NOTES FOR
HYDROGRAPHERS

SAFETY
HANDBOOK

Written and Compiled by: Senior Hydrographic Staff of
Department of Mines and Energy
Water Resources Division

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September 1986

SAFMAN: TEC
FOREWORD

This hand book has been prepared as a ready reference and a source of vital information to assist hydrographic personnel to apply safe working practises on the job and to provide a knowledge on best remedial procedures to adopt in the event of a mishap.

The information in this hand book came from varied sources, each of which is a specialist in their field. We have included excerpts from these sources where we thought it was relevant. The hand book is just that, a hand book. The writers strongly recommended the reading of references referred to at the back of this hand book. The reference material is held in your regional offices in 2 volumes.
CARDIO-PULMONARY RESUSCITATION

DANGER
RESPONSE
CLEAR AIRWAY
HEAD TILT
JAW LIFT
CHECK BREATHING
NOSE OBSTRUCTED
DELIVER 5 QUICK BREATHS
CHECK PULSE -NECK (CAROTID)
LOCATE HEART
CORRECTLY PLACE HANDS
COMPRESS 5cm
COMPRESSION RATE 80/min.
COMPRESSION NUMBER 15
BREATHS 2
REPEAT CYCLE
RE-CHECK PULSE AFTER 1 min.

SAFMAN: TEC
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1. INTRODUCTION

The sound application of common sense to all work situations and activities will tend to ensure that safe practices are used.

The preservation of human life and the realistic minimisation of risk of injury to personnel and others must take precedence in all activities.

It is the responsibility of every individual to be thoroughly familiar with and to observe these safety instructions, and to act always in a manner as to ensure safety to himself, workmates and the general public.
2. GENERAL WATER SAFETY

Water safety awareness is crucial to all personnel required to work in or around water and even more so to persons whose occupation necessitates a large proportion of time working with water, as does hydrological survey work.

It is imperative to have a field party consisting of at least two personnel when doing hydrological activities.

All personnel must be able to swim, and need to be aware of potential hazards.

Suitable foot wear should be worn when working in or near water.

2.1 Potential Hazards

(a) Rapidly Rising Stage
(b) Fast Velocities
(c) Submerged Debris
(d) Eroding River Beds
(e) Tidal Bores

Aquatic Hazards

Crocodiles
Box Jellyfish
Snakes
Blue Bottle
Sharks
Stingrays
Stone fish
Leeches
reeds and weeds

I HATE SHOES!!

SAPMAN: TEC
3. DIVING

All diving carried out must be in accordance with the current Australian Standards Association (ASA) Number 2815.

Wetsuits should be worn during all dives for added buoyancy and insulation.

3.1 Snorkeling (most common for hydrological work)

No dive should be undertaken without the presence of at least one competent and fully equipped person on the surface.

All divers must carry a combination serrated/plain edge knife which should be securely fastened to the leg or thigh (not the waist belt).

No diver shall become reliant on fins (or flippers) or be unable to swim to safety without them.
4. SITE ACCESS AND RIVER BANK SAFETY

Particular care must be taken with hydrological sites to provide safe access for all conditions.

Tracks to recorder installations and staff gauges must be properly formed so that they are safe to use in wet conditions and darkness. Steps and handrails will often be necessary. Do not forget that heavy items may need to be carried.

Particularly in wet conditions, pay attention to possible local hazards such as falling rocks, slips, and unstable banks.

Carry a good torch when working at night to ensure safe passage along tracks.
5. GAUGING

All methods of gauging are potentially hazardous.

5.1 Wading Gaugings

A useful guide to remember when wading.

When the product of the depth and velocity is 1.0 or above conditions are unsafe.

5.1.1 Assess Situation

Before attempting a wading gauging the situation should be assessed and appropriate precautions should be taken for the following.

1. Depth
2. Velocity
3. Water Quality
4. Submerged objects
5. Rapidly rising stage
6. Floating debris

The appropriate safety equipment should then be selected to suit the conditions.
5.2 Gauging from Bridges

The main hazards in gauging from bridges are in being struck by passing traffic, or being tipped over the side of the bridge because of equipment being caught by floating or submerged debris.

5.2.1 Traffic Hazard

Whilst gauging from road bridges appropriate signs must be displayed in compliance with ASA 1743 Part 3. This is in the interest of the Public and Hydrographic personnel.

5.2.2 Debris

A continual watch must be kept upstream particularly when there is a possibility of the cable and instrument being snagged by floating or submerged debris.

Where there is even the remote possibility of debris floating or submerged being carried by the river the equipment must be fitted with a quick release system to provide maximum safety to personnel.

5.3 Traveller Gauging

Personnel must be aware of possible hazards when operating TRAVELLERS and associated equipment. Traveller Equipment consist of many moving parts which can prove hazardous to operators. i.e. cogs, pulleys and cables.

Prior to use personnel must ensure that all parts of the TRAVELLER are in good working order. i.e. Winches, anchorages and cables.

Whilst in operation personnel must be aware that TRAVELLER cables are under stress.

Also refer 5.4 Boat Gauging.

Loose clothing must not be worn when operating traveller winching equipment.
5.4 **Boat Gaugings**

Before attempting boat gaugings all equipment must be thoroughly checked to make sure it is safe to be used in the prevailing conditions.

Personnel must ensure that the cable is in good condition and the anchoring points at both ends are secure.

The boat must be serviceable and the correct size for the river conditions. The outboard motor must be the recommended size. The boat will carry the following equipment.

- (a) adequate buoyance
- (b) drain plug
- (c) oars and rowlocks
- (d) cable guides or similar
- (e) mooring rope and bailer
- (f) bolt cutters

Life jackets or buoyancy vests (ASA No 1512 and 1499) will be supplied and must be worn by all personnel.

Cables are a potential hazard and must be clearly marked when strung across rivers and flood plains.

Department of Civil Aviation (D.C.A.) must be advised of all high suspended cables.

Personnel must be aware that cables are potential conductors of electricity during electrical storms.

6. BOAT SAFETY

Life jackets or buoyancy vests must be worn by all personnel working from or travelling in boats. Life jackets or buoyancy vests must comply to ASA No 1512 and 1499 respectively.

Employees using boats must ensure that their boat is fully equipped with at least a mooring line, oars, bailer (tied to the boat) and a spare rope and paddle.

Equipment must be stowed safely and passengers seated properly; in the case of power boats going aground this will lessen the risk of injuries.

The boat operator is responsible for the safety of the boat and occupants, and he must take full charge of all matters related to this and also direct operations such as rigging taglines etc.

Boat operators must ensure that the craft is adequately maintained, and have adequate knowledge of how to cope with breakdowns and other potential problems.

Boats must be operated within their capabilities, and in particular must not be overloaded.

Boat operators must be familiar with emergency equipment and procedures. Training in these procedures should be undertaken at regular intervals.

All crew should be capable of swimming a reasonable distance in their working clothes. Depending on the hazards, all passengers should be questioned on their ability to swim and any who cannot should be discouraged from participating in the trip.

Buoyancy of craft must be checked at least annually, initially to determine its adequacy and thereafter to guard against deterioration.

6.1 Mishap Techniques

In case of a boating mishap, which can result in the over-turning or sinking of the craft, it is important to ensure all crew are familiar with the recovery techniques. These vary depending on the type of craft, and the body of water in which you are operating.

(a) Large body of water (Lake or Sea) - stay with the craft.

(b) Fast flowing streams - swim for the bank.
6.1.1 Inflatable Dinghy

This type of craft normally comprises at least three separate inflatable chambers so that the chance of puncturing all three and sinking is remote. Therefore, always stay with the craft.

6.1.2 Aluminium Dinghy

This type of craft normally has buoyancy chambers in the bow and/or under the seats and, providing these are in good condition, they will offer adequate flotation to the boat in the upturned position.

Righting this type of craft can be strenuous.

6.1.3 Power Boats

These are mostly too heavy to right therefore attempting to salvage the boat should be done when the conditions are safer.
7. MAINTENANCE AND OPERATIONAL ACTIVITIES

As prevention is better than cure, situations that an officer believes may lead to an unsafe condition must be reported.

7.1 Responsibility of Employees

It is the responsibility of every individual to make himself thoroughly familiar with, and to observe the safety instructions and rules pertaining to any work he may have to supervise, direct, or undertake and to act always in such a manner as to ensure safety to himself, his workmates, the general public and the Department's property.

7.2 Use of Safety Equipment

Safety equipment and guards are provided for the use of employees in the course of their duties. Such equipment must be used whenever required by instructions.

Employees shall satisfy themselves immediately before use that the safety equipment is in good order and condition.

e.g. (a) eye protection ) Refer ASA 1800 - 1981
     (b) helmets     
     (c) ear muffs  
     (d) footware   
     (e) protective clothing

7.3 Helicopter Strips

Helicopter strips must be constantly maintained to approved standards.

7.4 Equipment

(a) Chainsaw: Ref Chainsaw Operations Handbook published by Forestry Commission of NSW

(b) Small motors and associated equipment to be used in accordance with the manufacturers specifications.

(c) Surveying: beware of high voltage, overhead power lines.

SAPMAN:TEC
Beware of monsters in the Well!!

NEED A HELMET ???

No!! She be right mate.

SAWMAN: TEC
7.5 Stilling Wells

Water level recording installations often have stilling wells. Routine maintenance and operation often necessitates descending into these wells with their inherent hazards.

No observer shall descend a well unless a companion is at the top; that companion must be within hearing distance at all times. Frequent contact is essential - your companion could be in trouble.

7.5.1 Inherent Hazards

(a) foul air
(b) snakes
(c) spiders
(d) falling tools
(e) deteriorating conditions of structure

7.5.2 Precautions

A safety helmet must be worn down a stilling well at all times due to the danger of falling objects.

If a person is working above another, all tools and equipment should be tied to either the structure or the person.

A worker in the base of the well should have all tools attached to the access ladder or a float. This will avoid the chance of loss as well as the need to delve into deep cold water for sunken equipment.

Caution must be exercised when descending a well which may have a build-up of gases. On no account shall a person descend any stilling well with a naked light or cigarette.

For any suspect well the hatch should be opened sufficiently prior to a person descending the well in order to allow any gas build-up to escape.

Rope and tackle must be rigged and attached to the person descending into the well.
7.6 Camp Safety

We use field camps for extended periods of time during the wet season, and because of the isolated situation, safety in the camp must be a priority.

7.6.1 Potential hazards

A number of potentially dangerous goods are used in these camps.

- LP Gas, Fridges and stoves - Ref ASA 2658 - 1983
- Petrol, Diesel, AV Jet
- Power Tools
- 240 V Generators and extension cords
- Fire Arms and ammunition

7.6.2 Precautions

(a) First Aid Kit - Ref ASA 2675 - 1983

(b) Suitable fire extinguishers - Ref ASA No 1850/1980

(c) All potentially dangerous goods must be stored in such a manner as to pose the least hazard to the occupants of the camp.
8. DANGEROUS GOODS

Personnel should be aware of the potential hazards and should use the goods in accordance with the manufacturers specifications and or the relevant safety acts. Refer Transport and Works Safety Manual Section 5.2

8.1 Explosives

Refer Transport and Works Safety Manual Section 3.5.

9. OFFICE SAFETY

10. TRANSPORT

A number of different modes of transport are used for our field operations.

Licences are required for the operation of the following vehicles:
- conventional vehicles
- 4 x 4
- trail bikes
- helicopter
- fixed wing aircraft

Those vehicles for which licencing is not required, the operator must be trained and familiar with its operation.

- All Terrain Vehicles
- Boats - Refer Section 6 this Manual
- Air Boats - Refer Section 6 this Manual

10.1 Vehicle Safety

All appropriate Traffic Regulations must be adhered to.

Refer 1. Transport and Works Safety Manual Section 3.10
2. "The Art of 4 Wheel Driving under all Conditions" by Forestry Commission and National Parks and Wildlife of NSW.

10.2 Helicopter Safety

10.2.1 General

* The pilot is in charge at all times.
* Obtain guidance and instruction from the pilot.
* All passengers are to be fully briefed beforehand.
* Keep clear, helicopters can move in any direction.
* Never load equipment or tools without the pilot's knowledge.

SAFMAN:TEC
Helicopters are:
- extremely noisy
- create strong air downdraughts to 80 Km/hr

The strong downdraft can create clods of flying debris, dust, stones, leaves etc.

Loss of orientation can be caused by:
- noise,
- clouds of debris, dust,
- flashing rotor blades.

If orientation is lost or you are confused or blinded by dust:
- STOP,
- sit or lie down,
- wait until you have recovered or help has arrived,
- NEVER grope or feel your way.
10.2.2 On the ground

* Never take loose objects, papers, hats, etc., near a helicopter.
* Carry items in a bag on your shoulder; keep hands free as far as possible.
* Carry all equipment and tools horizontally below the waist, never over your shoulder.
* If the main rotor is moving erratically do not approach or leave the helicopter.
* Only touch labelled or obvious hand holds, never touch other parts.
* Keep unauthorised people away.
* Only approach on pilot's or crew member's instructions.
* Approach only from the front in the sight of the pilot.
* If on sloping ground proceed on the low side only.
* Move under the main rotor blades in a crouched manner.
* Keep away from the rear of the machine, particularly the tail rotor.
In Uneven Terrain Approach and Depart on the Low Side

Carry All Objects Horizontally

Approach and Depart From This Area

Avoid This Area

Avoid This Area

235 Miles Per Hour

Danger Area
10.2.3 In the helicopter

* Keep seatbelts fastened at all times.
* Unfasten seatbelts only on instructions from the pilot.
* Learn where the emergency exits are but do not touch them unless necessary.
* No smoking.
* Don't throw any object from the helicopter.
* Don't distract the pilot.
* Leave the pilot plenty of room to fly the aircraft.
* Avoid touching or obscuring instructions or controls.
* Don't leave loose objects in the cabin.
* Get in or out in a smooth motion, don't jump or jerk.
* Ensure seatbelts and headphones are disentangled and stowed properly before leaving.
* Read passenger information cards and placards in the aircraft.
* Keep equipment and tools securely fastened or held.

10.3 Fixed Wing Aircraft

Passengers shall not embark or disembark from aircraft while engine is in motion.
11. COMMUNICATION

On field trips of 2 days or longer duration, daily contact will be made with the local office, as per 11.1.

All field parties will carry a 2 way HF Radio for communication with base.

The exception is when helicopter flying: then radio contact has to be maintained through D.C.A.

11.1 Radio Operations and Procedures for Water Resources Division Field Staff and Base Operators

This Division operates 3 skeds a day for contact with field staff. The times are:

(1) 0730 - 0800  (2) 1030 - 1100  (3) 1530 - 1600

The base call sign is VZ80W the base operator may abbreviate this to 8DW when calling on Water Resources net.

Primary contact frequency will be 5400, secondary frequencies are 7922.5 and 3176.

Base operator will run through all "active" stations in order. e.g. R1, R2, R3, etc.
Hydro and groundwater will remain basically separate.

On contact the base operator will enquire if the active station has traffic. If he is all clear and 8DW have no traffic for him he can continue on his way.

If traffic is to be passed 8DW will advise that station to "Stand-by".

e.g. "8DW to R2"
"R2 to 8DW all clear"
"8DW to R2, I have no traffic, cheers."

R2 is now free to continue on his way.

"8DW to R2"
"R2 to 8DW all clear"
"8DW to R2, I have traffic, stand-by"
"R2 to 8DW standing-by"

This simple procedure will enable more efficient use of our limited sked time and enable stations without traffic to continue on with their tasks.
If you require parts urgently or have an urgent message to pass, when contacted by 8DW state "I have urgent traffic" and 8DW will return to you as priority when checked all other stations.

If reception is poor on 5400 the 8DW operator will call all active stations on 5400 and if possible pass advice on traffic. He will then advise all stations that he is switching to 7922.5 again he will follow the same procedure and call all active stations in order.

If contact has not been established and you have urgent traffic use VJY. However, only use VJY if the traffic is urgent. When using VJY you MUST GIVE FULL CALL SIGN. e.g. R2 should call "VJY this is VZ8DW Mobile R2"

Hydro field crew are to report in at least daily on either, one of the skeds or by telephone, with the exception of helicopter operations without ground support, where contact with head office should be at least every second day (48 hours). Groundwater crews will report on each sked.

In the event of radio failure in the field, alternate contact by C.O.B. on the following working week day is required.

Unless a mobile station is relaying traffic between base and another mobile inter-mobile, traffic should not occur (unless on 3176) without the permission of the base operator.

11.2 Emergency Procedures

When medical or other assistance (police or ambulance) is required or if life is at risk.

If between 0730-1600 use 5400 or 7922.5 or 3176. e.g. Call VZ8DW "This is R2, I have an emergency". VZ8DW control will then clear all other traffic and allow you to pass your message. Your message should be complete and precise without chatter.

i) Give the nature of emergency. e.g. car accident.

ii) Assistance required. e.g. medical advice, ambulance or police.

iii) Location. e.g. 14.8 km north of Bulman Station on the Gove track.

Exact location is important as a great deal of time can be lost if location information is incorrect or vague.

SAFMAN:TEC
VJY or any other frequency can be used to obtain assistance in an emergency.

### 11.3 Frequencies

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<th>VJY</th>
<th>FLYING DOCTOR</th>
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<td>7975</td>
<td>5410</td>
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<tr>
<td>7922.5</td>
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<td>6950</td>
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<td>3176</td>
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12. SEARCH AND RESCUE (S.A.R.)

The procedure of S.A.R. is for the benefit of all field crews therefore it is the responsibility of each officer to be thoroughly familiar with the procedure.

Radio and phone contact must be made with base every day including weekends. At every call an S.A.R. must be nominated.

Keep in mind that base will instigate S.A.R. 27.5 hours after your last call unless a S.A.R. has been nominated.

Example: Monday 0730 call
         1045
         1530

Tuesday 0730 No call
        1045 No call Start S.A.R.

In selected areas when your radio becomes u/s e.g. Arnhem Land the field crew will proceed immediately to the nearest phone and ring base. Stay in place until a new radio is forwarded from base.

Should radio failure occur in an area where access to telephones is possible then phone contact must be made and an S.A.R. nominated.

NOTE: IF S.A.R. IS INSTIGATED THROUGH LACK OF COMMUNICATION AND FOUND TO BE NOT NECESSARY, SERIOUS REPERCUSSIONS WILL OCCUR.

12.1 Air S.A.R.

All travel by charter helicopter or fix wing is under the control of D.C.A.

D.C.A. rules require helicopter and fix wing to carry U.H.F., V.H.F. and H.F. radios, a survival beacon, first aid box, survival food and water. Use Standard Procedure 14.2

NOTE: D.C.A. have a S.A.R. procedure in place when all or anyone of the following occur.

S.A.R. Time is not cancelled
A "may day" is put out
A survival beacon is activated.

SAPMAN: TEC
12.2 Land/Vehicle S.A.R.

Go to Standards Procedure 11.2 and 14.2.

12.3 Sea S.A.R.

a) Refer Section 6 Boat Safety.
b) Advise somebody of your itinerary and ETA before you leave.
c) In Darwin: if your ETA is not cancelled contact will be made with police or emergency services.
13. FIRST AID

All personnel are to be certificated First Aiders by attending a first aid course at St John's Ambulance. Personnel must keep their certificate current by attending a refresher course every 3 years.

Every field officer will familiarize himself with the C.P.R. chart in the front of this Manual.

All medical kits will contain a St John's First Aid Book.

All bush vehicles and bush camps will have a First Aid Kit. It is the party leaders responsibility to keep the First Aid Kit maintained and medicines up dated.

13.1 Accident and Injury Reporting

All accidents/injuries will be reported as soon as practical, by radio or phone. Appropriate forms and paper work must be completed.

Refer Transport and Works Safety Manual Section 5.9.

SAPMAN:TEC
14. SURVIVAL

Man has a great will and capacity to survive and this is enhanced if he **DOES NOT PANIC**.

The responsibility of Safety in the field lies with each crew member.

The crew must work within its own limitations of physical endurance and ability.

14.1 Plan and Prepare before Departure

- flight plans
- itineraries
- maps
- supplies; food, fuel and water
- vehicle spares
- First aid kit
- generator
- insect repellent and mosquito nets

14.2 Standard Procedure (Accident/Injury)

- Don't Panic
- Assess situation
  - attend to injury - first aid
  - resources
- Establish communication with base
- Improve situation and effect repairs or wait for S.A.R.
15. OTHER CONSIDERATIONS

For general reference on survival "Stay Alive" by Maurice Dunleavy will be carried in all medical kits.

15.1 Bush Fire

* Don't panic.
* Assess situation e.g. wind, your location.
* Put on protective clothing e.g. jeans, long sleeve shirt, shoes and socks, overalls.
* Use any and every means to protect against radiated heat.
* Take refuge:
  - light a back-burn and use the burnt country as a refuge;
  - use gravel pits, or clearings in the forest and roads, for this purpose;
  - lie down on the ground – air is freshest and coolest at ground level.
* Conserve energy.
* Resist panic reaction to danger.
* Use vehicles to shelter from heat radiation when the temperature becomes uncomfortable.
* Don't take refuge in elevated water tanks. Immersion in lukewarm water can kill.
* Limit breathing rate when smoke is dense – wait for small pockets of fresh air.
* Exposure to smoke can be distressing and cause extreme irritation to eyes, throat and lungs. Protect yourself against excessive smoke inhalation.
* Dense, hot smoke could damage lungs but dry air at 350°C can be breathed for some time with no lung damage.
* If it is necessary to move through the flames:
  - do not linger in front of the flames;
  - use clothing to the best advantage as a shield;
  - select an opening where flame height is lowest;
  - move through the flames on to burnt ground as quickly as possible;
  - beware always of the danger from burning limbs and trees in burnt country.

* Don't shout, don't run, don't worry and above all, don't quit.

* As a last resort, if trapped, lie on the ground taking advantage of any protection available.

15.2 Exposure

See St John's First Aid Manual.

15.3 Snakes/Spiders/Sea Wasps etc

See St John's First Aid Manual.
15.4 *Finding and Purifying Water*

The obvious sources of water are rain and supplies on the earth's surface such as rivers, streams, springs, waterholes, soaks and dams.

<table>
<thead>
<tr>
<th>Condition and max. shade and temp</th>
<th>Total Resting at night,</th>
<th>Approx. Travelling (in km)</th>
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<td></td>
<td>1 litre</td>
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<tr>
<td>37°C C</td>
<td>2 litres</td>
<td>2-6</td>
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<td>and above</td>
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<td>10 litres</td>
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<tr>
<td>Warm</td>
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<tr>
<td>26°C C</td>
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<td>to</td>
<td>2 litres</td>
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<tr>
<td>37°C C</td>
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<td>10 litres</td>
<td>11-23</td>
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<tr>
<td>Cool</td>
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<td>9-11</td>
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<tr>
<td>26°C C</td>
<td>1 litre</td>
<td>11-12</td>
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<tr>
<td>and below</td>
<td>2 litres</td>
<td>12-13</td>
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<tr>
<td></td>
<td>4 litres</td>
<td>14-16</td>
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<tr>
<td></td>
<td>10 litres</td>
<td>23-25</td>
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You may collect rain as it falls by storing the run-off from large leaves, collecting it in plastic or metal containers, or in a sheet of plastic. The greater the collection surface, the greater the volume you may collect. If you collect rain in clean containers, it will be ready for drinking. The water in some surface sources may also be pure, but it is safer to assume that it isn't. The rule is to filter and purify water where possible.

Even if it looks clear it isn't necessarily pure. Boil it for 5 minutes, or use water purification tablets if you have them (spericaps, halazone, chlorine), or add eight drops of 2.5 per cent solution of iodine to a litre and leave it to stand for 10 minutes before drinking. One or two small Condy's crystals to a litre will also purify water. Allow it to stand for 30 minutes. Some of the taste may be restored by pouring it from one container to another for a while.

Water found in free-flowing streams may be pure, but if they are coastal streams, they may be polluted by manufacturing or urban wastes. The water from muddy streams may be partly cleared by allowing it to stand overnight. It may then be filtered through several thicknesses of cloth or allowed to seep through a bank into a hole dug 300 mm away. Water from waterholes, animal watering places and large rivers should be filtered, allowed to stand, and purified. If you must drink from dirty or stagnant water and can't purify it, try placing a handkerchief on the surface and drinking through it.

Water may be found in limestone springs and caverns, in rock pools and in narrow clefts. It is sometimes found seeping through lava rocks and in springs in valley walls.

If you can't find water on the earth's surface, try tapping groundwater, which is the water flowing or lying beneath the surface. On the coast it may be found in the hollows between sand dunes, by digging behind sandhills, or by digging holes in the sand at low tide about 100 metres inshore from the high tide mark. Dig until you see the first sign of water, then allow it to seep into the hole. If fresh water is mixed with salt water, the fresh water will be found on top. Digging too deep may yield salt water as the fresh water may be a layer of no more than 50 mm on top of the heavier salt water.
Other good places to dig are at the base of cliffs and rocks where vegetation seems to be thriving, or in dry mudholes. Dig at the lowest point on the outside of bends in dry riverbeds. Dig anywhere the ground is damp or muddy. The water table is normally close to the surface in river plains, low forest and along the seashore. When you dig for water be sure that you aren't digging blindly. Dig only where you see signs that water is there. Above all, don't deceive yourself that you are a water diviner. Forget forked sticks, magic switches and twitches of wire. Your body may need the water you waste on fruitless digging.

Don't neglect dew as a source of water. If you are stranded with an aeroplane or motor vehicle mop up the dew on it each morning with a clean rag and squeeze it into a container. Some people have tied rags or tufts of grass to their ankles and waked through grass before sunrise. Others have drained it from plants and mopped it up from stones. One person may mop up as much as a litre of dew in an hour. Some people dig holes (dew pits), line them with plastic, and place a smooth or shiny object in them. The dew forms on the smooth object and runs into the plastic-lined pit.

Water may also be obtained in desert areas from condensation in solar stills. To make one you need a sheet of plastic about 1-2 metres square, a water container such as a billycan or plastic bucket and, if you can get one, a plastic drinking tube. You dig a hole a little less than a metre square (the exact dimensions will be determined by the size of your sheet of plastic) and about 450 mm deep. The sides should slop at about 45 degrees so that they don't cave in. At the bottom of the hole you place your water container and into the hole you can place leaves and plants and any waste liquid, including urine. If you have a plastic drinking tube, place one end in the container and stretch the tube up one side and over the edge of your hole. Then stretch the plastic sheet across the hole and allow it to hang in the hole without touching the sides. If necessary, some sticks may be used to prop it clear. The plastic sheet is held in position, and the hole is sealed, by placing dirt along its edges and the centre of the sheet is weighted down with a rock.
The solar still makes water by evaporation and condensation from the ground, the leaves and the waste fluid. The water condenses on the underside of the plastic sheet and runs down the sheet into the container. Depending on the area, it may make from one to two litres a day. The water may be drunk from the container through the plastic tube without disturbing the still. Several holes may be necessary to provide enough water for one person each day and new stills must be made every three or four days as the old ones are exhausted of their moisture. In some areas small frogs, lizards and snakes may be attracted to the stills, thus providing food along with the water. If you are making solar stills in the desert, remember to ration your sweat and dig them at night.

Water may also be obtained from trees. Two of the best known water trees are the baobab of the Kimberley region of north-western Australia and the Queensland bottle-tree. Water may be extracted from the baobab by cutting a strip of bark from the trunk and extracting pieces of the spongy sapwood beneath the bark. These can be chewed and each mouthful may yield the equivalent of about a teaspoonful of water. The Queensland bottle-tree may yield water if a V-shape cut is made in the bark and into the sapwood. Water will drip from the bottom of the V and a leaf may be used as a funnel to direct the flow into a container.

Although the baobab's capacity to yield life-giving water is well known, it is not so well known that the roots and branches of many other trees, including many eucalypts, the she-oak and bloodwood wattle, will also yield fluid. Roots several metres long and only a few millimetres below the surface may be ripped up, cut into metre lengths, be stood in a bark trough and allowed to drain from there into a pannikin or billycan. The fluid, like all vegetable fluids, should be drunk on the day on which it is obtained as it goes bad when stored. To get a flow it is important to cut the roots or branches into short lengths. As a general rule, fluid from trees may be drunk if it is colourless and tasteless. If it is a milky sap, regard it as potentially dangerous. The same rule also applies to fluid obtained in a similar way from vines. To get fluid from vines, cut the vine as high as possible, then cut it off close to the ground, then cut it into metre lengths. Allow the fluid to drip into a container or directly into your mouth, taking care that the vine doesn't touch your lips as this may irritate them. When the fluid ceases to drip, cut off the top third of the piece and more liquid should drip from it.
Some fleshy plants such as pigface, pigweed and cactus-like plants will also yield fluid. It is best to crush it from them into a container, although thirsty men have sucked it directly from them. One American survival expert said that sucking a cactus was like drinking glue and the same may be said of sucking many other fleshy plants.

A sugary fluid may also be obtained from burie, coconut, sugar and nipa palms. The fluid of a coconut palm will flow if you cut off the flower stalk and bend it downward. Coconuts themselves are a source of fluid. You will get the best drink from green coconuts which contain more milk than the ripe ones. As the milk is a laxative, you should drink no more than a litre a day. Coconuts may be opened with a knife. If you have no knife, sharpen both ends of a stick, drive one end into the ground, bash the coconut against the other end to crack the outer fibrous covering, then smash the inner shell against a rock or tree.

15.4.1 Water Indicators

Bees are a good sign that water is near, but the water might be anywhere within a radius of several kilometres, so you should look for other signs as well.

A column of ants may also indicate the presence of water. If the column is on a tree, you will probably find a small reservoir hidden within the tree.

Hornet-like mason flies are another indication. They normally build their nests close to a soak or wet earth. Dig where they alight to roll a pellet of mud for their nest.

Grain-eating birds such as finches and wild pigeons need water as well as grain. Watch the direction of their flight around dawn and dusk and follow it.

Animals also need water so follow any well-developed game trail. If two or more trails converge, they will probably lead to water.
15.4.2 Dos and Don'ts of Water

Do...

Try to consume enough water to replace your body's losses.
Conserve your water by rationing your sweat.
Stay in shade and remain still on hot days.
Leave physical exertion until the night.
Keep your clothes on in the heat. Loosen them.
Rest above the ground.
Purify water chemically or by boiling or filtering.
If you can't find surface water, dig for it.
Mop up dew.
Make solar stills.
Seek water in trees and tree roots and branches.
Look for bees, ants, mason flies, grain-eating birds and animal trails.
Remember it's the water in your belly, not what's in the bottle, that will keep you alive.

Don't...

Drink urine or sea water.
Ration water below your body's losses.
Drink polluted water.
Drink water from a radiator containing anti-freeze or rust inhibitor.
Dig unless you have some indication of water.
Dig in the heat of the day.
Kid yourself you are a water diviner.
16. REFERENCES AND ACKNOWLEDGEMENTS

DRAWINGS BY NEIL HOLMES - ALICE SPRINGS

SECTION REF PAGE NO

2 GENERAL WATER
   New Zealand Water and Soil Conservation (N.Z.W.S.C.)
   Hydrographers Safety Handbook 22

3 DIVING
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   3.1 Snorkeling N.Z.W.S.C. 23

4 SITE ACCESS AND RIVER BANK SAFETY
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   5.2 Gauging from Bridges
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7 MAINTENANCE AND OPERATIONAL SAFETY
   7.1 Responsibility of Employees N.Z.W.S.C. 34-37
   7.4 Chainsaws
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      Forestry Commission of NSW
   7.5 Stilling Wells N.Z.W.S.C. 42
   7.6.1 LP Gas, Fridges and Stoves ASA 2658/1983
   7.6.2 (a) First Aid Kit ASA 2675/1983
   (b) Fire Extinguishers ASA 1850/1980

8 DANGEROUS GOODS
   T&W Safety Manual Section 5.2
   8.1 Explosives
      T&W Safety Manual Section 3.5
      NT Explosives Act,
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<tr>
<td>15.4 Finding and Purifying Water</td>
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