 30 minutes. Try to remove victims from water in the horizontal position and handle them as gently as possible. Treat victims of cold water immersion as hypothermia or shock victims. See sections 3.1 General First Aid Treatment and 3.3 Field Treatment for Mild Hypothermia and Frostbite.

#### If the boat capsizes or you fall into cold water:

- **Don't panic:** Keep your head above water. Try not to swallow water while gasping for air. Regain control of breathing. "Cold shock" may last one to two minutes.
- **Do necessary jobs that require your hands:** Retrieve whistle and flare gun and use them after righting the boat. Cold incapacitation usually causes hands to become numb within 2 to 5 minutes.

- **Stay with the boat:** Climb into it (even if it is full of water) or onto it (if it is upside down) and paddle or drift to shore.
- **Don't swim to shore:** If you remain in water, do not swim or tread water. Remain still. "Swim failure" results from cold incapacitation and you can only swim one-tenth to one-fourth of your normal ability. Assume the HELP position (see chart below).
- **Once on shore, build a fire immediately:** Warm your hands (without burning them) and then concentrate on warming your trunk area. Put on dry clothing. If none is available, remove clothing one item at a time, wring out and put it back on. Eat/drink available food/liquids, especially if they are calorie rich.

<b>Heat Escape Lessening Posture (HELP)</b>	
<b>If alone</b>	<b>If in a group</b>
<ol style="list-style-type: none"> <li>1. Hold arms tightly against your chest.</li> <li>2. Squeeze legs together.</li> <li>3. Draw your knees up close to your chest.</li> <li>4. Stay still. Do not expend energy by moving.</li> </ol>	<ol style="list-style-type: none"> <li>1. Huddle together to minimize heat loss.</li> <li>2. Form a circle facing inward with chests close together.</li> <li>3. Place your arms around the back of the next person (right arm up, left arm down).</li> </ol>

## 8. Field Camp



## 8. Field Camp

Main camps and fly camps are both generally best located in dry, sunny, well-drained sites, free of hazards (e.g. potential flooding, insects, dangerous trees), yet near a fresh water supply. Arrange camp to minimize the spread of fire. Keep camps as clean as possible through careful attention to sanitation. Plan a safe means of access. If helicopter support is planned, obtain expert advice regarding the placement and required space (in relation to the camp) before constructing the landing pad.

**Significant risks:** Fire, carbon monoxide poisoning, diseases.

### 8.1 Employee Health

- Have a general medical check-up and a dental check-up before working in a remote area. Immunizations should be up-to-date for diseases employees may be exposed to while working in the field, including foreign locations.
- Employees should complete a medical information sheet with current and past medical information, including allergies, and file with a contact person in case this is needed in an emergency. Supervisors and first aid workers must keep health form information in strict confidence and can only disclose personal health information with the employee's permission or as required by law. However, **if an employee has a special medical condition or allergy, they should teach co-workers to recognize symptoms of an impending attack.** Teach others to administer medication (e.g. insulin, epinephrine) because they may be unable to self-administer the medication. People who require such a medication should keep it with them at all times.
- Frequent handwashing and bathing reduces the likelihood of contracting contagious diseases.
- Use sunscreen with an SPF of at least 30. Apply frequently and rub it in thoroughly. When using insect repellent, apply the sunscreen first followed by the repellent, preferably 30 minutes later.

#### **Camp Heaters and Carbon Monoxide (CO) Poisoning**

Toxic carbon monoxide levels build up very quickly, especially in confined or semi-confined spaces. **NEVER** use any heat source inside a tent without excellent cross-ventilation. Open vents at the top are not sufficient. Small heat sources in small tents or cabins are a deadly combination. Start vehicles outdoors or in well-ventilated areas, especially in cold temperatures when engines produce more carbon monoxide.

## Malaria

You risk exposure to malaria wherever there are infected *Anopheles* mosquitoes. Prior to travel, check with a travel medicine clinic for up-to-date information about risks at the destination and appropriate prophylactic medication. **Do not buy anti-malarial medications in developing countries** as they may be counterfeit; you cannot tell the difference between real and fake drugs by their appearance and packaging.

### Take active measures to avoid mosquito bites:

Locate camps in dry open areas away from mosquito breeding places. Follow the preventive measures. Remove and empty objects that may hold standing water and keep camp structures well-screened.

### Personnel should:

1. Avoid exposure to mosquitoes. Remain in well-screened areas from dusk until dawn.
2. Wear appropriate clothing that covers your body (long pants, long sleeves, socks, shoes).
3. Use appropriate insect repellents containing DEET on skin. Use repellent or insecticides on clothing. Spray quarters before bed and sleep under treated bed nets.
4. Take the correct prophylactic medication as directed. Take a full supply of drugs, including enough to cover treatment in an emergency. Complete the full course of medication – even for short trips.

**Symptoms of malaria:** Malaria can be treated effectively in its early stages, but a delay can have serious or even fatal consequences. Severe illness with unrelenting headache, mental confusion, fever, and prostration calls for immediate evacuation to a treatment facility. With *P. falciparum* malaria, a cerebral infection can be fatal. Malaria may progress very rapidly from the onset to death from severe complications – this can take only 36 to 48 hours in some cases. Seek urgent medical attention for the following symptoms:

- Sudden high fever (continuous or episodic) accompanied by sweating and chills
- Headache, diarrhea, fatigue and muscle aches
- Loss of appetite, nausea, vomiting.

**Diagnosis of malaria:** Symptoms of malaria can begin as soon as one week after exposure, or take many weeks or even months to become evident. Should you become ill after you return home – even if up to three months later – inform your doctor of your previous travel and request tests for malaria.

## 8.2 Fire Prevention

**Fire is a significant risk in a camp.** The abrupt loss of a camp may result in an immediate and serious survival situation, especially in cold weather. Remote camps should have a designated tent away from the camp with sufficient first aid, food, water, and survival equipment for everyone to survive for at least two days.

- Comply with or exceed the jurisdictional firefighting equipment requirements. Keep appropriate fire extinguishers and smoke and carbon monoxide detectors in strategic locations in tents and permanent structures. Keep a sand-filled bucket at the entrance of each structure.
- Camps should have a trained fire response team. Periodically hold practice fire drills so everyone in camp is familiar with their responsibilities.
- Set up a central firefighting cache and use the equipment only for firefighting. Equipment should be regularly inspected and maintained. This may include checking the weight and/or pressure gauge of each extinguisher.
- Develop an emergency response and evacuation plan (and alternate plans if necessary). Post the plans in common areas and make sure all people on-site, including visitors, are familiar with them and know the muster station in case of fire.
- Consider the prevailing wind direction and arrange tents at least 15m apart to reduce the spread of fire.
- Establish a smoking policy. Do not permit smoking in or near aircraft and helicopter landing areas, all fuelling areas, storage areas for fuels, chemicals, and flammable materials, or any designated “No Smoking” area. Smoking should be discouraged in sleeping tents and trailers or caravans. Permit smoking only in areas declared safe.
- Allocate vehicle parking so there are two exit routes, if possible. Vehicle exhaust systems should not come in contact with dry, flammable materials. Check for build-up of grasses, seedpods, twigs, and other organic debris under the vehicle chassis and sump guard. Clean out these areas regularly.
- Construct firebreaks around camps where applicable, e.g. grasslands, dry seasons in Africa or Australia. Firebreaks should be at least 5m to 10m wide.
- Tents: Do not hang clothing to dry within 1m of or over a heating stove. Do not hang items from electrical cords. Light lanterns outside a tent and bring them inside only when burning properly. Use caution when burning mosquito coils. Place them in a metal container when lit and be sure to extinguish them before you leave camp.

- Clear brush and grasses from around portable generators, water pumps, compressors or any small motors. Make sure proper safeguards remain in place around induced polarization motor generators and transmitters, as this equipment is a significant fire hazard.

### Fire Extinguishers

- The classification of fires by type of fuel is internationally recognized (see Figure Q below). Depending on the country, fire extinguishers carry letter symbols (A, B, C) and/or specific colours to indicate the class of fire they are designed to extinguish. The background colours, shapes, and/or picture symbols on fire extinguishers are variable and not internationally recognized. Many fire extinguishers are multi-purpose and carry two or more symbols. For example, a 5BC extinguisher is for extinguishing Class B and C fires. The “5” indicates roughly how many square feet of fire can be extinguished.
- Numerical ratings indicate the relative effectiveness of the fire extinguisher – the higher the number, the greater the firefighting capacity. For camps, a “2A 10BC” is the minimum acceptable size of multi-purpose fire extinguisher; it is adequate for vehicles. Higher-rated fire extinguishers are required for many locations (e.g. kitchen, drill shack). Handheld extinguishers are sometimes referred to by weight (e.g. 9kg or 20-pound).

**FIGURE Q**

Class of fire	Fire extinguisher to use	DO NOT USE
CLASS A Ordinary combustibles	Pressurized water Foam Multipurpose dry chemical	Carbon dioxide (CO <sub>2</sub> ) Ordinary dry chemical
CLASS B Flammable liquids	Foam Carbon dioxide (CO <sub>2</sub> ) Ordinary dry chemical Multipurpose dry chemical	Pressurized water
CLASS C Electrical equipment	Carbon dioxide (CO <sub>2</sub> ) Ordinary dry chemical Multi-purpose dry chemical	Pressurized water Foam

Classification of fires and the appropriate fire extinguishers to use

## 8.3 Firearms

In certain areas, firearms may be required for the safety and protection of employees in camps or on traverses. It is advisable to hire trained bear guards or trained security guards to provide this armed protection. Firearms should not be permitted in any camps unless written permission is given by a company manager. **It is the manager's responsibility to ensure that employees adhere to government firearms regulations.** Refer to section 18.2.2 Firearms Regulations and Policies in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.

## 9. Personal Protective Equipment (PPE) and Hand Tools



## 9. Personal Protective Equipment (PPE) and Hand Tools

Recognition and elimination are the most effective methods of controlling risks and hazards. As mineral exploration is done outdoors, physical hazards can rarely be removed, although some hazardous situations can be mitigated. Use PPE to reduce exposure to hazards when other controls are not possible or practical.

### 9.1 General Recommendations for Personal Protective Equipment (PPE)

Where working conditions expose an employee to risk of injury, PPE should be used in compliance with Occupational Health and Safety (OHS) legislation and the company's safe operating procedures. Some work may require specific PPE for particular risks (e.g. uranium or asbestiform mineralization) or when working in mountainous terrain or on glaciers. Know which PPE is supplied by the company and which PPE you must provide yourself.

- Use all required PPE and follow company procedures and training regarding the use of PPE and protective clothing. Use PPE that conforms to national and international standards, e.g. Canadian Standards Association (CSA) or American National Standards Institute (ANSI). Use the correct PPE for the job. Know how to wear and adjust PPE so it functions correctly. Inspect PPE daily, maintain it, and replace it when damaged or worn out.
- Consider the size, fit, weight, and comfort of PPE. PPE must be compatible, e.g. safety glasses should not interfere with earmuffs.

FIGURE R. Recommended Personal Protective Equipment (PPE)

Type of Work or Transportation	Safety Glasses	Gloves	Good Hiking Boots	Steel-toed Boots	Helmet or Hard Hat	Hearing Protection	Dust Protection	Life Jacket (Personal Flotation Device) (PFD)	Sun/UV Protection
Field Work	X <sup>1</sup>	X	X						X
Rock Sampling and Core Splitting	X	X	X			X <sup>3</sup>			X
Soil Sampling		X	X						X
Stream Sampling			X					X <sup>2</sup>	X
Chainsaws	X	X		X	X	X			X
Slinging Operations	X	X	X		X	X			X
Old Underground Workings	X	X		X	X		X		
Trenching	X			X					X
ATVs	X <sup>4</sup>	X	X		X				X
Snowmobiles	X <sup>4</sup>	X	X		X				X
Boats	X <sup>4</sup>							X	X
Aircraft						X			

<sup>1</sup> Depending on type of work, terrain, vegetation

<sup>2</sup> Depending on shoreline slope, water depth, or if sampling from a boat

<sup>3</sup> Hearing protection required if sawing core

<sup>4</sup> Appropriate eye protection such as face shield, goggles, sunglasses, etc according to light conditions.

## 9.2 Hand Tools

**Significant risks:** Eye injuries, cuts, impact injuries.

### Preparation and Prevention

- **Be familiar with the manufacturer's operator manual** and refer to it for safe operating procedures when using a tool the first time.
- **Pre-job tool check:** Before use each day, check that tools are in good condition, e.g. the head of the axe or hammer is securely attached to the handle; use tools that are sharp and free of damage, dirt, and grease.
- **PPE:** When using most hand tools, wear safety glasses and good fitting gloves for a firm grip.
- **Rock hammers and chisels:** Eye protection is important when breaking rocks and splitting core. Do not use another hammer in place of a chisel. Use the largest chisel suitable for the job and wear a hand guard.
- **Axes:** Only use axes that are in good condition, properly sharpened, and properly fitted with good handles. To sharpen an axe blade, wear leather gloves and use an axe file or sharpening stone.
- **Swedish brush hooks:** Swedish brush hooks are safer to use than an axe for clearing underbrush, especially hardwood branches and stems up to 6cm to 7cm thick.
- **Knives:** The best knives have a steel shank extending to the butt end of the handle; they are less likely to break under stress.
- **Machetes (Pangas):** Use a wrist loop when using a machete. If working with a machete in steep terrain, try to carry it on the downhill side of your body so your uphill hand is free to stabilize yourself if you lose your footing.
- Keep others at a safe distance when using sharp tools. Make sure the swing area is clear and that shrubs and branches will not deflect the swing. Do not swing an axe or machete in the direction of others – even when they are out of range – in case you lose your grip.
- Transport sharp tools in an appropriate holster or sheath for protection in case you fall on them.

### 9.3 Power Tools, Chainsaws, and Other Motorized Tools

Specialized training is needed before operating electric or gas powered tools and equipment, such as chainsaws, rock saws, brush cutters, water pumps, and survey equipment – especially IP (induced polarization) equipment. Follow the inspection, maintenance, and safe operating routines specified in the manufacturer’s operator manuals. Appropriate PPE should be worn. Refer to sections 5.5 Power Tools and 5.6 Chainsaws in the Excellence in Health and Safety e-toolkit in *e3 Plus: A Framework for Responsible Exploration*.





PROSPECTORS &  
DEVELOPERS  
ASSOCIATION  
OF CANADA

Founded in 1932, the association represents the interests of the mineral exploration and development industry across Canada and abroad. Members benefit from advocacy, networking, program and information services provided by the association, its volunteers and staff.

[www.pdac.ca](http://www.pdac.ca)



**A Framework for  
Responsible Exploration**  
l'exploration minérale  
responsable

The Prospectors and Developers Association of Canada (PDAC) launched Phase I of *e3 Plus – A Framework for Responsible Exploration* in March 2009.

The acronym *e3* stands for excellence in exploration in three areas: social responsibility; environmental stewardship; and health and safety.

Prospectors and Developers Association of Canada

800-170 University Avenue

Toronto, Ontario, M5h 3B3

Telephone 416 362 1969

info@pdac.ca

<https://www.pdac.ca/priorities/responsible-exploration/health-and-safety>



PROSPECTORS &  
DEVELOPERS  
ASSOCIATION  
OF CANADA



A Framework for  
**Responsible Exploration**  
l'exploration minérale  
**responsable**