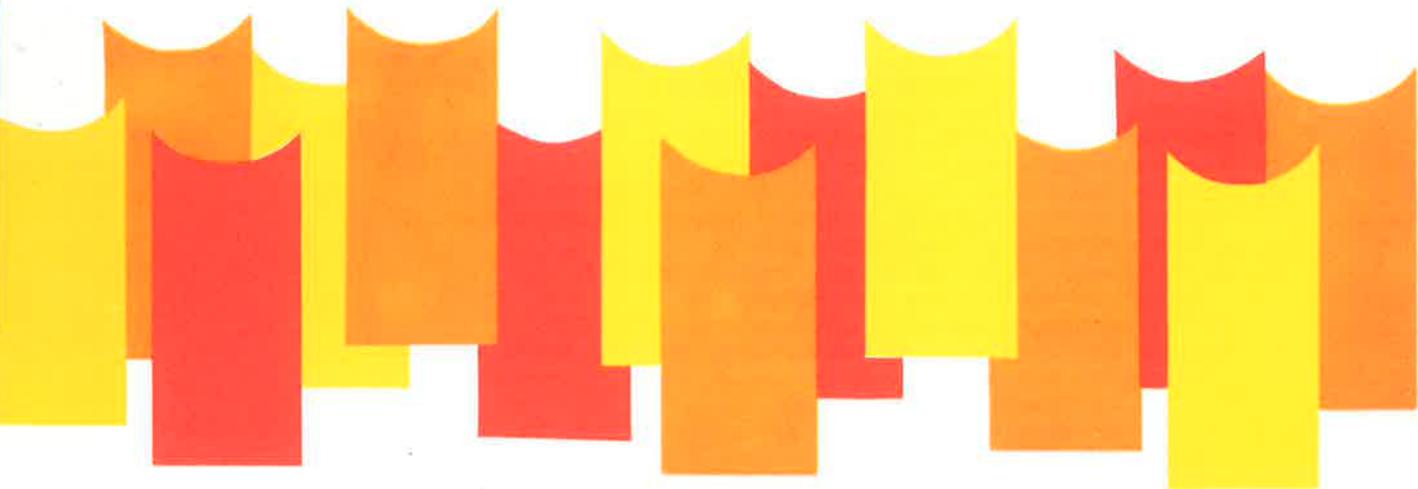


WATER & SOIL

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No 64

Hydrologists Safety Manual



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WELLINGTON 1984

Hydrologists Safety Manual

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The manual gives information designed to assist hydrological personnel to apply safe working practices on the job and to provide a knowledge of best remedial procedures to adopt in the event of a mishap. It provides details and illustrations of handling techniques, hazards and safety precautions for all situations hydrologists may encounter.

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HYDROLOGISTS SAFETY HANDBOOK

C O N T E N T S

	PAGE
FOREWORD	
1 WADING AND WADING GAUGING	1
1.1 Assessing the Situation	1
1.2 Lifejackets	2
1.3 Wading Technique	2
1.4 Mishap Technique Whilst Wearing Waders	2
2 USE OF CABLEWAYS	5
2.1 Cableway Safety	5
2.2 Construction Precautions	8
2.3 Navigation and Aviation Requirements	9
2.4 Slackline Cableways	10
3 GAUGING FROM BRIDGES	11
3.1 Traffic Hazard	11
3.2 Debris Hazard	12
4 BOATS AND GAUGING FROM BOATS	14
4.1 Boat Safety	14
4.2 Gauging from Boats	16
4.3 Handling Dinghies	16
4.4 Mishap Technique	17

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
4.4.1	Inflatable Dinghy	17
4.4.2	Aluminium Dinghy	18
4.4.3	Fibreglass and Wooden Dinghies	21
4.4.4	Power Boats	21
5	GENERAL WATER SAFETY	22
5.1	Awareness	22
5.2	Lifejackets	22
5.3	Diving	23
5.3.1	With S.C.U.B.A.	23
5.3.2	With Snorkel	23
5.4	Cold Water Survival	24
6	SITE ACCESS AND RIVER-BANK SAFETY	33
7	CONSTRUCTION AND MAINTENANCE OF HYDROLOGICAL INSTALLATIONS	34
7.1	General Safety	34
7.2	Responsibilities of Employees	34
7.3	Causes of Accidents	36
7.4	Notifiable Construction Work	36
7.5	Use of Safety Equipment	37
7.5.1	Eye Protection	38
7.5.2	Safety Helmets	38
7.5.3	Footwear	38
7.6	Work Practice Precautions	40
7.6.1	Excavations	40
7.6.2	Using Electrical Equipment	40
7.6.3	Decking of Working Platforms	40
7.6.4	Guard-rails	40
7.6.5	Toe Boards	41
7.7	Equipment for Particular Applications	41
7.7.1	Surveying	41
7.7.2	Chainsaws	41
7.7.3	Power Tools	41

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
8	STILLING WELLS	42
9	USE OF MOTOR VEHICLES	44
9.1	General	44
9.2	Trail Bikes	46
9.3	Back Country Driving	47
9.3.1	Gravel Roads	47
9.3.2	Off Road Driving	47
10	MOUNTAIN SAFETY	50
11	HELICOPTERS	54
12	RADIOACTIVE EQUIPMENT	57
13	REPORTING OF ACCIDENTS	58
13.1	Accidents to be Reported	58
13.2	Accident Reporting Procedure	58
14	FIRST AID	60
14.1	First Aid Treatment	60
14.1.1	Resuscitation	60
14.1.2	Unconsciousness	63
14.1.3	Bleeding	63
14.1.4	Burns or Scalds	63
14.1.5	Poisoning	63
14.1.6	Eyes	63
14.1.7	Fractures	64
14.1.8	Shock	64
14.2	First Aid Kits	64
14.3	First Aid Training	65
14.4	Civil Defence	65
14.4.1	Role of Ministry of Works and Development	65
14.4.2	Contact Officers	66
14.4.3	General Emergency Procedure	66

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
15	REFERENCES - Safety Codes and Guides, Statutory Acts and Regulations	67
15.1	Department of Labour Safety in Construction Publications	67
15.2	Acts and Regulations Containing Safety Legislation	67
15.3	Standard Specifications and Codes of Practice	67
15.4	National Roads Board Publications	67
15.5	General Safety Books and Publicity Material	67
15.6	Ministry of Works and Development Internal Reports	68
15.7	Miscellaneous Manuals and Specifications	68
16	ACKNOWLEDGEMENTS	69

Index to Illustrations

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1	Buoyancy of waders with air trapped in legs	3
2	Cable cutting cartoon	6
3	Cable car retriever trolley	7
4	Cable car braking mechanism	8
5	Cable car safety bar	9
6	Overloaded boat cartoon	15
7	Righting an inflatable dinghy	18
8	Buoyancy of an aluminium dinghy	18
9	Refloating and reboarding an aluminium dinghy	20-21
10	Too large a lifejacket bunching up around wearer's face	23
11	Safety helmet cartoon	39
12	Depth of ford cartoon	48
13	Safety around helicopters poster	55

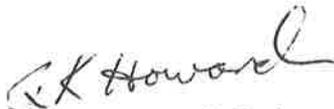
FOREWORD

Hydrological field operations by their nature require personnel to carry out a wide range of tasks in potentially hazardous situations, often in remote areas, which places added responsibility on the individual.

A general awareness of potential hazards and the safe work practices required to avoid or minimise them is essential for a high level of job safety to be attained.

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

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.



Director of Water and Soil Conservation

1 WADING AND WADING GAUGING

Wading in stationary or flowing water is hazardous when either the depth and/or current is excessive.

1.1 Assessing the Situation

Water depths are often deceptive and the force of flowing water must not be underestimated.

A useful guide to an upper wading limit is: "when the depth of water in metres multiplied by the velocity in metres per second exceeds one (1.0) the river should be assumed to be unsafe to wade". At lesser depths and velocities the river may be unsafe to wade due to site conditions and the individual's capabilities.

A tagline or rope fixed to the bank may be carried as a safety line but it must not be tied to the person. Once fixed securely to both banks this line can serve as a useful support, providing it is only used whilst standing on the downstream side.

If required to cross a river suitable fording places may be found -

- A Where the river widens or divides. The water flows quietly, is shallow and clear.
- B At a shingle bar above shallow rapids.
- C Between river bends. (Deeper water and stronger currents occur on the outside bank of a curve.)

If no shallow ford is available select a slow-flowing pool to swim across.

Find a ford where the river bed has a smooth shingle bottom. Avoid boulders, logs and smooth rock slabs. It is worth spending time looking for the best crossing place. A bad ford is a side stream close to a swiftly flowing river, or where the runout below the ford has dangerous rapids, bluffs, deep holes or obstacles.

1.2 LIFEJACKETS (Refer NZS on Buoyancy Aids^{21*})

Lifejackets are to be worn when waders are being used in calm water above crotch level or in flowing water above knee depth.

Lifejackets are also to be worn when waders are being used in any other situation where there is a risk of falling or slipping into calm water above crotch level or flowing water above knee depth. Personnel should be accompanied in the above situations where a life-jacket is required to be worn.

1.3 Wading Technique

Study the river and select the best crossing.

Usually the best method of crossing is to face the opposite bank and move directly across or diagonally downstream. Take short shuffling steps, keeping your feet low. Feel with your boots or probe with a pole for obstacles or change of slope. Brace yourself against the current. Keep calm and don't rush. If the crossing becomes too difficult, retreat and try to find an easier ford. Safety must not be sacrificed in the interest of job expediency.

Greater stability can be gained in a river crossing by the method of mutual support. With the tallest/strongest person upstream, two or three people can take a firm grasp of the next person (at shoulder level.) Proceed across, keeping close together and always in line with the current. This is one method in common use but other methods of mutual support are available as detailed more fully in the 'Bushcraft' and 'Mountaincraft' Manuals^{30,31}.

Resistance to the flow can be minimised by standing side on to the current and support can be gained by using a rod or a pole on the upstream side.

If in doubt don't cross.

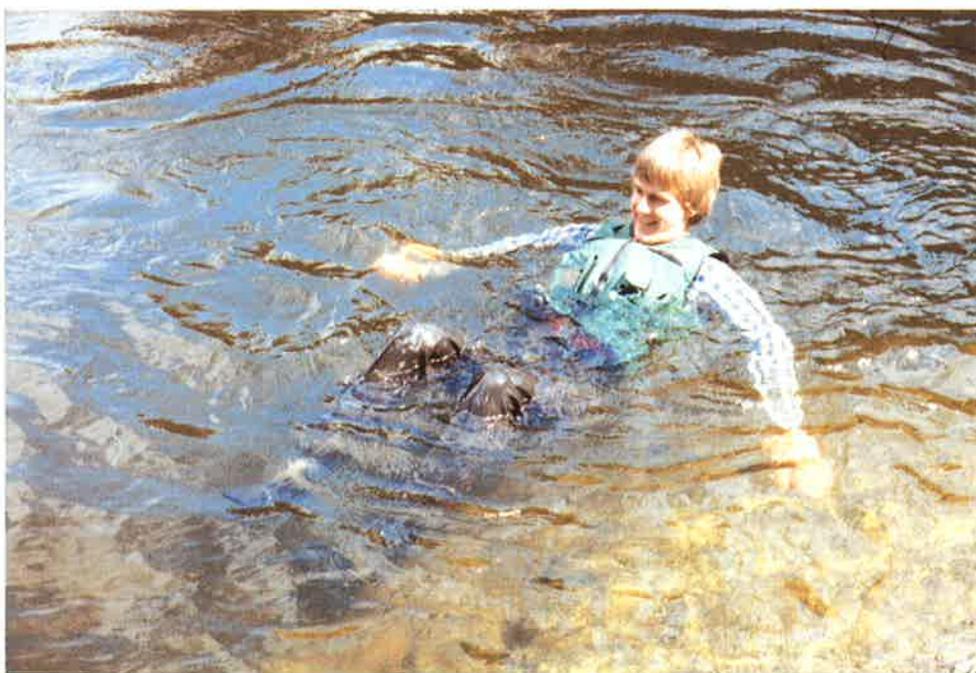
1.4 Mishap Technique Whilst Wearing Waders

If swept over or footing is lost recovery can be achieved using the following techniques -

- A If the depth of water is not over your head run and/or bounce with the current towards the bank. Face downstream and do not attempt to fight the current. (This technique is applicable in any attire.)

*Superscript number refers to the numbered reference is Section 15.

- B If the depth of water is over your head immediately turn on to your back then quickly bend your head forward and draw your knees up to your chin maintaining balance by paddling with your hands. This aims to trap air in the lower section of the waders which, combined with a lifejacket will provide adequate buoyancy to enable you to paddle to safety (Figure 1). The wearing of a leather or diver's webbing weight belt (without weights) around the waist can assist the trapping of air in the waders, as will a lifejacket's belt if worn firmly.



Buoyancy of waders with air trapped in legs

FIGURE 1

Photograph R J Curry
MWD Wellington

A comfortable floating position can be achieved whilst facing downstream, with feet first. Direction of travel can be controlled by paddling. Rapids if unavoidable can also be negotiated in this manner.

- C If deep water needs to be negotiated over a long distance removal of the waders is recommended This should not be attempted if there is a risk of snagging the waders on submerged objects. To

facilitate removal it is preferable to wear the wader straps over the lifejacket. Tight fitting waders should be avoided as they are extremely difficult to remove.

The preferred method for removing waders in the water is to undo the straps and waist belt, then work the top of the waders down to the waist. Using the slack, work the feet out of the boots one at a time, work the waders down and swim out of them. Avoid turning the waders inside out because this makes removal extremely difficult. Slow, methodical removal is easiest. Removing them too energetically increases the risk of tangling. Remember that waders and gumboots can be emptied and air trapped for use as a buoyancy aid.

2 USE OF CABLEWAYS

2.1 Cableway Safety

2.1.1 Prior to use, check as far as practical that the cableway and car are in good order. The cableway must not be used unless it has a current certificate and all conditions of that certificate must be observed.

2.1.2 Cablecar occupants must never touch the cable.

Note: Many hand injuries have resulted from disregarding this rule.

2.1.3 Care must be taken that the maximum load specified on the cableway certificate is not exceeded. Note that the load, including personnel, equipment and an allowance for the breaking strain of the instrument cable must not exceed the specified load.

Copper PVC load limiting pins for connecting the PB connectors and hanger bars are available to limit the load on the instrument cable. These pins must be used to safeguard the cablecar occupants in the event of the instrument cable becoming snagged.

2.1.4 High cableway towers should have a winch or other device mounted for raising and lowering equipment. Safety helmets must be worn whilst working on the ground under or near the tower when there is a likelihood of injury by falling objects. Preferably only one person should be on the tower ladder at any one time.

2.1.5 Personnel with long hair must wear appropriate head gear to prevent hair being caught in the cablecar wheels.

2.1.6 Personnel must ensure that loose clothing such as scarves, if worn, is securely fastened. Adequate clothing should be worn or taken in the cablecar bearing in mind that conditions are more severe over the water.

2.1.7 A continual watch must be maintained upstream whenever there is any possibility of equipment being snagged by floating or submerged debris. A suitable cable-cutting tool must be carried.

If the sounding cable becomes snagged above the

PB connector and the cablecar and debris cannot be moved to quieter water, the cable should be cut. (Not as shown in Figure 2.) This cut should be made close to the car side of the top cablecar pulley to reduce the danger of whiplash from the loose end.

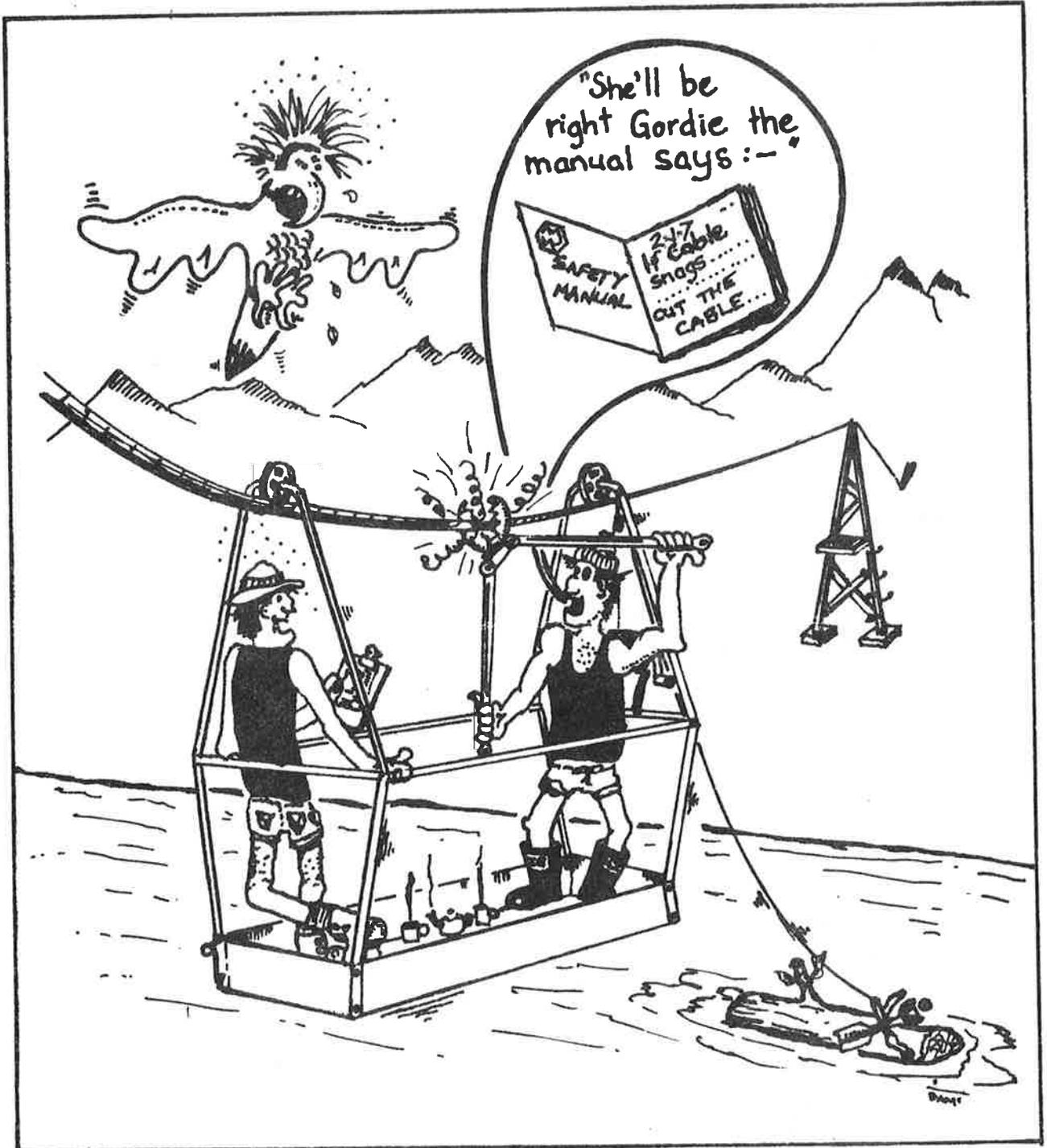


FIGURE 2

- 2.1.8 Puller bars, cable cutters and other tools should be attached to the cablecar by cords to avoid loss.
- 2.1.9 Dangerous or difficult efforts to retrieve cablecars from the middle of a cableway must be avoided. A cablecar retriever trolley (Figure 3), as detailed in a report on the 'Design and Operation of a Manned Cablecar Retriever Trolley'³⁵, should be used in such instances.



Cablecar retriever trolley

FIGURE 3

Photograph R J Curry
MWD Wellington

- 2.1.10 Be wary of the possibility of fine metal or paint flakes being flung from the cablecar wheels. Shield the eyes from these while the cablecar is in motion.
- 2.1.11 Cableways must not be used unless there are at least two people on site.

In flood conditions it is preferable that there be a third member of the party who would be stationed on the bank (and would normally be engaged in reading stage values, etc.). Portable radio telephones aid communications in this instance.

2.2 Construction Precautions

- 2.2.1 All ladders, platforms and catwalks must be constructed in accordance with AS 1657:1974²².
- 2.2.2 Guard rails and toe boards must be installed to comply with AS 1657:1974²².
- 2.2.3 Timber decking on steps, platforms and catwalks should be treated against rot to TPA Commodity Specification C3³⁶ and covered with a fine wire or raised expanded mesh to avoid a slippery surface.
- 2.2.4 All structures where failure could result in a loss of life or limb must be inspected annually by a certified civil inspector. Steel structures should also be inspected every five years by the Superintendent of Steel Structures and manned cableways must be inspected annually in accordance with Civil Engineering Publication 814³⁷.
- 2.2.5 It is preferable that metal cableway towers be electrically earthed to guard against lightning strike, particularly in areas subject to electrical storms.

FIGURE 4

A puller handle stop fitted to a Type 3 cablecar. Similar fittings are available for the Type 2 cablecar. (Note turned block under cable to prevent car from jumping off the cable.)

Photograph R J Curry
MWD Wellington



- 2.2.6 Ensure that puller handle stops are fitted to all cablecars to prevent hands being crushed between the puller and the cablecar frame (Figure 4).
- 2.2.7 Cablecar brakes have recently been developed and should be fitted to all cablecars as soon as practicable. These eliminate the temptation to put hands on the cable and make the general operation of the car completely controllable. An example of a braking mechanism as fitted to a Type 3 car is shown in Figure 5.

FIGURE 5

Braking mechanism fitted to a Type 3 cablecar. A solid rubber brake pad is preferable to the hardwood block shown. Note anti de-cable block and retriever trolley draw bar.



Photograph R J Curry
MWD Wellington

2.3 Navigation and Aviation Requirements

- 2.3.1 The Ministry of Transport must give approval for all wires and cables to be suspended above

"navigable water". This is a broad definition and must be taken literally. Navigable waters thus includes rivers and streams which, in flood conditions, are at least navigable by craft such as jet boats.

- 2.3.2 The presence of wires and cables above rivers should be notified to the Civil Aviation Division of Ministry of Transport as a possible hazard to aircraft (generally Helicopters).

The Civil Aviation Division should also be given prior notice of intention to erect a cable across a waterway and their consent awaited prior to erection taking place.

2.4 Slackline Cableways

Care should be taken to ensure that ratchets and braking mechanisms lock firmly in position.

In the event of a winch rapidly unwinding under the weight of the equipment no attempt should be made to stop the racing winch handle with any part of the body.

3 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.

3.1 Traffic Hazard

It is imperative to warn motorists of the hazard of the gauging party. Adequate warning signs must be displayed, and the "Manual on Temporary Control of Traffic"²³ and "Manual on Traffic Signs and Marking"²⁴ must be referred to for the regulations governing these.

- 3.1.1 The "SURVEY PARTY" sign is generally the most applicable of the approved signs. Temporary speed limits may also be used where warranted, and these require the prior permission of the road controlling authority (local authorities, or Ministry of Works and Development for State Highways). A telephone call will usually suffice.
- 3.1.2 When using a trailer crane, the signs "PLEASE STOP ON REQUEST" or "SINGLE LANE", as applicable, should be displayed. If traffic must be stopped use a stop-go paddle. Reference should also be made to "Hand Signals for Controlling Traffic at Work Sites"²⁵ ."
- 3.1.3 Signs should be so placed that drivers have an uninterrupted view of them for 60 metres in urban areas and 120 metres in rural areas. (See Section 4 Positioning of Signs in "Manual on Temporary Control of Traffic"²³ .)
- 3.1.4 Plastic or rubber marker cones can be used to help guide vehicles around the work area or encourage them to travel more slowly.
- 3.1.5 "Day-glo" red or bright orange coloured vests, jackets, or overalls (as used by highway construction staff) should be worn by all members of the party, to make them more visible to the motorist. (Refer also NZS 5807:1980¹⁷ .)

- 3.1.6 Revolving flashing lights mounted on the vehicle and/or bridge should be used when gaugings are being done from a road bridge at night.

They are also worthwhile during daylight. (Portable models are available.)

- 3.1.7 Pay particular attention to the danger from passing traffic. Look both ways each time when stepping away from the crane or moving into the carriageway.

Be aware that the noise of the river may mask the sound of approaching traffic.

- 3.1.8 The gauging party's vehicle must not be parked in a position where it obstructs the vision of motorists or the gauging crew.

3.2 Debris Hazard

- 3.2.1 Where there is even a remote possibility of debris (floating or submerged) being carried by the river, cranes must be tied down (where possible) securely enough to prevent them being tipped unexpectedly over the side of the bridge.
- 3.2.2 Personnel must not sit on, lean or stand with both feet on the gauging crane due to the hazards of the instrument cable becoming snagged by floating or submerged debris. (This practice was the cause of a fatal accident.)
- 3.2.3 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.
- 3.2.4 Copper load limiting pins must be used between the PB connector and the hanger bar. The equipment should be raised as soon as debris is seen to be a threat.
- 3.2.5 Trailer-mounted cranes must be sufficiently counter-balanced to prevent their being tipped over by a force of up to the breaking strain of the cable being exerted on the end of the boom.

Because of the amount of leverage produced by the length of the boom, the required counterweight can be unexpectedly large. The moments of each trailer and crane combination must be calculated. For details see a report on 'Safety Aspects on the Use of Trailer-Mounted River Gauging Cranes'^{3 4}.

4 BOATS AND GAUGING FROM BOATS

4.1 Boat Safety

- 4.1.1 Lifejackets must be worn by all personnel working from or travelling in boats.
- 4.1.2 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.
- 4.1.3 Equipment must be stowed safely and passengers seated properly; in the case of jet boats going aground this will lessen the risk of injuries.
- 4.1.4 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.
- 4.1.5 Boat operators must ensure that the craft is adequately maintained, and have adequate knowledge of how to cope with breakdowns and other potential problems.
- 4.1.6 Boats must be operated within their capabilities, and in particular must not be overloaded (Figure 6).
- 4.1.7 Boat operators must be familiar with emergency equipment and procedures. Training in these procedures should be undertaken at regular intervals.
- 4.1.8 All crew should be readily 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.
- 4.1.9 Buoyancy of craft must be checked at least annually, initially to determine its adequacy

and thereafter to guard against deterioration.

- 4.1.10 Where practical it is advisable to have one person on the bank/shore to organise assistance if needed.
- 4.1.11 Boat operators must ensure that flat bottomed boats, especially aluminium dinghies, are kept well bailed because the stability of the boat deteriorates rapidly as the wetted area of the bottom increases.



FIGURE 6

4.2 Gauging from Boats

- 4.2.1 Taglines can be dangerous to handle during boat gauging because of the long spans and large strains often involved. Anchorages must be substantial. Heavy duty tagline reels with ratchet, brake and geared drive should be used for long spans. Each person must be informed of the technique to be used to rig the tagline and be aware of the possible problems. The end of the tagline must not be fastened to the boat.
- 4.2.2 Taglines strung across waterways must be adequately marked to ensure visibility from other craft. Bright fluorescent markers must be fastened to the tagline at no less than 10 metres apart across all navigable water.
- They should, if possible, be rigged at a sufficient height for boats and their occupants to pass safely underneath.
- Wire cutters must be readily available to cut the tagline if necessary.
- 4.2.3 Taglines must not be left unattended.
- 4.2.4 Jet boats must display an orange flashing light (as for road construction vehicles) at all times when a tagline is rigged or during other operations which present a possible hazard to other river users.

4.3 Handling Dinghies

- 4.3.1 When rowing a dinghy on fast or rough water, the rowlocks should be the type that are secured in their mounting and completely hold the oars to prevent them from lifting out.
- 4.3.2 The oars should be approximately one and a half times as long as the width between the rowlocks. This length is best for one-person rowing.

- 4.3.3 In fast flowing rivers a rowing boat should always be pointed upstream with the rower facing downstream. This has many advantages, some of which are -

It is easier to row into and away from a bank.

A rower can hold position better against the flow of the river while manoeuvring round obstacles or traversing to the other bank.

The rower can see where, or towards what, the river is attempting to carry him.

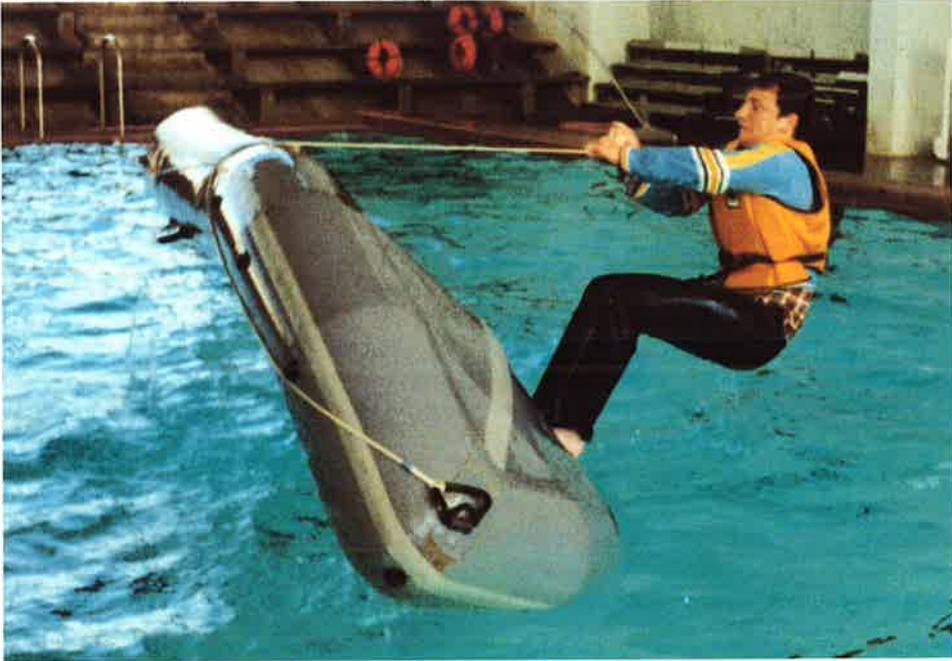
4.4 Mishap Techniques

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.

4.4.1 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.

Inflatable dinghies are the simplest of craft to right and can easily be righted by one person. In order to achieve this, the bow or mooring rope must be fed through the rowlock or side loop approximately half way along the side of the dinghy. With the person's feet on the other side of the upturned dinghy, the craft can be righted by pulling hard on the rope and turning the dinghy over (Figure 7). Care must be taken to move back as the dinghy passes the point of no return to avoid it landing on top of oneself. Climbing aboard is assisted if a second person can hold the opposite side down.



Righting an inflatable dinghy

FIGURE 7

Photograph R J Curry
MWD Wellington

4.4.2 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



Buoyancy of an aluminium dinghy

FIGURE 8

Photograph Courtesy R Jensen
MWD Hamilton

position (Figure 8). It may be best to stay with the upturned craft. Righting this type of craft can be strenuous.

Providing the dinghy does not sink, it can be righted from the semi-submerged position by two people using the handles or holds available on the craft. (Hand-holds may need to be fitted.) For quick success and the minimum of effort, the righting operation must be well coordinated and each crew member must have an allotted sequence of tasks. Staff should be made familiar with these procedures by way of the training exercises.

Once righted the dinghy will still float very low in the water and, unless held level, will take in more water and it will not be possible to bail it out. Once righted, the best technique is for two people to depress the stern into the water (Figure 9a) until the bow is well out of the water, and then raise the stern as quickly as possible (Figure 9b). (A third person may be useful at the bow.)

This action removes the first 10 - 15 cm of water from inside the boat and makes bailing possible, although initially this must be done whilst floating beside the boat. When the level of water has been lowered sufficiently one person should enter the boat from the stern whilst the other holds the bow down (Figure 9c). The remaining water can then be bailed out. Care is required while the second and subsequent people clamber aboard.



Refloating and reboarding an aluminium dinghy

FIGURE 9 (a)

Photograph courtesy R Jensen
MWD Hamilton



FIGURE 9 (b)

Photograph courtesy R Jensen
MWD Hamilton



FIGURE 9 (c)

Photograph courtesy R Jensen
MWD Hamilton

4.4.3 Fibreglass and wooden dinghies

These types of dinghy, although now seldom used on hydrological work, are best righted using a similar technique to aluminium dinghies. However, their weight, size and lack of buoyancy generally make this more difficult and sometimes impossible. Floating with this type of dinghy may well be the preferred option, particularly if any injury has been sustained.

4.4.4 Powered boats

These are mostly too heavy to right, but as long as they remain afloat, it is best to stay with the boat unless the shore can be easily reached.

5 GENERAL WATER SAFETY

Water safety awareness is crucial to all persons 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.

5.1 Awareness

All personnel should be able to swim, and need to be aware of potential hazards and be completely conversant with the appropriate recovery techniques when using various clothing and equipment in water.

Regular training exercises should be practised to give the personnel concerned more than just a casual and theoretical acquaintance with safety and emergency procedures. These procedures are outlined under sections 'Wading and Wading Gauging' and 'Boats and Gauging from Boats'.

It will be the group leaders responsibility to ensure training exercises are carried out annually and that a register of participants is kept.

5.2 Lifejackets (Refer NZS Buoyancy Aids²¹)

Lifejackets are required to be worn in a variety of situations as noted throughout this handbook.

5.2.1 All lifejackets must be of an approved type and should be tested annually to ensure they meet the buoyancy requirements. (Refer NZS 5823:1982²¹.)

5.2.2 Lifejackets should fit properly.

The correct size of lifejacket is important because too small a jacket is restrictive on movement and may fail to provide adequate buoyancy, and too large a jacket will bunch up around the neck causing a mild sensation of suffocation (Figure 10).



Note too large a lifejacket bunching up around
wearer's face

FIGURE 10

Photograph courtesy R. Jensen
EWD Hamilton

5.3 Diving

All diving carried out must be in accordance with the current State Services Commission rulings, and the Department of Labour Code of Practice for Diving on Construction Work⁶.

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

5.3.1 With S.C.U.B.A. (Self Contained Underwater Breathing Apparatus)

All scuba diving must be done in accordance with the Department of Labour's 'Code of Practice for Diving on Construction Work'⁶.

5.3.2 With snorkel (most common for hydrological work)

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

- 5.3.2.2 All divers must carry a combination serrated/plain edge knife which should be securely fastened to the leg or thigh (not the waist belt).
- 5.3.2.3 No diver shall become reliant on fins (or flippers) or become unable to swim to safety without them.
- 5.4 Cold Water Survival^{2 8}

Introduction

Many scientists around the world have been studying the effects on humans of immersion in cold water under conditions similar to those experienced following boating accidents. The results are being used to find ways to increase survival time through various behavioural and technological means.

Even a small increase in survival time can mean the difference between being alive or dead when rescuers arrive.

Boaters (and others in danger of accidental immersion in cold water) should be aware of the factors that determine body cooling rate and eventual death from hypothermia. Such knowledge can improve chances of survival if an accident occurs. Remember, drowning is a problem that is easily solved by use of an approved buoyancy aid or lifejacket. They will keep you afloat, with your head out of the water, but most do not give you any significant protection against hypothermia. Hypothermia is a problem that is not easily solved, and deserves your careful attention.

The following questions attempt to focus attention on the major problems and recommendations about cold water survival.

A What is "Hypothermia" and How Does it Kill?

Hypothermia means lowered, DEEP-BODY temperature. In cold water, the skin and peripheral (external) tissues become cooled very rapidly. But it takes 10-15 minutes before the temperature of the heart and brain begin to cool. Intense shivering

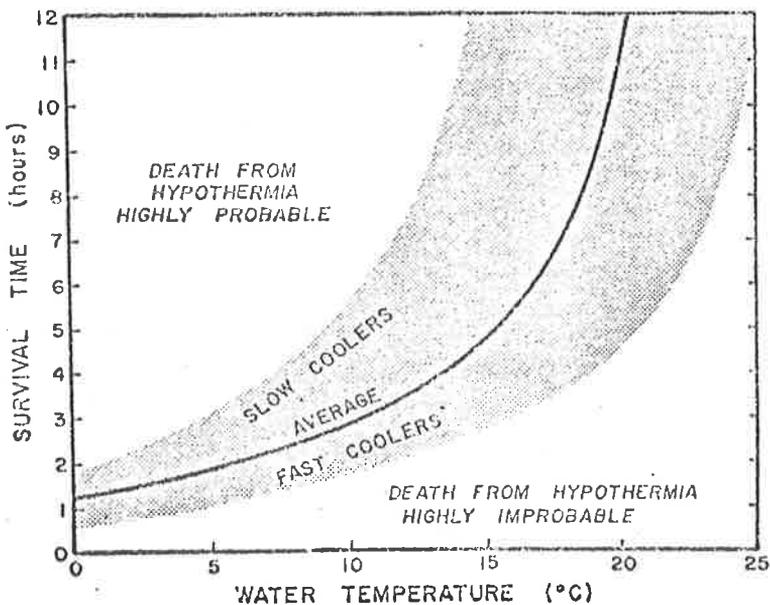
occurs in a futile attempt to increase the body's heat production and counteract the large heat loss. Decreased consciousness occurs when the deep-body temperature falls from the normal 37°C to approximately 30°C to 32°C. This can make drowning more likely. Heart failure is the usual cause of death when deep-body temperature cools to below 30°C.

B How Long Can I Survive in Cold Water?

The accompanying graph shows potential average predicted survival times of normal, adult humans in water of different temperatures. This data is based on experimental cooling of average men and women who were holding-still in ocean water and wearing a standard lifejacket and light clothing. The graph shows, for example, that in water of 15°C, which is a fairly average water temperature around New Zealand, the predicted survival time would be in the range of 4 to 5 hours. This time would be increased by extra body fat and decreased by small body size. Although women usually possess slightly more fat than men, they cool at about the same rate because of their generally smaller body size. Due to even smaller body mass and relatively little fat, children cool much faster than adults.

POTENTIAL LIFE EXPECTANCY

for persons holding still, wearing standard life-jacket and normal light clothing.



C Should I Swim to Keep Warm?

No! Although the body produces almost three times as much heat when swimming slowly and steadily (eg side stroke) in cold water compared to holding-still, this extra heat (and more) is lost to the cold water due to more blood circulation to the arms, legs and skin, and increased water circulation through the clothing. Results show that the average person swimming in a lifejacket cools 35% faster than when holding-still. When no lifejacket is worn, treading water increases the cooling rate by the same amount. Drownproofing which is a technique specifically designed for warmer waters, would in colder water increase cooling rate by as much as 80%, due to the frequent immersion of the head. This technique should never be attempted in New Zealand waters.

D How Far Can I Swim?

Shore may be close enough to reach by swimming, despite a faster cooling rate with this activity. Tests conducted on people swimming in ocean water of 10°C, while wearing standard lifejackets and light clothing, showed that the average person could cover a distance of just over one kilometre before being incapacitated by hypothermia. It is not easy to judge the distance, especially under emergency conditions in rough, cold water, but at water temperatures 10°C to 15°C, shore should be within one kilometre before making the decision to swim. The distance covered will obviously be affected by one's swimming ability, amount of insulation and water conditions. It should be remembered that even the cooling of the outer body will decrease a persons swimming capability, especially when no lifejacket is worn.

E What Body Regions are the Most Critical for Heat Loss?

In addition to the head (which is normally out of the water) certain other body regions have high rates of heat loss while a subject is holding-still in cold water. Infrared pictures show that the sides of the chest (where there is little muscle or fat) are major routes for heat

loss from the warm chest cavity. Also the groin region loses more heat due to large blood and lymph vessels near the surface and a thin body wall. If an effort is made to reduce body heat loss, these regions deserve special attention, particularly the chest area.



F What Behaviour will Increase Survival Time?

In any situation, your first consideration must be to reduce heat loss. Based on the heat loss information above, two techniques can be employed to reduce heat loss from the 'critical areas'. Both of these techniques can increase the predicted survival time by about 40%.

IF YOU ARE ALONE

This technique involves holding the inner sides of the arms in contact with the side of the chest, over the 'hot regions'. The thighs are held together and raised slightly to close off the groin region. This position often termed "H.E.L.P." (Heat Escape Loss Posture), increases survival times significantly.

It should be noted that the picture shows a person wearing a lifejacket that has its bouyancy high on the body, close to the surface of the water. A standard approved lifejacket such as this is particularly suitable for maintain- in this position.



Where the buoyancy is more evenly distributed, as in a buoyancy vest, the centre of the buoyancy is lower and the drawing up of the knees too far can lead to instability in the water.

The picture illustrates one form of the concept only - the vital need is to understand the principle that deliberate behaviour to minimise exposure of body surfaces to the cold water will result in a slower cooling rate.

FOR GROUPS OF TWO OR MORE

In this situation the sides of the chests and the lower body areas are pressed together in a position which is often referred to as "HUDDLE". Apart from reducing the rate of body cooling, there are probably some psychological advantages in being together in a group. This position can also be used to slow down the rapid rate at which childrens' bodies cool, by sandwiching them in the middle of the group. Where small children are involved, this should be your first priority.



Again, the principle is reduction of exposed body surface, with the chest having first priority.

G Do Different Types of "Lifejackets" Offer More or Less Thermal Protection?

The major advantage of having a lifejacket in this situation has already been stated. Apart from this, lifejackets can offer varying degrees of protection from heat loss.

- i Kapok lifejackets and loose-fitting, foam lifejackets of the vest or yoke type offer very little protection from cold water.
- ii Foam vests that possess good adjustability for close fit to the chest, can provide about a 40% increase in predicted survival time.

- iii Floatation jackets where the buoyant insulative foam extends throughout the body and sleeves, can provide a 60% to 70% increase in predicted survival time. These jackets can be used as a normal leisure garment or windbreaker and consequently are more likely to be worn at the time of any sudden immersion situation.

H Does Clothing Help?

Broadly speaking the more clothes that are worn on entry into cold water, the longer will be the survival period. This will vary significantly depending on the type of clothing and the amount being worn. Even at best however the maximum increase in survival time that could be expected with conventional types of clothing would be in the vicinity of only 30%. It should be remembered that conventional clothing is designed for insulation in air, not water. Air spaces among the layers of clothing or wool fibres are soon replaced by water - and this submerged clothing will give only a slight restriction to body heat being conducted to the colder water.

Nevertheless, if time permits, don as much clothing as possible, including headgear, prior to entry into cold water.

I Does it Help to Get Your Body out of the Water?

The answer is almost invariably "yes". The body surrenders its heat to the water many times more quickly than to air of the same temperature, and it is often possible to stabilise body temperature once you are out of the water. Therefore, if possible, get on top of an overturned boat or any wreckage that is available. If this is not possible, even getting the neck and chest area clear of the water, will add significantly to survival times. This is particularly important for children due to their rapid cooling rate. A person may feel colder and more miserable once out of the water, however it is now an established fact that the body progresses into deep body hypothermia at a much more rapid pace in water, regardless of seemingly colder air temperatures.

J Does Alcohol Consumption Affect Survival Time?

The cooling rate in cold water of legally-impaired subjects (blood alcohol near 0.08g/100ml) was little different than from the cooling rate when sober. The consumption of alcohol while boating is undesirable, because it makes you more likely to enter the water in the first place! As well as this, the effects of alcohol in this situation greatly increase the likelihood of death because it can impair rational decision-making which is necessary to reduce cooling rate or to avoid drowning.

K Do People Ever Die of "Shock" When Falling into Cold Water?

Immersion in cold water (especially if sudden) causes immediate major changes in body function, and there are instances of 'sudden death' being reported. There are several causes of this 'sudden death'. One is heart attack resulting from the increase in heart-rate and changes in blood pressure which accompany immersion in cold water. Another cause is related to hyperventilation (overbreathing - very often at a rate 5 times faster than normal over the first 1 - 2 minutes), which everyone experiences in response to the shock of cold water. This is involuntary, difficult to control, and occasionally leads to unconsciousness and subsequent drowning. It is possible that, if one had plunged under water or were in a rough sea, that the hyperventilation could cause uncontrolled aspiration (inhalation) of water and a form of drowning.

Because panic can magnify any of the above responses, it is important to remain calm and methodical if faced with a cold water emergency. If possible, enter the water gradually, allowing the body to adjust to the changing temperature, and keep the head well clear of the water. Consciously control your breathing as much as possible. The more clothing and insulation your body has, the less will be the initial shock on entry into cold water.

L How do you Recognise Hypothermia in Another Person?

The early recognition of hypothermia requires a very high degree of suspicion; if you don't think of it, you will not recognise it. Symptoms include: quietness, irritability, loss of coordination, weakness, slurred speech and poor judgement. Shivering commences early but remember, the sudden cessation of shivering is an important sign of hypothermia. A victim at this point is unlikely to accept the fact that anything is wrong.

M How do you Rewarm Someone who has been in Cold Water?

This is a difficult question because of the circumstances regarding the level of hypothermia and facilities available for rewarming. OBVIOUSLY THE VERY FIRST CONSIDERATION, IN ALL CASES, MUST BE TO PREVENT FURTHER HEAT LOSS. INSULATE THE VICTIM AS MUCH AS POSSIBLE. IT IS MOST IMPORTANT TO CONCENTRATE THE INITIAL ATTENTION ONLY TO THE CHEST AREA. Care must be taken since improper rewarming may allow the blood to flow through the arms and legs. Since these may have taken on the temperature at or near that of the cold water, any blood flowing through them will be drastically cooled. When this very cold blood returns to the body, the temperature of the core, the heart and lungs, may drop to a level where life can no longer be sustained.

Rewarming methods could include any of the following -

- Body contact (warm person(s) huddle with the victim)
- Hot, wet towels and water-bottles
- Electric and chemical heating pads
- Heated blankets (electric or by pouring warm water over them)
- Hot baths (keeping arms and legs well clear)
- Heated, water saturated air or oxygen (inhalation rewarming), using the steam from a kettle directed (carefully) under a makeshift "hood" over the victim's head.

Remember it is important for the severely hypothermic, to heat the "core" of the body only (head, neck and trunk) leaving arms and legs alone. Do not rub the surface of the body. If the person is severely hypothermic (probably unconscious), handle the body gently particularly arms and legs, and avoid "jolts" that may adversely affect the heart's function. A hypothermic victim should be transported to a site providing medical attention, preferable a hospital, as quickly as possible. Only give hot drinks if victim is fully conscious and capable of drinking without choking - never alcohol!

N What if the Person Appears Dead from Hypothermia?

Extremely difficult to detect. Even if very careful examination shows no vital signs - don't give up. Recent examples have shown that persons who are apparently dead from hypothermia, or drowning in cold water, can often be resuscitated successfully even after a long period without breathing and blood circulation (10 - 40 minutes)! The main reason is that cold body tissues (eg brain) require less oxygen than when warm. Maintain rescue breathing/CPR until reaching a hospital or other medical facility.

O Summary

The danger of accidental hypothermia in cold water is a major reason to learn and practice safe boating techniques. In the unfortunate event of cold water immersion, your rate of progress into hypothermia depends on water temperature, who you are (body build and fatness), how you behave in the water, and what you were wearing when you went in. These factors have been reviewed in this section to help you be prepared for this important aspect of water safety. More detailed information on cold water survival is obtainable from NZ Water Safety Council, C/o Department of Internal Affairs, Private Bag, Wellington.

6 SITE ACCESS AND RIVER-BANK SAFETY

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

- 6.1 Tracks to recorder installations, staff gauges and cableways 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 often need to be carried.
- 6.2 Catwalks, cableway platforms and other wooden structures should be treated against rot to TPA Commodity Specification C3³⁶ and should be covered with fine mesh or some other non-slip material.
- 6.3 Particularly in wet conditions, pay attention to possible local hazards such as falling rocks, slips, and unstable banks.
- 6.4 Carry a good torch when working at night to ensure safe passage along tracks.
- 6.5 Lifejackets should be worn in any situation where there is a risk of falling into deep or swift water. This will often apply to river-bank work.

7 CONSTRUCTION AND MAINTENANCE OF HYDROLOGICAL INSTALLATIONS

7.1 General Safety

Hydrological staff are often required to carry out construction work associated with the installation and maintenance of recording structures. This calls for a general awareness of the requirements of the Construction Act 1959 and the Construction Regulations 1961¹⁴ and any amendments.

There are Codes of Practice, NZ Standard Specifications, Manuals of Safe Working Practices and pamphlets published by such bodies as the Department of Labour, The Standards Association of New Zealand, The National Safety Association and others. These documents provide a working guide to safety from which compliance with the relevant statutes can be ensured. The following lists the Department of Labour publications which should be consulted where appropriate. (Copies should be held by your Local Safety Officer.)

- No 1 A Short Guide to the Construction Act¹
- No 3 Code of Practice for Scaffolding²
- No 5 Code of Practice for Excavation³
- No 14 Trench Collapse on Construction Work⁵
- No 16 Powder-Powered Tool Guide⁷
- No 18 Code of Practice for Work in Compressed Air⁸
- No 19 Safety Supervisors Guide⁹
- No 20 Safe Use of Electricity¹⁰
- No 24 Code of Practice for Cranes and Lifting Appliances¹¹
- No 26 Rigging Code of Practice¹².

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 Responsibility of Employees

It is the responsibility of every employee to guard against the creation of dangerous conditions, and

to observe safe practices.

In particular employees must -

- Adopt a responsible attitude towards their own safety, the safety of fellow employees and members of the public.
- Seek instruction from their supervisor when performing an unfamiliar task.
- Not operate any equipment outside the scope of their normal duties unless authorised and specifically instructed to do so and have the appropriate licence when necessary.
- Where appropriate, remove hazards or report unsafe working conditions and/or unsafe working practices to their supervisors.
- Wear or use all necessary protective clothing, equipment or devices in such a way as to achieve the purpose for which they were supplied.
- Use appropriate and correct tools and appliances and ensure that defective items are repaired or replaced.
- Properly care for all items of protective equipment issued and ensure replacement when such equipment becomes unserviceable.
- Report all injuries regardless of severity and seek prompt attention for any injury sustained.
- Not consume intoxicating liquor on the job, nor report for work while their performance is likely to be adversely affected by alcohol or other drugs.
- Not indulge in practical joking or "horseplay" on the job.
- Promptly report to their supervisor any condition due to illness or other disability which would render them unable to perform their duties safely.

7.3 Causes of Accidents

Unsafe conditions

Accidents can be caused by unsafe conditions. Examples of unsafe conditions are -

- Improper guarding: such as unguarded moving parts of machines, unbarricaded floor openings and excavations, unprotected electrical equipment, insufficient warning signs.
- Defective material or equipment: such as mushroom-head chisels, split handles, poorly constructed or weak equipment.
- Hazardous arrangements: such as those due to poor housekeeping, unsafe planning of or inadequate working space.
- Unsafe clothing: such as loose clothing, ties and jewellery when worn near machinery, inadequate footwear.
- Poor lighting: such as insufficient light, objectionable shadows or glare.
- Unsafe design and construction: such as inadequate means of isolating plant for maintenance, poor access to equipment.
- Insufficient ventilation: such as insufficient change of air, presence of harmful vapour, dust or gas.
- Excessive noise: such as mechanical or machine-induced noise.

7.4 Notifiable Construction Work

There are two categories of construction work; notifiable and not notifiable. The essential difference is that one is likely to be more dangerous than the other and is designated notifiable work.

Notifiable construction work is any work in which -

- A Workmen risk a fall of 5 metres or more.
- B Where scaffolding of more than 5 metres in height is erected or used.
- C Any lifting appliance, other than a self propelled mobile crane, excavator or forklift truck, is used to lift a mass of 5 kg or more through a height of 5 metres or more.
- D Workmen are required to work in a trench, shaft or pit or other excavation more than 1.5 metres deep and with a depth greater than its horizontal width at the top.
- E Workmen are required to work in a drive or excavation with a ground cover overhead.
- F Any excavation face that has a vertical height of more than 5 metres and an average slope steeper than 1:2.
- G Explosives are used or kept on site.
- H Workers are required to work in or breath air that is or has been compressed or a respiratory medium other than air (eg SCUBA diving).

The Act requires that before any construction work which is a notifiable work is commenced, at least 24 hours notification must be given to the safety inspector at the office of the Department of Labour nearest to the work.

Any work which subsequently becomes a notifiable work unwittingly after it is commenced must be notified as soon as practicable after the commencement of the work.

7.5 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.

Note: Under the "Factories Act"¹⁵ and the "Construction Regulations"¹⁴ employees are liable to prosecution (by the Department of Labour) for non-use of safety equipment.

7.5.1 Eye protection

The appropriate type of eye protection shall be worn in designated "eye hazard" areas and whenever there is a danger of damage to the eyes. Such situations are -

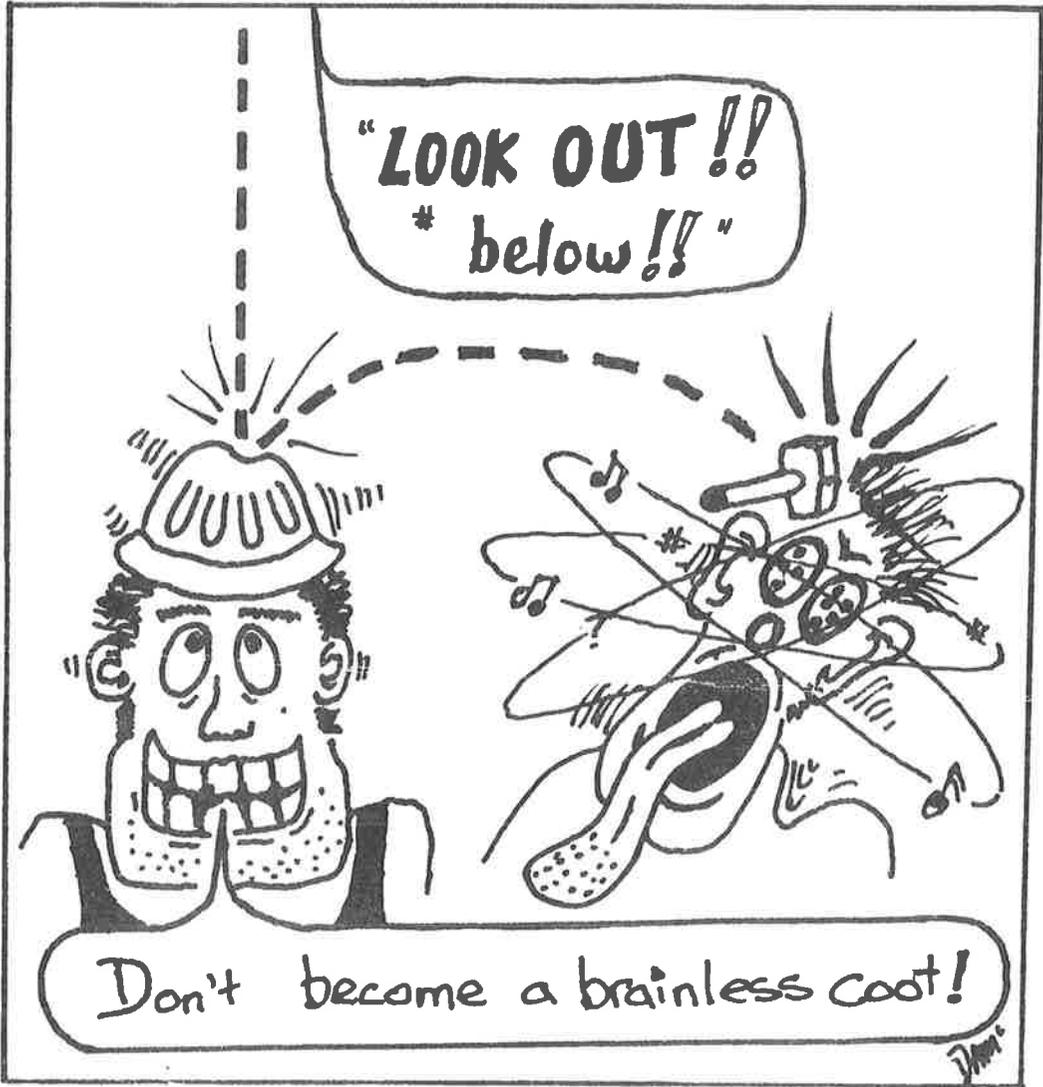
- Where there is a risk of eye injury during any cutting, grinding or drilling operations or hammering steel or striking rock.
- Where there is a risk of wires or cables breaking and the ends whipping about.
- Whilst cable car wheels are running there is a risk of small flakes of metal flying off. The eyes should be averted in such situations.

7.5.2 Safety helmets (Refer NZS 5806:1980¹⁹)

Safety helmets are to be worn at all times in designated 'hard hat' areas and also when there is a likelihood of injury by falling objects or in areas where there is a danger of striking the head.

7.5.3 Footwear (Refer MWD Safety Manual²⁶)

Safety footwear shall be worn at all times by employees working on construction sites, workshops and other areas where the wearing of such footwear is necessary for safety.



"A safety helmet must be worn ..."

FIGURE 11

7.6 Work Practice Precautions

7.6.1 Excavations Any excavation that has a face of more than 1.5 metres high shall be timbered unless -

- A The face is cut back to a safe slope in order that the material in it will not slip under all conditions of wind or weather.
- B The material in the face is of proven good standing under all anticipated conditions of work and weather such as would be found in an excavation through solid rock.
- C Timbering is impracticable or unreasonable by reason of the nature of the work and alternative precautions are taken.
- D By reason of the nature and position of the workmen there is no danger to the workmen.

7.6.2 Using electrical equipment

Portable electrical appliances, irrespective of whether double insulated or not, when used outdoors or in a damp situation, must be used with a safeguard as recommended in D3 of the Ministry of Works and Development Safety Manual²⁶. This is normally an isolating transformer or portable generator.

Care must be taken to ensure that leads are suspended overhead to prevent damage from abrasion and to prevent plugs from coming in contact with pools of water.

7.6.3 Decking of working platforms

All working platforms must be decked to within 200 mm of the guard-rail.

7.6.4 Guard-rails (catwalks and cableway tower platforms)

Must be fitted to all working platforms over 3 metres in height and are to be placed in order to comply with AS 1657:1974²².

7.6.5 Toe boards

Must extend above any material stacked on working platforms. Toe boards should be provided whenever there is a likelihood of anything falling off the platform, particularly if workmen have to work below the area.

7.7 Equipment for Particular Applications

7.7.1 Surveying

- Be aware of the danger of touching power wires with staves (especially metal ones).
- Where laser survey instruments are in use, an officer should be designated as Laser Safety Officer and be consulted for information and instructions.

7.7.2 Chainsaws (refer NZS on Chainsaws¹⁸)

Chainsaws must only be operated by employees trained in their use and operation.

- Drop starting of petrol driven chainsaws is not permitted.
- Chainsaws must not be carried while the chain is in motion.
- A safety mitt shall be fitted and kept in position and in good working order while the saw is in use.
- Protective equipment such as hard hat, ear muffs and face visor shall be made available to all employees operating chainsaws.

7.7.3 Power tools

- Always use safety goggles with all cutting, grinding or drilling equipment.
- Only use power tools for their designated purpose and always in accordance with the manufacturer's specifications.
- See also 7.6.2 and Powder-Powered Tool Guide¹⁶.

8 STILLING WELLS

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

- 8.1 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.
- 8.2 Above every accessible stilling well a length of rope (sufficient to reach the bottom of the well) must be kept.

Most large concrete installations have a large hook in the ceiling for rigging rope and tackle. If a lengthy period is to be spent in the well rig up the rope and tackle beforehand and ensure that the gear is operational (Refer also to NZS 5811²⁰).

- 8.3 A safety helmet¹⁹ must be worn down a stilling well at all times due to the danger of falling objects (Figure 13).

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.

- 8.4 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. The rope and tackle must be rigged and attached to the person descending into the well.

- 8.5 Care should be taken to ensure that the hinged lids on the steel recorder housings (normally on top of the steel stilling well tower sections) are properly secured open before standing under them.

9 USE OF MOTOR VEHICLES (Refer also Traffic Regulations ¹⁶)

Travel by vehicle forms a large part of hydrological field operations and, because driving conditions are often not ideal, an awareness of safety in this area is most important.

9.1 General

Vehicle-related mishaps offer the most potential for serious accidents.

- 9.1.1 Before driving any vehicles, motorcycle or plant the driver must be experienced in operating the class of vehicles or plant, be authorised to do so by his supervisor, and hold a current driver's licence of the correct class for the vehicle. He must also check that the tyres are correctly inflated and have adequate tread.
- 9.1.2 Seat belts must be used when provided.
- 9.1.3 No person shall ride, and the driver shall not permit any person to ride, on any vehicle in a manner or position which may be liable to cause injury to that person.
- 9.1.4 All loads carried on vehicles must be properly secured. The tying-down ropes are to be secured without trailing ends. Vehicles must not be overloaded.
- 9.1.5 When reversing, the driver must make certain the way is clear and use a signalman if vision is obscured.
- 9.1.6 When a vehicle is raised on jacks or with a hoist, no work must be done under it, until the vehicle has been securely propped in position with stands or heavy wooden blocks.

9.1.7 Drivers must not drive a departmental vehicle if they are affected by alcohol or other drugs.

9.1.8 Drivers must not continue to drive if they are fatigued, ill or unable in any way to exercise complete and alert control of their vehicles.

Falling asleep at the wheel is a very real hazard on long journeys or when working late. Stop at the first sign of sleepiness. Get someone else to drive. If alone, a quick walk in the fresh air may help, but if it doesn't curl up to sleep on the seat. You will most likely find yourself waking again very shortly, perhaps 10 minutes or so later, refreshed enough to carry on. If you sleep longer, you can take it that you would have almost certainly had an accident.

9.1.9 Drivers should practice "defensive driving". That is, make every effort to avoid an accident even though the other party may be at fault. Do not insist on your so-called right-of-way. Safe driving is in everyone's interest.

It is well established that drivers in the younger age group are more likely to have accidents and junior staff should be taught to drive safely (directly, if necessary, but also by example). Do not hesitate to tell a person that you think their driving is unsafe; you owe it to yourself (and them) to do so.

9.1.10 Speeds up to the regulatory limit must be governed by the road and weather conditions.

Some people readily develop the dangerous fault of driving too fast for the conditions. It is easy to do and get away with for a while. Make sure it is not you!

9.1.11 Only approved-type trailer couplings are to be used when towing trailers. Safety chains must be fitted and used.

9.1.12 No vehicle must be driven or used if it is in any way unsafe, e.g., has defective brakes or steering, or the vehicle is not up to warrant of fitness standard.

9.2 Trail Bikes

Motorcyclists are generally more vulnerable to injury. Speeds must be kept down to a safe and reasonable limit to suit the prevailing conditions.

9.2.1 No person shall ride a trail bike on or off the road unless they hold a current drivers licence for that class of vehicle. General road regulations and rules should be accepted as a guide to off-road practice.

9.2.2 Every controlling officer who authorises or directs an employee to ride a trail bike as part of that person's official duties shall satisfy himself that -

A The employee has a riding capability appropriate to the terrain he will be riding over. (Such competence should be demonstrated in an observed riding test over suitable terrain.)

Inexperienced riders must be allowed to gain experience at their own speed on easy routes.

B The employee is familiar with the bike he is to ride. Because the bikes are likely to be operated in remote areas, the employee must be tutored on basic maintenance including field servicing of the ignition, fuel and chain-drive systems.

9.2.3 Every employee who is required to ride a trail bike shall have available to him protective clothing including boots, leggings, gloves and crash helmet.

9.2.4 No employee shall ride a trail bike unless a crash helmet is worn.

9.3 Back Country Driving

9.3.1 Gravel roads

- 9.3.1.1 Drivers must take extra care on gravel roads because braking distances are greater and road holding ability is reduced.

The traffic regulations require drivers to travel at a speed at which they can stop in half the distance of clear road ahead. Many accidents on narrow back-country roads are directly caused by disregarding this regulation. Its observance is extremely important.

- 9.3.1.2 Drivers must travel slowly on gravel roads when passing pedestrians, stockmen, farm animals, other vehicles, etc, to minimise the hazards from dust, flying stones and narrow roadways. This courtesy is expected by residents and workers in remote areas.

9.3.2 Off-road driving

- 9.3.2.1 Drivers must be experienced in the operation of cross-country vehicles in difficult terrain.

- 9.3.2.2 Drivers descending steep or slippery inclines, must use the same or a lower gear than would be required to ascend. The use of brakes must be avoided in such conditions to prevent loss of grip.

The gears will hold the vehicle back on most inclines and the slowly turning wheels will maintain a better grip than locked wheels. Even a light application of the brakes will tend to lock all or some of the wheels; thus the need to apply the brakes must be avoided by selecting the appropriate gear initially.

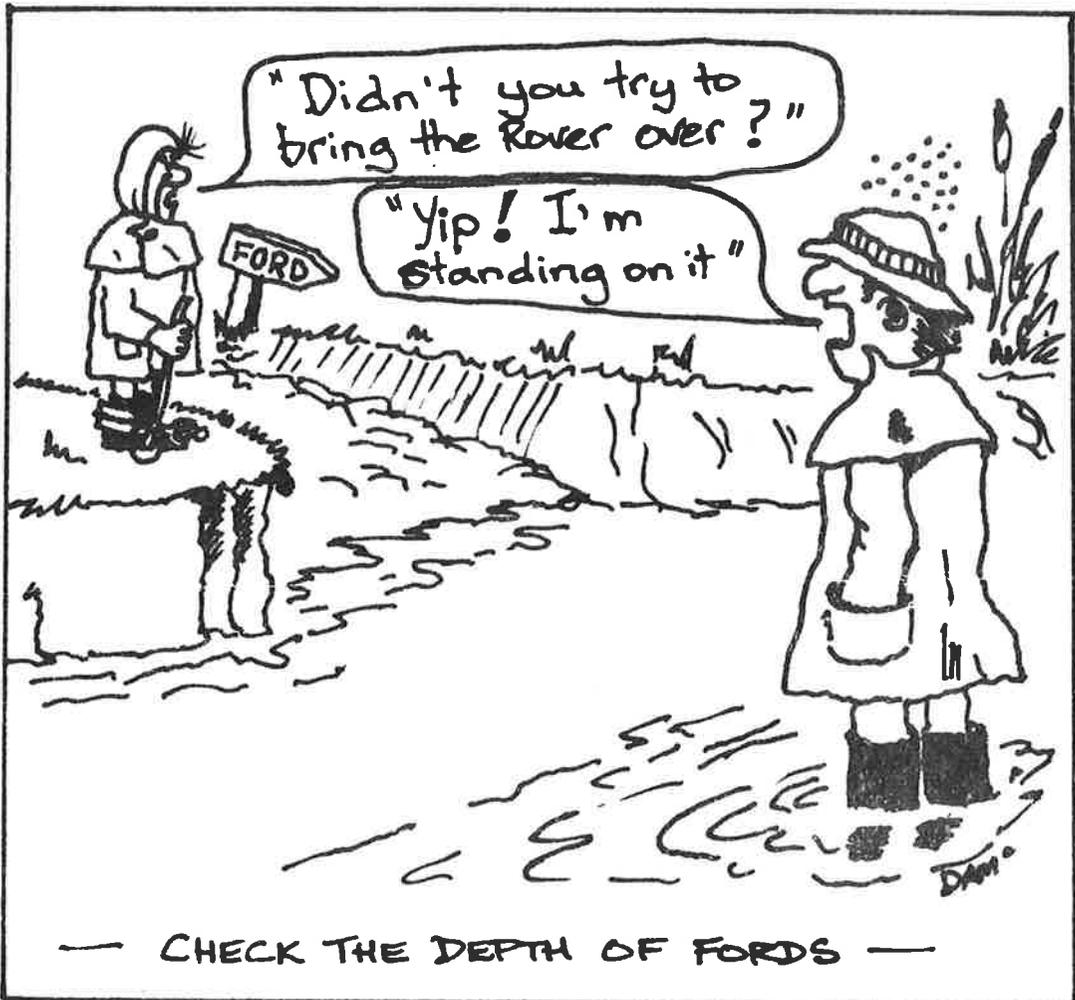
- 9.3.2.3 Drivers must treat fords with caution and ascertain the depth of water and firmness of the bed before entering.

For unformed fords the path through and out onto the far bank must be picked out beforehand.

The force of the river current must be considered. A route diagonally downstream will generally be best.

Passage through the ford should be in a low gear and at a slow speed to prevent water splashing up onto the motor.

Know the limits of your vehicle's capability, determine the suitability or otherwise of the conditions, and if there is any doubt do not enter the water (Figure 12).



"... if there is any doubt do not enter ..."

FIGURE 12

9.3.2.4 Drivers must be aware of the hazards of wet brakes after negotiating fords or pools of water. Care must be taken to dry the brakes whilst driving slowly with the left foot on the brake pedal. The brakes can be ineffective or pull sharply to one side if not completely dry.

9.3.2.5 Drivers must engage a suitable low gear before ascending steep inclines or traversing fords or boggy sections.

9.3.2.6 An emergency kit containing warm clothing, food, firelighting equipment and an identification panel should be carried in a vehicle if snow or cold conditions are likely to be encountered.

This kit may prove invaluable in the event of the party becoming stranded and the brightly coloured identification panel, when mounted on the roof of the vehicle, will aid location from the air when stranded in snow conditions.

9.3.2.7 A first aid kit and fire extinguisher should also be carried in the vehicle.

10 MOUNTAIN SAFETY

Weather in the mountains can change rapidly presenting problems for the unprepared.

- 10.1 Personnel must advise a competent authority of their plans and timing of their trip.
- 10.2 Personnel working in the mountains must either be experienced or be with someone who is experienced in the conditions likely to be encountered.
- 10.3 Personnel must be equipped with adequate waterproof and warm clothing when working in remote country.
- 10.4 No person should travel alone in rough or unfamiliar back country.
- 10.5 Parties travelling in the back country must be equipped with at least one basic first aid kit complete with an aluminium foil survival sheet.
- 10.6 Personnel should carry a two-way radio and a map of the area, especially if required to traverse an unfamiliar area.
- 10.7 Personnel travelling by helicopter must ensure that adequate clothing and supplies are on hand in the event of being stranded in a remote area.
- 10.8 Personnel should not venture onto hard snow without at least an ice axe and knowledge of how to use it. Crampons and a climbing rope may be necessary, but it is essential to know the techniques required to use them.
- 10.9 Personnel should refrain from travelling in areas where there may be an avalanche danger.

The most dangerous times are in the middle of winter when the snowpack is very cold and uncompacted, in spring when the snow is wet and sticky, and just after snowfalls.

Whatever the snow conditions, avoid travelling on or below steep faces and keep to the ridges.

If caught in an avalanche, make every effort to stay on top of it and avoid being buried. Try to cover your mouth and nose to avoid suffocation. If you are buried, try to make an air space in front of your face and chest.

- 10.10 Personnel must be aware of the dangers, symptoms and treatment of exposure (hypothermia). Refer New Zealand Mountain Safety Council's Manual No 5 - Exposure or Hypothermia²⁹. See also pages 52 and 53 which are extracts from the New Zealand Mountain Safety Council pamphlet on Hypothermia.

WHAT IS EXPOSURE? (Hypothermia)

The human body is a machine which works at 37°C. The outer parts can get much colder but the vital organs in the “core” must stay at this constant temperature.

In cold, wet, windy conditions the “core” may start to cool; unless checked, this cooling will cause rapid progress towards death—

- mental deterioration
- loss of co-ordination
- unconsciousness
- failure of breathing and circulation

WHAT CAUSES EXPOSURE?

This loss of body heat is caused by:

- **COLD**—remember temperature drops with altitude
- **WIND**—will drag out heat more quickly
- **WET CLOTHING**—spoils the insulation qualities

Contributory factors are:

- **LACK OF FOOD**—not enough, or the wrong sort
 - **FATIGUE**—lack of fitness, too arduous a trip, or too heavy a load, perhaps
 - **INJURY** and **ANXIETY**
 - **RECENT ILLNESS**, especially ‘flu’
- Always assume that any accident victim in the bush and mountains is already (or will soon be) suffering from exposure also.

SYMPTOMS OF EXPOSURE

Watch for the early warning signs, and don’t always expect complaints of cold from the victim:

- Signs of tiredness, cold or exhaustion
- Lack of interest, lethargy
- Clumsiness, stumbling or falling
- Slurring speech; difficulty in seeing
- Irrational behaviour

The later signs, indicating a *very serious medical emergency* are:

- Obvious distress
- Shivering stops, despite the cold
- Collapse and unconsciousness
- Coma

The victim will often make no complaint, but *may* feel:

- Anxiety or lethargy
- Sense of unreality

The progress of exposure can be very fast, with only as little as 30 minutes from the first symptoms to unconsciousness.



WHAT TO DO

Signs of exposure are a medical emergency; you **MUST NOT** ignore them.

The immediate needs are:

- **PREVENT FURTHER HEAT LOSS**
- **ASSIST REWARMING**
- **TRY TO PREVENT UNCONSCIOUSNESS**

“Bashing on”, for even quite a short distance, can cause rapid onset of serious conditions.

- **STOP AND FIND SHELTER**
Find natural shelter, pitch a tent or dig a snowcave. Get out of the wind.
- **GET PATIENT INTO THE DRY**
Quickly get patient into dry clothes and into a sleeping bag. A warm companion can provide some warmth.
- **WARM SWEET DRINKS**
are valuable, but **NOT** for an unconscious patient. These help to warm from the inside.
- **HEAD DOWN POSITION**
Lying down flat with the head slightly lower than the feet. If a patient is later carried by stretcher this may be very important.
- **NO ALCOHOL**
- **NO RUBBING OR RAPID REHEATING**
- **IF BREATHING STOPS**, start resuscitation.

With warmth and shelter, patients often *appear* to recover quickly; don't be hasty; full recovery can take up to two days. Don't press on again, or collapse becomes very likely.

HOW TO PREVENT EXPOSURE DON'T LET EXPOSURE START!

Prevention is much easier than cure.

- **GOOD CLOTHING**

However fine the weather, be prepared for it to get worse. Have waterproof and windproof clothing—parka and trousers. Wear woollen clothing; wool will help to keep you warm even when wet. Mitts (gloves) and a woollen head-cover are equally important. Heat loss from the head is high and is often overlooked.

- **FOOD**

A good breakfast is essential to provide energy for the day. Take quick-energy food—chocolate, lollies, scroggin—and eat frequent snacks. Have it easily to hand, not at the bottom of the pack.

- **PLAN YOUR TRIP**

Don't try to attempt too much. Leave time for halts. Don't get too hot on the move, but put on spare clothing at halts.

- **DRINK LIQUIDS**

This will help to prevent exhaustion. A “thermos” of hot liquid is an ideal but a fast brew on a primus is also effective.

- **MODERATE LOADS**

Don't try to carry too heavy a load. (This is especially important for young people.) The combination of **COLD, WET** and **WIND** can be lethal. These conditions should make you consider turning back or seeking shelter.

Always check all party members at intervals for any signs of exposure.

11 HELICOPTERS

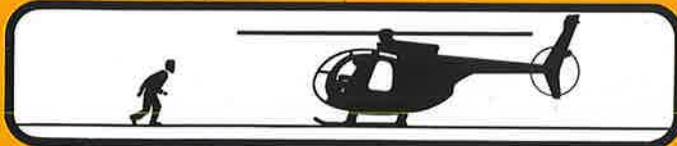
Refer Code of Practice for Cranes and Lifting Appliances,¹¹ and Civil Aviation Safety Order No 9³³.

- 11.1 Personnel must not approach or leave the helicopter without the pilot's knowledge and clearance, and always be within his field of vision.
- 11.2 Personnel must not walk around the rear of the helicopter; tail rotors are almost invisible and easy to walk into.
- 11.3 Personnel must be aware of the main rotor and on sloping ground always approach or leave the machine on the downslope side for maximum rotor clearance.
- 11.4 Personnel must ensure that all equipment and loose articles will be well clear of the effects of rotor wash or heavily weighted down. Even relatively heavy objects can be blown about.
- 11.5 Personnel must ensure that all long objects, e.g., survey staves, are carried horizontally at waist level to avoid the risk of contacting the rotors.
- 11.6 Personnel must keep well away from the landing pad to allow the pilot the maximum choice of approach route and landing position. Beware of being struck or blinded by swirling dust or grit. If this happens, crouch low and await assistance or clearance.
- 11.7 Personnel must load helicopters carefully and under the supervision of the pilot. Make sure the pilot knows about particularly heavy or hazardous items, e.g., lead-acid batteries, cans of fuel, survey staves, etc.
- 11.8 When hooking on cargo slings, personnel must ensure that they know what the pilot expects of them. Care must be taken to ensure the sling is not across the skid!
- 11.9 Cableways and aerial wires are particularly hazardous to helicopter operations.

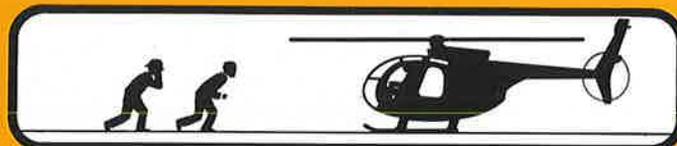
SAFETY AROUND HELICOPTERS



APPROACHING OR LEAVING A HELICOPTER



Do not approach or leave without the pilot's knowledge and clearance. Keep in pilot's field of vision. **Observe Helicopter Safety Zones.**



Proceed in a crouching manner for extra rotor clearance. Hold onto hat unless chin straps are used. Never reach up or chase after hat or other articles that blow away.



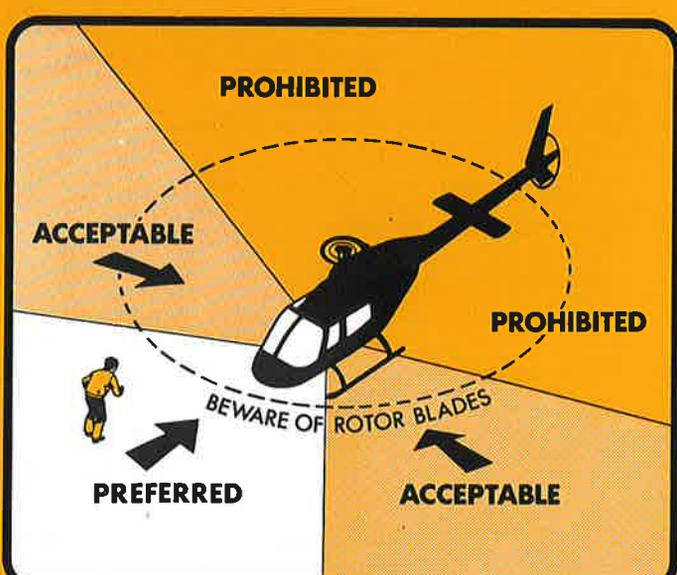
On sloping ground always approach or leave on the downslope side for maximum rotor clearance.



Carry tools, etc. horizontally below waist level - never upright or on the shoulder.



If blinded by swirling dust or grit, **STOP** - crouch lower, or sit down and await assistance.



If disembarking while helicopter is at the hover, get out and off in a smooth unhurried manner.



Do not approach or leave a helicopter when the engine and rotors are running down or starting up.

HELICOPTER SAFETY ZONES

LANDING, TAKE OFF AND LOADING OPERATIONS



Keep helipad clear of loose articles - water bags, ground sheets, tins, etc. Secure other gear from effects of rotor wash.



When transporting personnel, loading staff should ensure that:



When directing pilot for landing, stand with back to wind and arms upraised.

- Passengers are briefed as above;
- They are grouped together and well back at side of landing zone;
- They face away from helicopter during take-off and landing;
- Each man looks after his own gear;
- They are paired off and ready to board in turn as soon as the pilot gives the signal.



When directing pilot by radio, remember that he may be too busy to give an acknowledgement.



After hooking up cargo sling, move forward and to the side to signal pilot. Ensure sling is not across skid. Never ride on sling.



Fasten and adjust seat belt on entering helicopter and leave it fastened until pilot signals to get out.

Take note of all locations of these, inform your pilot and point them out to him. When involved in installing these, ensure that the towers or anchorages are clearly visible from the air because these are what pilots notice, not the wires.

- 11.10 Personnel required to work with helicopters must be aware of the helicopter safety rules (see Safety Around Helicopters poster - Figure 13).

12 RADIOACTIVE EQUIPMENT

Some items of equipment such as moisture meters and geophysical instruments have radioactive sources. These instruments will be appropriately marked and must be handled and stored with special care.

- 12.1 Radioactive materials are usually sealed within a stainless steel pellet to minimise the possibility of leakage. (There have been cases of instruments being severely damaged whilst the pellet has remained intact.)

Radiation emitted by the source can be hazardous to health. However distance protects, and with most pellets the exposure is only significant less than 1 cm away.

- 12.2 The following rules must be followed -

- 12.2.1 Under no circumstances handle the stainless steel pellet. If it does have to be moved by hand, use tongs or a similar implement to pick it up.
- 12.2.2 As part of the equipment the pellet will be surrounded by a material such as plastic or lead which absorbs the emitted radiation. Make sure that the source is within this absorber when the equipment is not in operation.
- 12.2.3 All radioactive sources are by law required to be administered by a person who possesses a Radioactive Materials Certificate issued by the National Radiation Laboratory. This person is responsible for arranging the annual inspection of the pellet through the Water and Soil Instrument Service Centre, Christchurch.
- 12.2.4 If at any time radioactive leakage is suspected, the following authority must be contacted immediately -

National Radiation Laboratory
PO Box 25099
Christchurch

Telephone 65 059.

13 REPORTING OF ACCIDENTS

Accident reporting procedures are mandatory in terms of the 'Construction Act'¹⁴ and the 'Accident Compensation Act'¹³.

The following procedure is laid down for Ministry of Works and Development personnel. (Other organisations should follow their own procedures.)

13.1 Accidents to be Reported

All accidents however slight are to be reported immediately to the controlling officer or to the senior employee present and an accident report or notification in the first aid notebook completed.

Failure to do so could prejudice any claim for compensation. The notebooks in all first aid kits are to be used to record all first aid treatment, giving details of the accident however trivial.

13.2 Accident Reporting Procedure

Employees must promptly inform their immediate controlling officer of any injury received.

The controlling officer is to advise the resident engineer or equivalent of full details of the accident and names of eye witnesses. Unless the injury is trivial and involves neither medical attention nor absence from duty, written statements should be obtained from the injured employee and from eye witnesses.

The controlling officer shall ensure a 'Notification of Accident and Claim' Form (ACC - C1) is completed and immediately forwarded to the wages or staff clerk together with a medical certificate (if relevant) and names of and comments from any witnesses.

The controlling officer should also complete an ACC - S28 Supervisors Accident Investigation Report

Form for all work-related lost time accidents, near misses, or potentially serious accidents, and forward it to the local safety officer.

If a loss of time of 2 days or more is expected then a copy of Labour Department Form Lab 376 must be sent to the Department of Labour in the district where the accident occurred as soon as possible within 48 hours of the accident.

In the case of a serious or fatal accident nothing must be done at the site which might prevent ascertaining the cause of the accident until authorised by a Department of Labour Safety Inspector.

For Fatal Accident Reporting Procedures refer to the Ministry of Works and Development Safety Manual ²⁶.

14 FIRST AID (Refer also First Aid⁴)

14.1 First Aid Treatment

It is the Department's policy that adequate First Aid Kits are provided and trained First Aiders are available at all work headquarters.

When someone is injured, what is done or what is not done for the patient in the interval before the trained First Aider or medical assistance arrives can make the difference between life and death, or permanent or temporary disability.

Instructions outlined below are broad guidelines for emergency treatment only. Further medical aid (Industrial Nurse, Doctor, Ambulance or Hospital) should be obtained as soon as possible in all cases.

14.1.1 Resuscitation

"Rescue Breathing Can Save a Life"

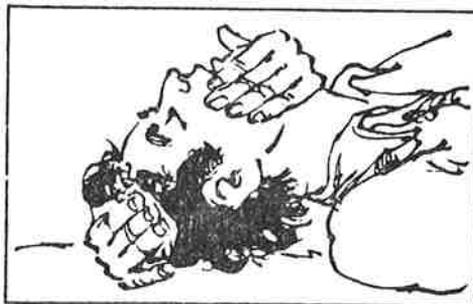
If patient is not breathing or is having difficulty breathing ...

Do Not Waste Time - the first four breaths are vital.

Place patient on his back if possible.

Ensure clear airway by turning head to one side, clearing mouth,

Then tilt head back.



Patient may start breathing, if not
 Place your mouth over patient's mouth or nose.
 Blow in until chest is seen to rise.



Remove your mouth, watch chest fall and listen
 for air to come out.

Repeat at your normal breathing rate.

If chest does not rise, check airway is clear, and
 head is well back.

For infants or children, inflate lungs with less
 pressure.

Otherwise continue as above.

Keep constant check on pulse and if felt, continue
 Rescue Breathing.

If not felt heart has stopped beating.

Check carefully. If no pulse, no colour improvement
 and pupils dilated (very large) commence External
 Heart Compression at once.

Combine chest compressions with Rescue Breathing.

Place heel of hand on lower half of breast bone.



Depress chest 20 to 40 mm.

If alone give two breaths then 15 compressions, and repeat at rate of 80 compressions per minute.

If two rescuers, give one breath and five compressions and repeat at rate of 60 compressions per minute.

For infants or children apply very light compressions at a rate of 100 compressions per minute.

Check for pulse after every four lung inflations.

If present stop compressions and continue lung inflations.

If not felt, continue as before.

When the person starts breathing voluntarily, place in the recovery position and keep under observation.



Recovery position

14.1.2 Unconsciousness

If a person is found unconscious ascertain that he is breathing, that there are no spinal injuries, then place him in the recovery position.

14.1.3 Bleeding

Apply direct pressure to wound, cover with clean dressing, secure with firm bandage.

Sit or lie patient down.

Elevate bleeding part.

14.1.4 Burns or scalds

Immediately immerse or cover burnt/scalded area in cool water.

Remove constrictions, rings, watches, belt, boots etc.

When pain eases, cover area lightly with clean dressing.

If conscious, give water to sip at frequent intervals.

14.1.5 Poisoning

For correct treatment check label of the poison container.

All Poisons

If patient is conscious, give copious quantities of milk or water.

Do not induce vomiting.

Do not waste time, get patient to medical aid urgently.

Keep sample of poison or container and send with patient.

14.1.6 Eyes

Acid or irritant in the eyes:

Wash for at least 10 minutes with clean running water.

Foreign body in the eye:

If not easily removed by washing, cover both eyes with soft pad and take patient to doctor.

Any serious eye injury, lie patient down, cover both eyes with soft pad and transport as stretcher case.

Always seek medical aid for eye injuries.

14.1.7 Fractures

Support the fracture, do not move unnecessarily.

Cover any wound, no direct pressure on site of fracture.

Protect with padding and secure to splint or patient's own body.

Treat for shock.

14.1.8 Shock

Symptoms: Skin pale, cold and clammy, bluish tinge to lips and fingernails.

Reassure and keep patient under observation.

Lie patient down and keep comfortable and warm.

Loosen tight clothing.

No alcoholic drinks, moisten lips only with water.

Treat any injuries.

14.2 First Aid Kits

14.2.1 First aid kits are provided in all Ministry of Works and Development buildings, and in workshops and construction sites according to the requirements of the Factories Act and Regulations¹⁵ and the Construction Act and Regulations¹⁴.

14.2.2 Portable first aid kits are to be carried in all vehicles used to transport construction and maintenance staff to or from worksites.

- 14.2.3 A suitable person is to be made responsible for stocking and replenishing each first aid kit. Whenever practicable this person should hold a current first aid certificate.
- 14.2.4 Size and content of first aid kits shall be as set out in the Government Stores Board Contract.
- 14.2.5 Cabinets containing first aid kits should be located in readily accessible areas with first aid direction posters displayed for the convenience of all staff.

14.3 First Aid Training

In order to ensure adequate numbers of trained first aiders are available the department encourages interested employees to attend Red Cross or St Johns ambulance courses. The department will arrange and pay for such courses and leave on pay is granted when courses are held during normal working hours.

14.4 Civil Defence

New Zealand is vulnerable to floods, earthquakes, volcanic activity and other natural hazards, and man-made dangers which have the potential to cause widespread damage and loss of life. The occurrence of such a catastrophe normally results in the declaration of a "Civil Defence Emergency" which permits the local or regional authority to invoke the special powers extended to them by the Civil Defence Act 1962.

This department has a major role to play in such an emergency.

14.4.1 Role of Ministry of Works and Development

In the event of a major disaster, immediate action must be taken by the Ministry of Works and Development to restore essential public works. First priority will be given to the removal of hazards, the restoration of surface communications, and the provision of

essential sanitary and similar emergency services. If necessary, the Ministry of Works and Development will assist other departments in meeting their responsibilities.

14.4.2 Contact officers

The names, telephone numbers and addresses of Ministry of Works and Development contact officers are listed in the Ministry of Works and Development Emergency Organisation Booklet, which is issued six monthly to emergency staff. Copies are held by District, Project and Residency management staff and administration sections.

14.4.3 General emergency procedure

Earthquakes

- A There may be instructions for individual buildings, but generally, in the event of severe earthquake, you should keep away from windows and take immediate cover beneath a desk or doorway. You should not leave buildings until instructed to do so by your building warden.
- B Read, understand and follow civil defence advice given on the back of the Post Office Telephone Directory and Yellow Pages.

15 REFERENCESSafety Codes and Guides, Statutory Acts and Regulations15.1 Department of Labour Safety in Construction Publications

- 1 No 1 - A Short Guide to the Construction Act 1959
- 2 No 3 - Code of Practice for Scaffolding
- 3 No 5 - Code of Practice for Excavation
- 4 No 6 - First Aid 1981
- 5 No 14 - Trench Collapse on Construction Work
- 6 No 15 - Code of Practice for Diving on Construction Work 1981
- 7 No 16 - Powder-Powered Tool Guide 1982
- 8 No 18 - Code of Practice for Work in Compressed Air
- 9 No 19 - Safety Supervisors Guide 1981
- 10 No 20 - Safe Use of Electricity 1981
- 11 No 24 - Code of Practice for Cranes and Lifting Appliances
- 12 No 26 - Rigging Code of Practice.

15.2 Acts and Regulations Containing Safety Legislation

- 13 Accident Compensation Act 1972 (reprint 1975)
- 14 Construction Act 1959 and Regulations 1961
- 15 Factories Act 1946 and Regulations
- 16 Traffic Regulations 1976.

15.3 Standard Specifications and Codes of Practice

- 17 NZS 5807:1980 Code of Practice for Industrial Identification by Colour, Wording or Other Coding
- 18 NZS 5819:1981 Chainsaws, Safe Use and Design
- 19 NZS 5806:1980 Safety Helmets
- 20 NZS 5811 Industrial Safety Belts and Harnesses
- 21 NZS 5823:1982 Buoyancy Aids
- 22 AS 1657:1974 Code of Fixed Platforms, Walkways, Stairways and Ladders.

15.4 National Roads Board Publications

- 23 Manual on Temporary Control of Traffic
- 24 Manual on Traffic Signs and Marking
- 25 Hand Signals for Controlling Traffic at Work Sites.

15.5 General Safety Books and Publicity Material

- 26 MWD Safety Manual 1982
- 27 'Safety Around Helicopters' poster - issued by Flight Operations Branch, Civil Aviation Division, Ministry of Transport

- 28 'Cold Water Survival' pamphlet published by the NZ Water Safety Council, Department of Internal Affairs
- 29 'Hypothermia or Exposure' Manual No 5 published by the NZ Mountain Safety Council, Department of Internal Affairs
- 30 'Bushcraft Manual' published by the NZ Mountain Safety Council, Department of Internal Affairs
- 31 'Mountaincraft' Mountain Safety Manual No 3 published by the NZ Mountain Safety Council, Department of Internal Affairs
- 32 'Safety in the Mountains' published by the Federated Mountain Club of NZ
- 33 Civil Aviation Safety Order No 9.

15.6 MWD Internal Reports

- 34 'Safety Aspects on the Use of Trailer-Mounted River Gauging Cranes' by J K Fenwick, Water and Soil Science Centre Internal Report No 577
- 35 'Design and Operation of a Manned Cablecar Retriever Trolley' by R J Curry, Water and Soil Science Centre Internal Report No WS 842.

15.7 Miscellaneous Manuals and Specifications

- 36 Timber Preservation in New Zealand Specifications Amendment No 4, Timber Preservation Authority 1980
- 37 Reference Manual for Hydrological Structures Civil Engineering Publication 814, MWD, Wellington May 1979.

ACKNOWLEDGMENTS

The authors wish to acknowledge specific safety instruction issued over the years by the various Ministry of Works and Development offices. Although some of these instructions were in conflict over some issues, they generally provided a most useful source of information.

Comments and ideas received from members of the Wellington, Christchurch, Greymouth and Tekapo field parties were much appreciated as was the permission to reproduce: the NZ Water Safety Council's revision of its 'Cold Water Survival' pamphlet (in print); The NZ Mountains Safety Council's 'Exposure Can Kill' pamphlet; and the Flight Operations Branch of the Civil Aviation Division of the Ministry of Transport's 'Safety around Helicopters' poster.

Many thanks also to Mr D McMillan (Hydrology Centre, Ministry of Works and Development, Christchurch) for his cartoon interpretations, and to Messrs G N Martin (Ministry of Works and Development, Dunedin) and H J Freestone (Head Office, Ministry of Works and Development, Wellington) for their most helpful review and criticism.

WATER & SOIL TECHNICAL PUBLICATIONS

- | | |
|--|------|
| 1. Liquid and waterborne wastes research in New Zealand, 1976 (\$1) | 1977 |
| 2. Sampling of surface waters. (\$1) | 1977 |
| 3. Water quality research in New Zealand 1976. (\$1) | 1977 |
| 5. Late Quaternary sedimentary processes at Ohiwa Harbour, eastern Bay of Plenty with special reference to property loss on Ohiwa. (\$1) | 1978 |
| 7. Effects of domestic wastewater disposal by land irrigation on groundwater quality of the central Canterbury Plains. (\$1) | 1978 |
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