

Report on the investigation of
the capsizing of

**Army Cadet Force
Rigid Raiding Craft**

In Loch Carnan, South Uist,
Western Isles of Scotland

3 August 2007

Resulting in one fatality

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
United Kingdom
SO15 2DZ

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Extract from
The United Kingdom Merchant Shipping
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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

ACF	-	Army Cadet Force
ALARP	-	As Low As Reasonably Practicable
ATLJ	-	Assault Troop Lifejacket
BR	-	Book of Reference
CCF	-	Combined Cadet Force
CEO	-	Cadet Executive Officer
CFAV	-	Cadet Force Adult Volunteers
CO	-	Commanding Officer
Comdt	-	Cadet Commandant
CRF	-	Commander Regional Forces
DRFC	-	Directorate of Reserve Forces and Cadets
GPMG	-	General Purpose Machine Gun
GPS	-	Global Positioning System
GRP	-	Glass Reinforced Plastic
HP	-	Horse power
JSP	-	Joint Services Publication
kg	-	kilogram
LAIT	-	Land Accident Prevention and Investigation Team
LCLJ	-	Landing Craft Lifejacket
m	-	Metre
MCA	-	Maritime and Coastguard Agency
mm	-	millimetre
MoD	-	Ministry of Defence
N	-	Newton
NCF	-	Naval Cadet Force

RFCA	-	Reserve Forces and Cadets Association
RIB	-	Rigid-hulled Inflatable Boat
RM	-	Royal Marine
RNLI	-	Royal National Lifeboat Institution
RRC	-	Rigid Raiding Craft
RRC1	-	Rigid Raiding Craft Mk1
RRC2	-	Rigid Raiding Craft Mk2
RYA	-	Royal Yachting Association
SAR	-	Search and Rescue
SOLAS	-	International Convention for the Safety of Life at Sea
SSEL	-	Sea Survival Equipment Log
SST	-	Safe System of Training
TA	-	Territorial Army
TSA	-	Training Safety Advisor
UK	-	United Kingdom
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency

All times used in this report are UTC + 1 unless otherwise stated



Army Cadet Force Rigid Raiding Craft Mk 2

SYNOPSIS



At approximately 1000 on 3 August 2007, three Army Cadet Force rigid raiding craft set off from Loch Carnan jetty, South Uist to transport a group of cadets and their adult instructors to an exercise area in Loch Skipport. Shortly after setting off, the sea conditions worsened and the officer in charge of the activity decided that the boats should turn back. At about 1005 one of the boats, which had accumulated a large amount of water on its deck, capsized.

Four of the twelve persons on board initially surfaced under the upturned hull, but only three managed to swim clear. The fourth, a 14 year old female cadet remained under the hull. Although a headcount was conducted, it failed to identify that the girl was missing. The survivors were returned to the jetty and onto their base camp in two groups. The trapped cadet was identified as missing at 1130 and was found under the boat on the rocky shores of Steisay Island at 1305. She was taken to the Western Isles hospital by coastguard helicopter but was pronounced dead on arrival.

The investigation identified a number of factors which contributed to the capsizing and the death of the cadet, including:

- The weight distribution within the boat reduced the freeboard forward and increased the likelihood of water being shipped.
- Water accumulated on the deck because the boat's self-bailers had not been lowered.
- The actions taken by the boat's coxswain did not take account of the free surface effect of the accumulated water.
- The lifejacket worn by the female cadet was not suitable for use by children and would have prevented her escape from the upturned hull once inflated.
- The delay in identifying that she was missing undoubtedly reduced her chances of survival.

A number of safety issues regarding the planning, control and authorisation of the activity were also identified. In particular, information, instructions and guidance included in numerous MoD publications pertinent to the ferrying of the cadets was not followed, and the verification and authorisation procedures for the ferrying activity were not robust.

The Ministry of Defence, Army and Army Cadet Force have taken, or initiated, a number of actions to address the issues identified with regard to the safety of cadet force training. In addition, the Royal Yachting Association has taken action to improve the knowledge of factors affecting boat stability among powerboat coxswains. Recommendations made to the Director of Reserve Forces and Cadets aim to: raise the awareness of non-syllabus activities conducted by individual units; provide all cadet forces access to external sources of expertise when planning and approving such activities; ensure that all activities are conducted in compliance with applicable instructions and guidance, and; ensure that approval to conduct such activities is given at an appropriate level in the chain of command.

SECTION ONE - FACTUAL INFORMATION

1.1 PARTICULARS OF RIGID RAIDING CRAFT MK2 AND ACCIDENT

Vessel details

Registered owner	:	Ministry of Defence
Type	:	Rigid Raiding Craft Mk2
Built	:	1994, RTK Marine Ltd - Poole
Construction	:	GRP Cathedral Style Hull
Length overall	:	7.35 m
Gross tonnage	:	1.88 T (complete with engine)
Engine power and type	:	Yamaha 200HP outboard engine
Service speed	:	Up to 32 knots
Other relevant info	:	Serial No. 9482

Accident details

Time and date	:	1005, 3 August 2007
Location of incident	:	57 22.5N 007 014.4W. Loch Carnan, east coast of South Uist, Western Isles of Scotland
Persons on board	:	12
Injuries/fatalities	:	One fatality
Damage	:	Structural damage to steering console, passenger seating and fuel supply system

1.2 NARRATIVE

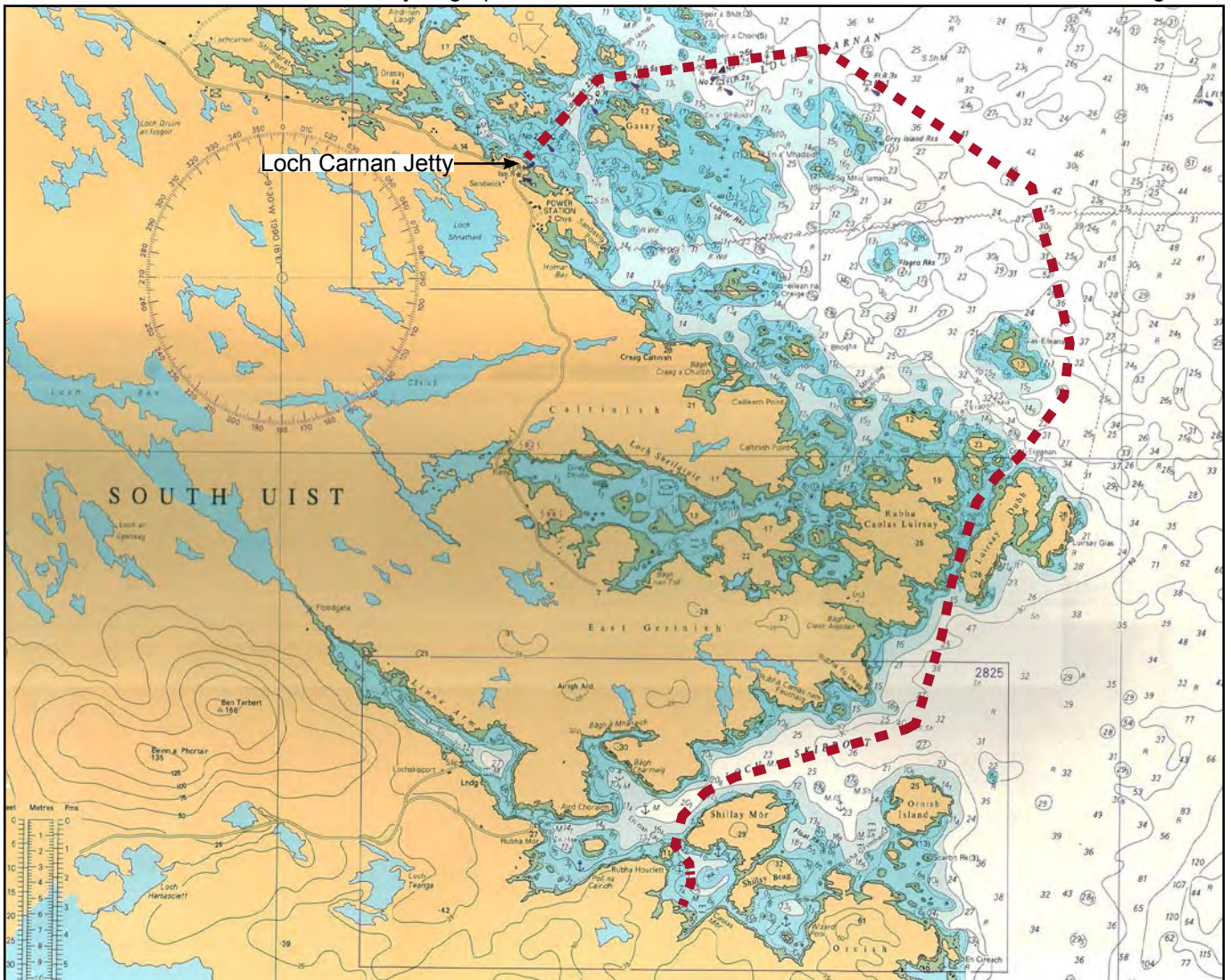
1.2.1 Events leading up to the capsizing

At approximately 0900 on 3 August 2007 four members of the 2nd Battalion the Highlanders Army Cadet Force (ACF) arrived at Loch Carnan Jetty, South Uist, to transport a group of 14 and 15 year old army cadets to the ACF training areas at Loch Skipport (**Figure 1**) in three rigid raiding craft. The battalion's Cadet Executive Officer (CEO) was in charge and was also the coxswain of a Mk2 Rigid Raiding Craft (RRC2). The other boats were Mk1 Rigid Raiding Craft (RRC1).

The CEO was aware of the Meteorological Office forecast for poor weather during the day. However, the water near the jetty was calm and the wind was light, and having consulted with the other coxswains he considered it safe to operate the craft as intended. The boats were launched from a slipway and then moored on an adjacent pier situated within the island's petrol terminal.

Reproduced from Admiralty Chart 2904 by permission of the Controller of HMSO and the UK Hydrographic Office

Figure 1



Intended route of vessel

At approximately 0915 a group of 34 cadets, referred to as a 'two star cadre'¹, and 4 adult instructors arrived at the jetty at the start of a 1½ day field craft² exercise. Due to the capacity of the boats available, the cadre was split into two groups. The first group (17 cadets and 3 adult instructors) assembled on the slipway. The cadets donned manually operated lifejackets over their weather resistant Gortex jackets and trousers. They were also wearing webbing belts and carrying training rifles. The lifejackets worn by the instructors were designed to inflate automatically on entering the water. With the exception of the only female instructor, all adults wore a dry suit and helmet.

The cadets and instructors were briefed on the operation of the lifejackets before being led through the petrol terminal to the boarding point. They were then helped onto the boats by the boat coxswains, who had recently completed their safety and communication checks. The remaining 17 cadets and adult instructor, who was the Major in overall charge of the cadre, returned to their minibus to wait for the boats to return.

The RRC2 was berthed next to the pier with the two RRC1s secured outboard. The cadets were seated in the outer boats first on a 'first come first served' basis. They were then briefed again by their respective coxswains on the operation of their lifejackets and the actions to take in the event of falling overboard. The cadets' training rifles were secured with rope to the bottom of the boats.

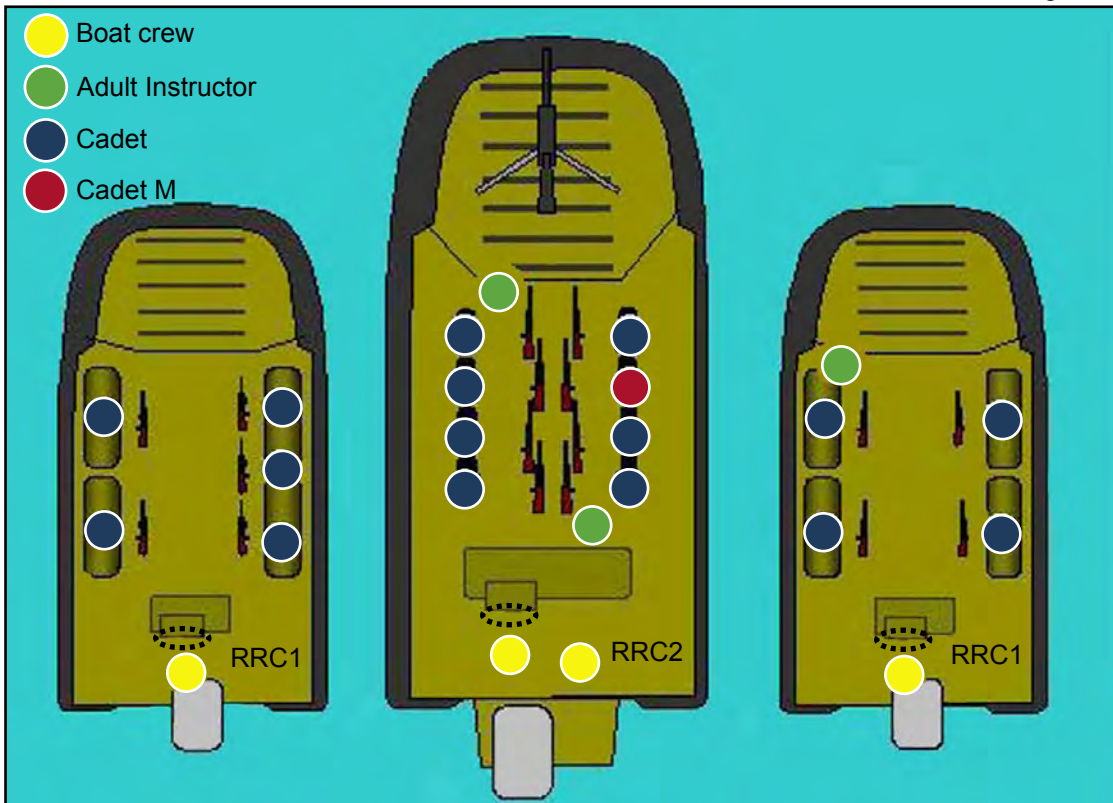
At approximately 1000, the boats set off in line astern with a distance between craft of about 100m. The RRC2 was second in the line of three boats and, in addition to the CEO, was carrying a crewman, two adult instructors and eight cadets. The eight cadets were seated in front of the steering console on two banks of four straddle seats. The female instructor was sitting on the deck in front of the console, and a male instructor was positioned in the bow next to a general purpose machine gun (GPMG) which had been lashed to the deck and fitted with a belt of blank ammunition (**Figure 2**). In addition to the coxswains, the lead boat was carrying four cadets and one instructor and the rear boat was carrying five cadets.

As the boats headed out to the buoyed channel between Gasay Island and Taigh Iamain Island (**Figure 3**), speed was increased to approximately 20 knots. As they reached the No2 starboard hand buoy, the sea conditions worsened. The RRC2 began to take on water over its bow and sides and the CEO decided to return to Loch Carnan. He slowed down and turned to starboard into the sea and the prevailing south-south west wind. The CEO then called the other coxswains on his hand-held VHF radio, but was unable to establish contact. However, he made his intention known to the rear boat by using hand signals. Accordingly, the rear craft turned around and headed back to the jetty. To attract the attention of the lead boat, the CEO ordered the instructor at the bow of his boat to fire a series of bursts on the GPMG. This failed to alert the coxswain of the lead RRC, and the CEO decided to manoeuvre in order to maintain visual contact with the distant craft. More water was shipped over the bow and sides, but in larger quantities, and this accumulated in the bottom of the craft.

As the coxswain of the lead RRC1 approached the No1 port hand buoy, he also became concerned at the deteriorating conditions, and turned back. When the CEO saw the lead boat turn around, he slowed down, turned his boat into the sea and held his position so that he could assess the situation.

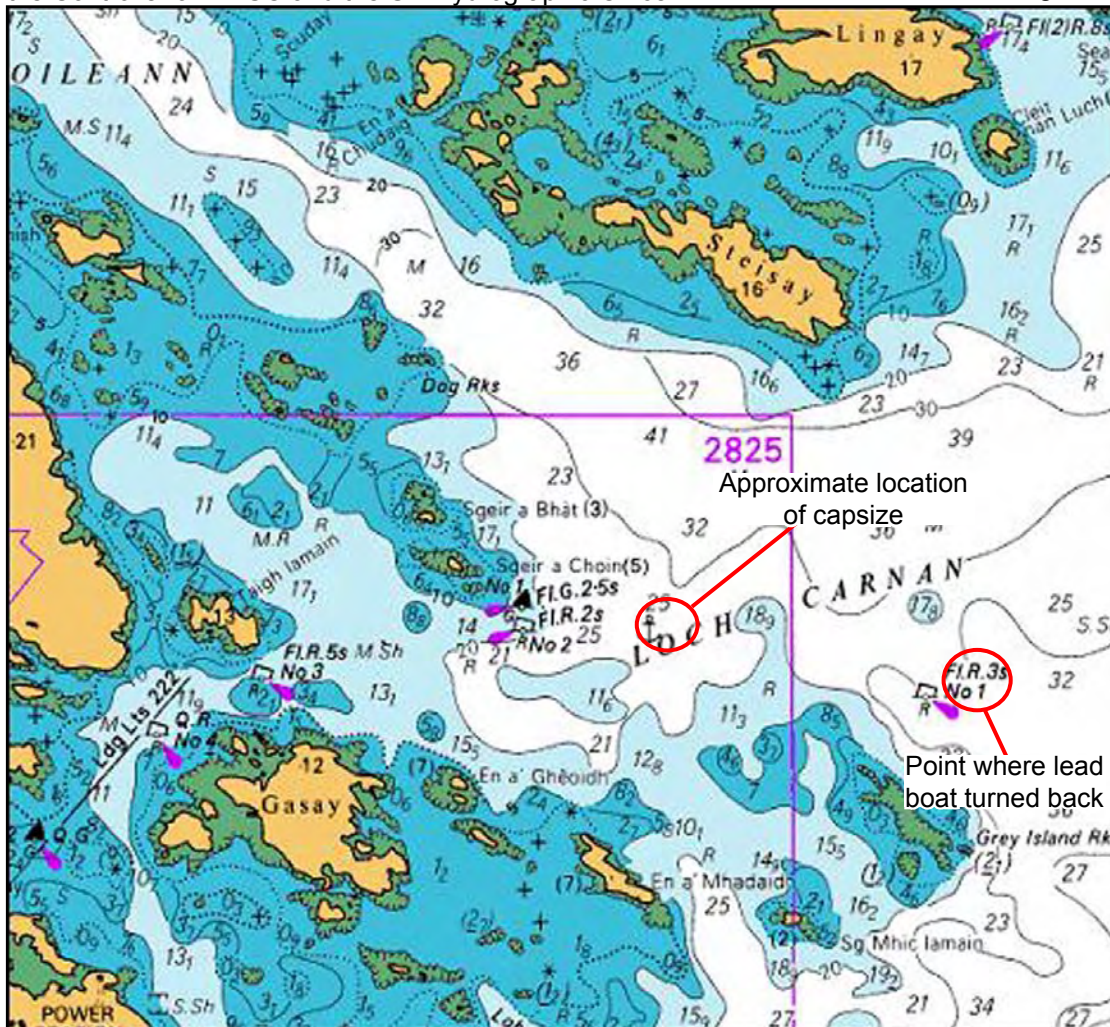
¹ "Cadre" refers to a group of cadets and "two star" refers to the level attained in their ACF training.

² "Field craft" covers the skills and techniques used by the military on the battlefield.



Boat loading at the time of capsizing

Reproduced from Admiralty Chart 2904 by permission of the Controller of HMSO and the UK Hydrographic Office



Location of capsizing

1.2.2 The capsize

The RRC2 was now listing to port, and the depth of water in the port aft quarter was estimated to be approximately 300mm. The CEO removed the engine kill cord from his leg to enable him to secure a buoyant oil reservoir, which was floating. He also ordered the crewman to lower the boat's port side 'trouser leg' drain³. The CEO then increased the throttle, started to turn to starboard and ordered the cadets to move to the starboard side. As the cadets on the port seats stood up and moved across, the boat immediately heeled to starboard, causing the water in the bottom of the boat to rush to the lower side. The CEO immediately ordered everyone to the centre of the boat, but the angle of heel was already sufficient for the boat's gunwale⁴ at its starboard quarter to submerge. Consequently, the craft took on more water and the heel to starboard continued until it capsized at approximately 1005.

The boat's occupants were thrown into the water, and three cadets and the female instructor came to the surface under the upturned hull where an air pocket had formed. The instructor and two of the cadets swam under the seats of the boat into clear water. The female instructor surfaced in a very distressed state and her lifejacket was activated for her by the CEO. The CEO also activated lifejackets for a number of cadets.

1.2.3 Events after the capsize

Several minutes after the RRC2 capsized, the CEO climbed onto its upturned hull while the crewman and one cadet clung to the floating engine oil box which was still attached to the stern. By now, six cadets and the two adult instructors were drifting away from the upturned hull. One female cadet, Cadet M, remained under the upturned hull.

The capsized boat was quickly spotted by the coxswain in the lead RRC1 who commenced broadcasting a "Mayday"⁵ on VHF channel 16. Communications with the coastguard could not be established immediately and the coxswain passed the VHF radio to the adult instructor in his boat to keep trying. Meanwhile, the RRC1 recovered the cadets and instructors from the water and took them to the upturned hull.

Stornoway Coastguard was alerted at about 1007 by the following VHF radio transmission:

"Mayday, Mayday, Mayday... This is boats one and two. We have just left the pier at Loch.... [transmission broken up]...at North Uist, about one mile out to sea. One boat overturned....Mayday, Mayday, Mayday...Over".

The transmission was difficult to understand, but Stornoway Coastguard immediately arranged for the launch of a search and rescue (SAR) helicopter and the Barra lifeboat. As the "Mayday" call received by the coastguard indicated that the RRC2 had capsized in the vicinity of North Uist, the initial search was focussed in this area.

As soon as the cadets and instructors were recovered from the water, the CEO and the coxswain of the RRC1 conducted a headcount. At this time, there were 11 people in the RRC1 and 5 people on the upturned hull. The crewman remained in the water,

³ RRC are fitted with two *trouser leg* drains on the aft transom which are designed to act as self bailers when the craft is underway.

⁴ The top edge of the side of the RRC.

⁵ International distress call

supported by the engine oil box. On completion of the headcount, which failed to identify that Cadet M was missing, the RRC1 returned to Loch Carnan jetty and landed five survivors from the RRC2, which included the female instructor, and the four cadets it had originally embarked. As the group made their way to the car park to report to the Major in charge of the cadre, one of the RRC1s returned to the scene of the capsized to recover the remaining cadets and instructors.

The Major in charge of the cadre, who was waiting in a minibus, was surprised by the return of the cadets. He was informed of what had happened by the female instructor who was very distressed. When the Major was told that the RRC1 had gone to collect the remaining survivors, he interpreted this to mean that everything was under control. The landed survivors were soaking wet and beginning to show signs of exposure. With little shelter and no support at the jetty, the Major decided to return the group to the hangar at the Range Head⁶.

When the second group of survivors arrived back at the slipway, additional transport and support had already arrived. The CEO sought assurance that everyone had been accounted for and interpreted the responses he received to be positive. The second group of survivors were then transported back to the Range Head by minibus.

At 1055, Stornoway Coastguard was advised that all the cadets and instructors had been landed ashore and were safe. The SAR helicopter and RNLI lifeboat were then stood down. At 1120, the CEO and the other two coxswains returned to sea in the two RRC1s to search for, and recover, the upturned RRC2 and weapons.

At the Range Head, the male and female cadets were split into two groups and instructed to get out of their wet clothes and into sleeping bags. At approximately 1130 it became apparent that one female cadet was missing. At this point, the female instructor recalled seeing Cadet M under the boat. The battalion's assistant training officer went to search the jetty area, where he met and advised a mobile coastguard team of the missing cadet. At 1152, the coastguard reactivated the SAR helicopter and the Barra lifeboat; the assistance of local fish farm workers was also requested.

Soon afterwards, both RRC1s returned to the jetty and they, too, were informed of the missing cadet. The CEO had re-located the RRC2 on the south side of Steisay Island, but had been unable to land the craft due to the rocky nature of the beach. Both RRC1s immediately joined the search but returned to the jetty at 1237 because of the deteriorating conditions.

The upturned hull was re-located on the south side of Steisay Island by a fish farm boat at 1251. Hampered by the rocky coastline, five fish farm workers and a member of the coastguard arrived at the RRC2 at 1305 and saw an inflated lifejacket under the hull. The SAR helicopter arrived at about the same time and a paramedic was winched down to assist. The paramedic confirmed that Cadet M was under the boat. She was lying face up, and there were no signs of life. The underside of the boat was difficult to access and, with the casualty stuck between the boat and the rocks, further manpower was needed to lift the boat clear. The SAR helicopter collected the CEO and two coxswains from the jetty and lowered them on to the island.

⁶ The Range Head is located at the head of a firing range approximately 15 to 20 minutes away from Loch Carnan jetty by minibus. The cadre had camped there the previous night.

The boat was then raised, the GPMG was cut away, and Cadet M's lifejacket was punctured to allow her to be removed. At 1333 Cadet M was winched in to the helicopter where advanced life support procedures were conducted en route to Stornoway. She was transferred to a waiting ambulance at 1420 and taken to the Western Isles hospital where she was pronounced dead at 1445. A post mortem examination was conducted on 6 August 2007, which concluded that Cadet M had drowned.

1.3 ENVIRONMENTAL CONDITIONS AND FORECAST

At the time of the capsizing of the RRC2, the wind was south-south west force 5 to 7, the sea state moderate and visibility was poor. The battalion received regular 3 day weather forecasts from the staff at West Camp during its stay on Benbecula. The forecast used by the CEO during the evening of 2 August 2007 was issued the day previously (**Annex A**) and predicted the conditions for the morning of 3 August to be:

Southerly winds, 15 knots gusting to 25 knots, becoming 20 to 25 knots, gusting 30 to 35 Knots; Sea state 4 (moderate) becoming 5 (rough); visibility moderate in slight rain becoming poor in moderate rain and drizzle.

Members of the training team were also advised of the predicted deteriorating conditions by pilots operating at the airport adjacent to West Camp during the evening of 2 August 2007.

During the morning of 3 August 2007 the Stornoway Coastguard broadcast the following forecast issued by the Meteorological Office on VHF radio:

South or southwest wind, force 3 to 4, increasing to 5 to 7 and perhaps gale force 8 later; Rain; Visibility moderate or good becoming moderate or poor

The CEO and the other RRC coxswains were not aware of this forecast.

1.4 ARMY CADET FORCE

1.4.1 Organisational structure

The Army Cadet Force (ACF) is one of several cadet forces within the UK sponsored by the Ministry of Defence (MoD). It is a voluntary youth organisation and provides military, adventurous and community activities. In May 2007 there were 1,708 ACF detachments⁷ within the UK, with nearly 45,000 cadets and over 8,000 Cadet Force Adult Volunteers (CFAV). Individual ACF detachments are grouped into battalions, batteries or counties according to their geographical location. These battalions, batteries or counties are themselves grouped by location and affiliated to one of 11 Regular Army brigades.

The day to day administration and management of ACF detachments is the responsibility of the Reserve Forces and Cadets Association (RFCA). The RFCA owns the majority of premises used by the ACF and is responsible for the general management of safety, health and environmental issues within them. To discharge this responsibility the RFCA employs a small team of permanent staff, led by a CEO, based within each battalion HQ (or county HQ). In addition to being a full time employee of the RFCA, the CEO is given the rank of Major within the ACF.

⁷ A detachment is one ACF unit.

Responsibility for army-related training activities is delegated through the military chain of command. In this respect, the ACF is under the command of Commander Regional Forces (CRF) based at Army headquarters (HQ), Salisbury, which determines training policy in line with the MoD's general cadet training policy formulated by the Directorate of Reserve Forces and Cadets (DRFC).

Brigade Commanders are responsible for overseeing the training activities of the ACF battalions and detachments within their area, and for ensuring that they are conducted in accordance with current policies and procedures. Each battalion is appointed a Commandant⁸ (Comdt), by brigade, to act as its commanding officer (CO) on a part time basis. The CEO, as the senior employee of the RFCA, is the professional advisor to the Comdt and, as such, supports him in the execution of his duties. A Training Safety Advisor (TSA) is also appointed by the brigades to assist Comdts and battalion training teams discharge their responsibilities relating to training safety.

1.4.2 The 2nd Battalion the Highlanders ACF

The cadets and adult volunteers involved in this accident were members of 25 detachments of the 2nd Battalion the Highlanders ACF located in Aberdeenshire and the Inverness region of Scotland. The battalion's military chain of command is through 51 Brigade, 2 Division to Army HQ, and its organisational structure is at **Annex B**. The battalion did not have access to the Army intranet through which key instructions and guidance contained in various Army and MoD publications was available.

1.5 ANNUAL CAMP

1.5.1 General

Annual camps are organised by the ACF battalions in consultation with their respective brigades. They are programmed to take place during 2 weeks of school summer holidays, and allow cadets the opportunity to complete the requirements set out in the ACF training syllabus to progress to the next rank. They also allow cadets to participate in a number of additional adventurous training activities and organised fun sessions. The camps are considered by many to be the highlight of the ACF calendar, and are always well subscribed.

The location of an annual camp is typically selected from a list of suitable sites available throughout the UK. The cadets and instructors are normally accommodated on RFCA premises or in military barracks. The location for each annual camp is decided 2 to 3 years in advance. Recent locations for the 2nd Battalion the Highlanders included York and Liverpool.

1.5.2 Planning

The 2nd Battalion the Highlanders camp during 2007 was originally scheduled to take place in Staffordshire, but during 2006 it was re-scheduled to West Camp, Benbecula. Although this was the first time that the ACF had used Benbecula for this activity, the CEO had trained there before with the Territorial Army (TA) in 2004 and had made his Comdt aware of its benefits.

⁸ The Second Battalion of the Highlanders ACF Commandant held the rank of Acting Colonel.

Members of the battalion visited Benbecula in November 2006 and March 2007 to assess the facilities available and to survey the proposed training areas. The option of transporting the cadets over water was discussed by the Comdt and CEO during these visits, but was not included in the planned 2 week programme (**Annex C**) due to the lack of available resources⁹.

The training programme covering the period 27 July to 11 August 2007 was determined in advance, and priority was given to activities included in the ACF training syllabus. However, additional adventurous training and non-standard activities, including boating activities, such as kayaking, were also scheduled during a number of 'fun days'.

The two star cadre's field craft exercise plan (**Annex D**) published on 1 August 2007 indicated that on 3 August the cadets were to be transported by road from the Range Head to the exercise area at Loch Skipport. However, on 2 August, the CEO, in consultation with the Comdt, decided to transport the cadre to the exercise area by boat, providing the weather conditions were suitable. As the forecast weather conditions were not good, the final decision to go ahead with the ferrying¹⁰ of the cadets was deferred until the following morning. The officer in charge of the cadre for the exercise was not included in this decision making process.

1.5.3 Manning

At the start of the camp, the battalion's training safety team comprised the assistant training officer plus two other adult volunteers. This was fewer in number than originally intended, and the team further reduced when one of the CFAV was employed on other tasks. This left only the assistant training officer and a driver. The Training Safety Advisor allocated to the battalion for the camp did not arrive on Benbecula until 2 August 2007 because he had been assisting another battalion with its annual camp in Weymouth, Dorset. The battalion's Comdt and CEO were scheduled to be present throughout. A total of 186 cadets and 45 adult instructors attended the camp.

1.6 BOAT OPERATION

The military role for the RRC is the rapid transportation of troops and equipment during coastal and river operations. Its cathedral style hull is similar to that of a commercially available dory and is considered to be very stable. However, the craft are best suited to inshore and sheltered waters as they are prone to slamming when they ride over waves.

The operating parameters for the craft are listed in BR 7887¹¹. Its operating limit is sea state 5¹² and it is normal procedure for the trouser leg drains to be lowered (open) when underway. The RRC2 is authorised to carry up to ten persons (two crew and eight passengers), and has a maximum weight capacity of 1850kg (90kg each person plus 680kg of equipment and 385 litres of fuel). It is designed to operate with two 140HP outboard motors enabling a top speed of up to 38 knots.

⁹ At this time the battalion had one RRC1 and a 6m rigid-hulled inflatable boat (RIB).

¹⁰ To ferry: "The process by which a boat or platform, either specifically manufactured, or improvised, transports troops and equipment across a water hazard" (Army Guidance and instructions (AGAI) Vol 1 Ch18.).

¹¹ A BR is a book of reference

¹² In Sea State 5 the average wave height is between 2.4m and 4m

It is MoD policy for all cadet force rescue boats to be fitted with propeller guards. Although guards were available for the 75HP outboard motors fitted to each RRC1, neither had these fitted. The RRC1 Hazard Detail Report, which forms part of the MoD's Safety Case for the craft, identifies the use of propeller guards during military training as a control measure to reduce the risk associated with the hazard of capsizing. The MoD Boat Manual (BR8161) requires coxswains of RRC to have completed bespoke military training courses.

The RRC2 had been used in Loch Carnan on 1 and 2 August, during which a maximum speed of 32 knots was measured using a Global Positioning System receiver (GPS).

1.7 BOAT ACQUISITION AND SAFETY MANAGEMENT

The battalion had four powered craft, all of which were acquired by its CEO. One of the RRC1 craft was obtained from the MoD in 2004 which, along with a 6m RIB obtained in 2005, had been used to train cadets and instructors to the Royal Yachting Association (RYA) powerboat level two standard and as safety boats for other waterborne activities.

The second RRC1 and the RRC2 were delivered to the battalion in July 2007. They were 'gifted'¹³ to the ACF by the MoD following a written request for safety boats from the CEO (**Annex E**). All three RRC were given without engines and on the understanding that the battalion would arrange and fund all appropriate maintenance and surveys. The RRC1s were fitted with single 75 HP outboard engines, which the CEO obtained from MoD sources. The RRC2 was fitted with a 200HP outboard engine, which had been purchased commercially.

The 2nd Battalion the Highlanders is the only ACF battalion to operate RRC and is the only cadet force unit to operate an RRC2. The Naval Cadet Force (NCF) has seven RRC1.

The *MoD Boat Manual* (BR8161) documents the procedures for the acquisition, allocation, reallocation and disposal of all boats owned or operated by the MoD. Although it does not refer directly to the ACF, it details the reallocation procedures and additional control measures applicable to the NCF. The manual does not refer to the gifting process used in the provision of the RRC1 and RRC2 to the 2nd Battalion the Highlanders.

The MoD reallocates boats to the NCF via a designated boat sponsor who acts as the user's representative and is the single point of contact for all boat acquisition matters. It is the boat sponsor's responsibility to ensure that units are adequately resourced to operate and maintain its boats in a safe manner. The NCF has a team of suitably qualified experts who audit its units' boating and sea survival equipment capabilities annually.

A similar role is carried out for the Army by its maritime inspection team. The ACF does not have a nominated boat sponsor and does not form part of the Army maritime inspector's audit programme.

¹³ "Gifting" is a process used by the MoD to release surplus or obsolete assets free of charge.

Marine activities are undertaken by many cadet force units associated with the military services. The majority of the activities conducted concentrate on non-powered craft such as kayaks and dinghies. Powered craft are normally only used as safety boats¹⁴ for the other activities. Details of the boats held by the ACF are at **Table 1**.

Table 1 - Army Cadet Force boat holdings (August 2007)

Unit	Canoe	Kayak	Dinghy	Windsurfer	RIB	Open Boat
2 Div 15 Bde	8	52	0	0	0	0
2 Div 42 Bde	31	83	0	0	1	0
2 Div 51 Bde	54	109	9	0	7	1
4 Div 2 Bde	12	27	0	0	1	6
4 Div 43 Bde	0	43	0	0	0	1
4 Div 145 Bde	15	20	0	0	0	0
5 Div 49 Bde	34	99	7	0	0	1
5 Div 143 Bde	16	0	0	0	0	0
5 Div 160 Bde	8	56	0	0	3	0
LONDIST	38	6	0	2	0	0
ACFA (CCAT)	18	48	0	0	0	0
TOTALS	238	570	16	2	12	9

Note: The 2nd Battalion the Highlanders ACF is part of 2 Division 51 Brigade.

1.8 LIFEJACKETS

1.8.1 General

The lifejackets used on board the RRCs were acquired by the CEO from MoD sources. The lifejackets worn by the cadets were 'Assault Troop' lifejackets (ATLJ). The lifejackets worn by the adults were 'Landing Craft' lifejackets (LCLJ). Neither type is SOLAS approved. They were designed for specific military applications and were not suitable for use by civilians or children. This is indicated in the 2006 Defence Information Notice 04-060¹⁵ (**Annex F**).

The ATLJ is a manually operated gas (Nitrogen) inflated lifejacket. It provides 498N of buoyancy and is capable of supporting the wearer and an additional 45kg of equipment. It was designed for landing operations where ease of removal is a requirement.

¹⁴ AGAIs volume 1 chapter 18 details the requirements for safety boats in multi craft operations. The nominated safety boat must be capable of carrying its crew and all the survivors from the largest craft taking part in the exercise or training serial.

¹⁵ DIN 'Water Safety Equipment Management – the selection of lifejackets and buoyancy aids for operational, training and recreational waterborne activities' is published annually.

The LCLJ is inflated automatically on entering the water and provides 260N of buoyancy. It was designed to support the wearer plus 8.6kg of additional equipment and was specifically designed for Royal Marine (RM) landing craft crews. The LCLJ can be modified to operate manually by fitting a blanking cap over its automatic operating head. The blanking caps are used during amphibious landing operations to prevent inadvertent activation when high surf is present.

Both types of lifejacket are fitted with a spray hood, automatic light, buddy line and whistle. The lifejackets also have the added capability of concealing their reflective patches and lights when operational requirements dictate.

At the time of the accident, the battalion held stocks of SOLAS approved lifejackets and buoyancy aids in both adult and junior sizes, but these were not used during the RRC boating activities. The battalion's lifejacket and buoyancy aid holdings are listed in the table below.

Table 2 - Total numbers, and types, of lifejackets and buoyancy aids held by the 2nd Battalion the Highlanders Army Cadet Force

Equipment Type	Number Held	Remarks
Landing Craft Lifejacket mk 3	12	8 acquired just prior to camp
Assault Troop lifejacket mk 4	37	27 acquired just prior to camp 9 have no record of maintenance
Crewsaver 275N mk 3	8	No record of maintenance or inspection since June 06
Crewsaver 150N (Adult)	8	No record of maintenance or inspection since June 06
Crewsaver 150N (Junior)	8	No record of maintenance or inspection since June 06
Buoyancy Aid 50N Ravine (L)	6	No record of maintenance or inspection since June 06

1.8.2 Maintenance

The MoD maintenance requirements for lifejackets and buoyancy aids are clearly defined. Prescribed planned maintenance schedules are detailed on job information cards and must be carried out by a qualified sea survival equipment maintainer. All maintenance operations are required to be recorded on individual sheets in a unit's Sea Survival Equipment Log (SSEL), which are then countersigned by a supervisor. There is a requirement for the SSEL to be inspected at 3 monthly intervals by the unit's executive/safety officer. In addition, the SSEL should be subjected to an annual audit/inspection by external HQ staff.

The battalion had been using the ATLJ and LCLJ for nearly 2 years and, although the majority of the assault troop and landing craft lifejackets had been inspected the month before the camp, there was no record of planned maintenance prior to these inspections. The SSEL had not been inspected 3 monthly or annually by either

the battalion Comdt or an external authority. Additionally, there was no record of maintenance conducted on the unit's non-military lifejackets and buoyancy aids after June 2006. Some of the LCLJs held in the battalion's store were found to have been stowed with the blanking caps fitted, and some without.

1.9 NAVIGATION

The CEO and other coxswains intended to navigate the 6 nautical mile route by eye. No passage plan was produced and the coxswain in the lead RRC had a different understanding of the intended route to that of the CEO. The coxswain in the rear RRC was unaware of the intended route and was following the CEO in the RRC2. None of the coxswains were clear about the distance to be travelled, but they estimated it would take approximately 1 hour to complete each round trip.

The coxswains did not have a nautical chart. Ordnance survey maps were carried in the lead RRC1 and the RRC2, but the coxswain in the lead boat was unable to refer to his map because he had put it in a pocket under his dry suit. The coxswain in boat three did not have a map. Compasses were the only navigational equipment carried; the coxswain of the lead RRC had his own personal GPS but this had been left in his room at West Camp and a GPS fitted to the battalion's RIB was not utilised. The lead RRC was not fitted with navigation lights.

1.10 COMMUNICATION

Each coxswain was issued an ICOM "IC-M1Euro V" hand-held VHF radio for the exercise, with channel 72 allocated as the working frequency. Additional hand-held VHF radios were available, but none were provided to personnel at the departure or arrival points. A fixed VHF radio was fitted in the rear RRC, and the CEO was carrying a mobile telephone. The helmets worn by the coxswains were fitted with headphones and microphones, but these were not connected to the radios.

1.11 THE CEO

The CEO was responsible for all boating activities during the camp. He and the other coxswains had completed a number of RYA powerboat courses since 2003 and the qualifications attained are listed in **Table 3**. The CEO had previously served as a paratrooper in the regular army. He then joined the TA in 1996 as a non-commissioned officer and gained his commission with the TA before joining the 1st Battalion the Highlanders ACF, where he served as quartermaster. He was appointed as the CEO of the 2nd Battalion the Highlanders ACF in 2005 but continued to be actively involved in the TA as a company commander. The CEO was described as a resourceful and persuasive character. In addition to the battalion's boats and lifejackets, he also obtained the GPMG and its blank ammunition. The GPMG is a weapon the ACF is not authorised to use, and was acquired for the camp through the CEO's connections within the TA.

On the evening of 2 August, the CEO went to bed at 2220 and got up at 0730. He had adopted a similar routine during the previous 7 days and had not consumed alcohol for over 36 hours before the accident.

Table 3 - Powerboat qualifications held by boat coxswains

	RYA Qualification	Date of Issue
Cadet Executive Officer	National Powerboat Certificate (Planing Craft)	31/05/03
	Intermediate Powerboat Certificate (with tidal endorsement)	21/04/04
	Safety Boat Certificate (Planing Craft)	26/04/04
Coxswain Boat 1	National Powerboat Certificate (Planing Craft)	31/05/03
	Intermediate Powerboat Certificate (with tidal endorsement)	31/10/04
	Safety Boat Certificate (Planing Craft)	26/04/04
	Powerboat Instructor Course	11/05/06
Coxswain Boat 3	National Powerboat Certificate Level 2	10/04/07

1.12 SAFETY MANAGEMENT AND GUIDANCE

1.12.1 Background

It is MoD policy to comply with the requirements of all relevant UK Safety, Health and Environmental legislation. Where legislation does not apply to the armed forces it is MoD policy to “introduce standards and management arrangements which are, as far as reasonably practicable, at least as good as those required by legislation”. To ensure the risks during military training are managed and reduced to as low as reasonably practicable (ALARP), the ACF is required to follow the MoD’s Safe System of Training (SST)¹⁶, which comprises four elements:

Safe Persons. *Safe Persons are cadets or adults who have received the correct training for the activity they will carry out. A competent person within the SST is an instructor who has passed the relevant course in order to carry out safe training. It is essential that ACF adults provide an appropriate level of supervision, and those conducting the training take the necessary time and pay sufficient attention to detail in order to eliminate mistakes.*

Safe Equipment. *ACF adults must ensure that their subordinates have, and make use of, the correct equipment to carry out an activity. ACF adults must ensure that equipment is used and maintained appropriately and ensure that only competent persons are allowed to operate and service the equipment. Completed training and maintenance records must be kept.*

Safe Practice. *Practices are to be conducted in accordance with drills and instructions specified by the Service authorities. Safe practices include following correct procedures, the presence of adequate training and supervision, the provision of warnings, and the use of Personal Protective Equipment (PPE) and special clothing. It is essential that all training be monitored to ensure that procedures are strictly adhered to. Adventurous Training activities are to follow the procedures as specified by the appropriate authority.*

Safe Place. *A safe place is one in which the controls necessary to enable authorised training to be conducted safely have been identified by a site-specific Risk Assessment (RA) and directed through appropriate standing orders such as range standing orders.*

¹⁶ JSP 375 MoD Health and Safety Handbook, Leaflet 11 Safety in Military training and exercises.

1.12.2 Risk assessment

The only risk assessment documented by the battalion for boating activities was an adapted generic assessment normally used for safety boats (**Annex G**). It was reviewed by the CEO on 28 July, and was to remain extant for the period of the camp.

'A Commanders Guide to Safety and Environmental Risk Management' repeats advice given in leaflet 11 of the MoD Health and Safety Handbook (JSP 375), 'Safety in Military Training and Exercises', which states:

"It is essential that the effects of any proposed changes to training exercises be subject to risk assessment. The Health and Safety Executive (HSE) have pointed out that many military training accidents are the result of last minute changes to exercises, the consequences of which have not been fully thought through".

1.12.3 Guidance for training on water

All cadet force adult volunteers (CFAV) are issued a copy of the joint services publication (JSP) 535, Cadet Training Safety Precautions. The handbook covers the safety precautions required for waterborne activities normally undertaken by cadet forces. It stipulates that CFAVs responsible for exercises and expeditions involving a water hazard should prepare 'safety orders for training on water'. The safety orders should include: limits for area of operation; maximum number of personnel for each boat; minimum crew requirements; safety boat requirements; communications; crew qualification requirements; details of required pre-training; safety equipment to be worn and carried; details of safety drills to be carried out; and identification of non-swimmers. No safety orders for training on water were produced on this occasion.

Cadet forces do not normally carry out the type of ferrying activity conducted on 3 August 2007 by the ACF, or train in waters extending beyond category D¹⁷. Guidance procedures for the type of activity which is not included in the ACF training syllabus, are laid down in the Army General Administrative Instructions (AGAI), volume 1, chapter 18, Safety Precautions in Training: The Hazards of Water.

1.12.4 Swimming ability

The cadet forces have very clear guidelines relating to swimming ability, and being a non-swimmer does not automatically preclude a cadet from carrying out activities on the water. Non-swimmers should be clearly and visibly identified and given additional supervision as appropriate. Non-swimmers should also be issued with auto-inflation lifejackets.

The coxswains were unaware of the swimming abilities of the cadets in their boats. One of the cadets in the CEO's boat was a non-swimmer, and this had been recorded on his detachment's parental consent data sheet.

1.13 POST-ACCIDENT SURVEY

1.13.1 Hull

With the exception of the damage caused to the boat's steering console and seats when it landed onshore (**Figure 4**), the interior of the recovered hull showed no significant signs of damage. Evidence of minor damage and earlier repairs was found on the external hull. The hull buoyancy material in an area of damage approximately 12cm long and 2cm wide (**Figure 5**) contained water.

¹⁷ Category D. Tidal rivers and estuaries where the significant wave height could not be expected to exceed 2.0m at any time.

Both trouser leg drain tubes were found to be in poor condition and porous. The starboard fuel tank filler cap and strainer securing mechanism were found to be incorrectly secured, and a watertight seal could not be achieved.

1.13.2 Engine

The Yamaha 200BETO, 2 cycle, 6 cylinder outboard motor fitted to the RRC2 was manufactured in 1991. The engine was positioned on the port side of the mounting bracket (**Figure 4**). Although there was evidence of minor water ingress on the spark plugs, the engine was in a sound condition. As the engine was not connected to any electronic control or monitoring device, it was not possible to determine the engine performance immediately prior to the accident. The kill cord¹⁸ was found attached to the engine cut out switch (**Figure 6**).

Figure 4



Rigid raiding craft after capsizing

¹⁸ Kill cords connect the coxswain to an engine shut down switch and stop the engine if the coxswain is thrown to the deck or overboard.

Figure 5



Water weeping from hull void space

Hull damage

Figure 6



Kill cord

Kill cord

The engine trim tab, designed to counter the lateral forces developed by the propeller as forward power is applied, was found to be set straight, with no adjustment made to account for the offset position of the engine.

The fuel system pipework had been modified to accommodate the single engine configuration and allow both the craft's fuel tanks to be in use simultaneously. Both fuel tanks were approximately $\frac{1}{3}$ full.

1.13.3 Safety equipment

The pyrotechnics found on board the RRC1s after the accident were out of date. The pyrotechnics recovered from the lead RRC expired in June 2006. They were stored in the boat's console cabinet in a carrier bag and were found to be wet and lying in a pool of water (**Figure 7**). The pyrotechnics in the rear RRC expired in August 2005.

Each boat was equipped with dry powder fire extinguishers. Some of the fire extinguishers were found to be in a poor condition (**Figure 8**). There were no procedures in place to inspect the extinguishers, and their maintenance history was unknown.

The lifejackets used by the adults and cadets recovered from the water were inspected after the accident, and a number of observations were noted. In particular, the lifejacket worn by the female instructor was found to have a blanking cap fitted over its activation head (**Figure 9**). One of the ATLJs was found to have partially deflated and its gas cylinder was found to be loose. The spray hoods had not been deployed and a number of the high visibility patches had been concealed by the green flaps (**Figure 10**).

1.14 STABILITY AND HANDLING TESTS

A standard passenger heel¹⁹ test (as defined in Section 3, Schedule 2 of Merchant Shipping Notice No. 1669) was conducted by the Maritime and Coastguard Agency (MCA) on 22 August 2007 using Royal Marines as passenger weight. This was initially done with the boat dry, and resulted in an angle of heel of 4.43°. This was within the maximum limit of 7° for a passenger vessel. The heel test results are at **Annex H**.

A dynamic test representing the recorded movements of the day of the capsizing was also undertaken. A similar level of water estimated to have been present immediately before the capsizing was added, and three Royal Marines were used to represent the movement of cadets from port to starboard. During the test, which was conducted when stationary and in calm conditions, the transverse movement of the craft was much more pronounced than the previous test, and the boat's freeboard at its aft end was eliminated. However, the rate of heel was relatively slow and capsizing was avoided by moving the Royal Marines to port.

On 3 October 2007 the Fleet Landing Craft and Raiding Craft Trials Authority, at the request of the Army's Land Accident Prevention and Investigation Team (LAIT), carried out a series of static and dynamic stability trials using an in service RRC2 configured similarly to the craft operated by the ACF (**Figure 11**). The observed results supported the findings of the MCA tests. During the trials, it was noted by the experienced trials coxswains that the positioning of the outboard motor on the port side of the engine mounting bracket had a detrimental effect on the handling characteristics of the craft. It was also noted that when accelerating from a standing start in a straight line, with a similar amount of water in the boat to that present prior to the capsizing, the water was removed in 38 seconds with the trouser leg drains deployed.

¹⁹ Rotation about the fore and aft axis of a vessel is known as rolling or heeling

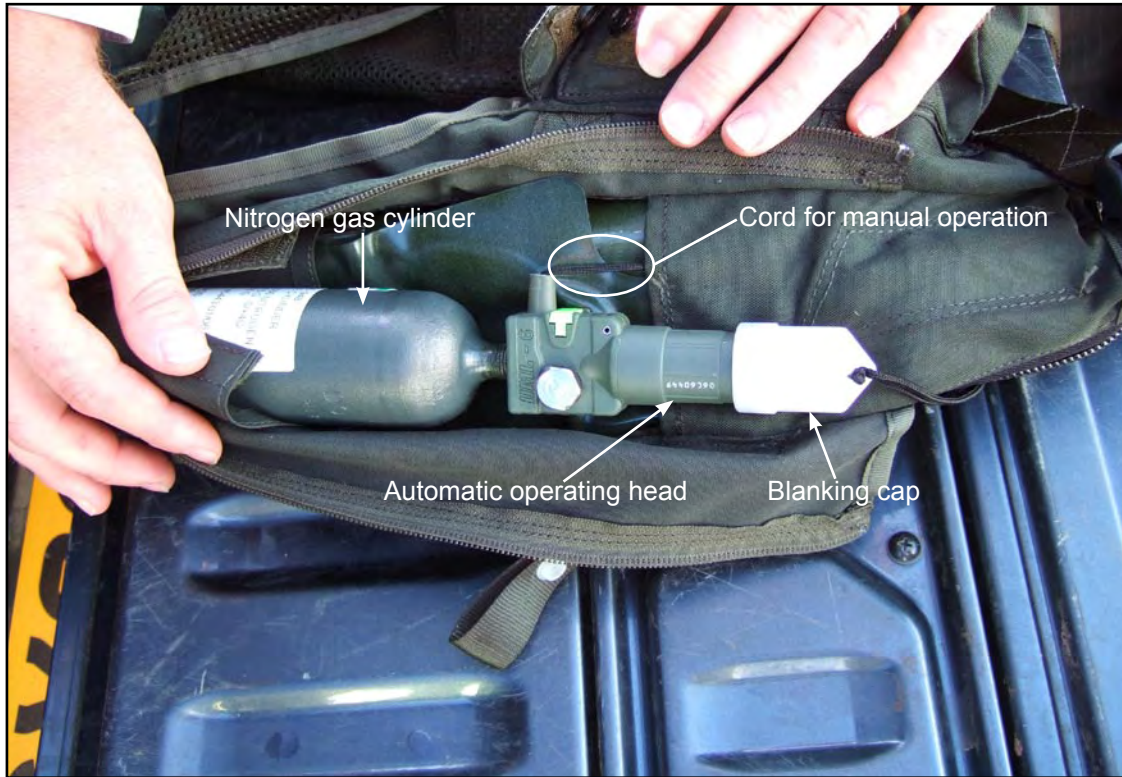


Boat one pyrotechnics



Dry powder fire extinguisher from vessel

Figure 9



Manually operated Landing Craft lifejacket used by the female instructor

Figure 10



Lifejackets recovered from cadet survivors



Rigid raiding craft (Mk 2) capsizing trial conducted for the Army

1.15 LIFEJACKET DEMONSTRATION

The Fleet Landing Craft and Raiding Craft Trials Authority also conducted a demonstration of the effect of the buoyancy of the ATLJ. For the demonstration, a wooden mock up of the port forward quarter of a capsized RRC2 was constructed and lowered into a pool to leave an air gap similar to the one generated by the upturned craft. A Royal Marine Commando, wearing an inflated ATLJ, was then positioned under the rig and instructed to force his way under the upturned seats. However, the inflated lifejacket pinned him to the deck of the rig and he was unable to make an escape (**Figure 12**). The trial was repeated using an approved 150N buoyancy lifejacket during which the marine found it relatively easy to escape from beneath the rig.

Figure 12



Full scale mock-up of inverted forward quarter



Royal Marine wearing an inflated Assault Troop Lifejacket

Assault Troop lifejacket escape trial

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 SIMILAR ACCIDENTS

Fourteen incidents involving capsizes of craft similar to the RRC2 have been reported to the MAIB since 1996 (**Table 4**). Nine of these incidents resulted in loss of life.

The circumstances of the capsizing of a dory carrying a group of school children, in 1999²⁰, are similar in a number of ways to this accident. The dory capsized during a boat trip in Portsmouth harbour and resulted in the death of a school girl who was trapped under the upturned boat. The casualty's lifejacket was considered to be a factor that might have adversely affected her chance of escape. The possibility that the dory might capsize had not been considered prior to the trip and, once the capsizing occurred, the teacher in charge of the boat initially failed to realise that one child was missing.

Table 4 - Dory capsizes reported to MAIB since 1996

Vessel Name	Year	Deaths
Cigi	1996	2
Morennol	1998	1
Fleetwing	1999	
Red Osprey	1999	
Unnamed School Dory - Portsmouth	1999	1
Unnamed Dory - Loch Uwe	1999	3
Loch Ryan Dory	2003	3
Hell Raiser	2003	
Barmouth Dory	2004	2
Unnamed Dory	2004	
Ex-Ministry of Defence Dory	2006	
Loon A Sea	2006	1
Stromness Dory	2007	1
Shayne	2007	2
	TOTAL	14
		16

²⁰ Report No. 6/2001: Report of the investigation of the capsizing of a school boat on Fountain Lake, Portsmouth with the loss of one life on 16 September 1999.

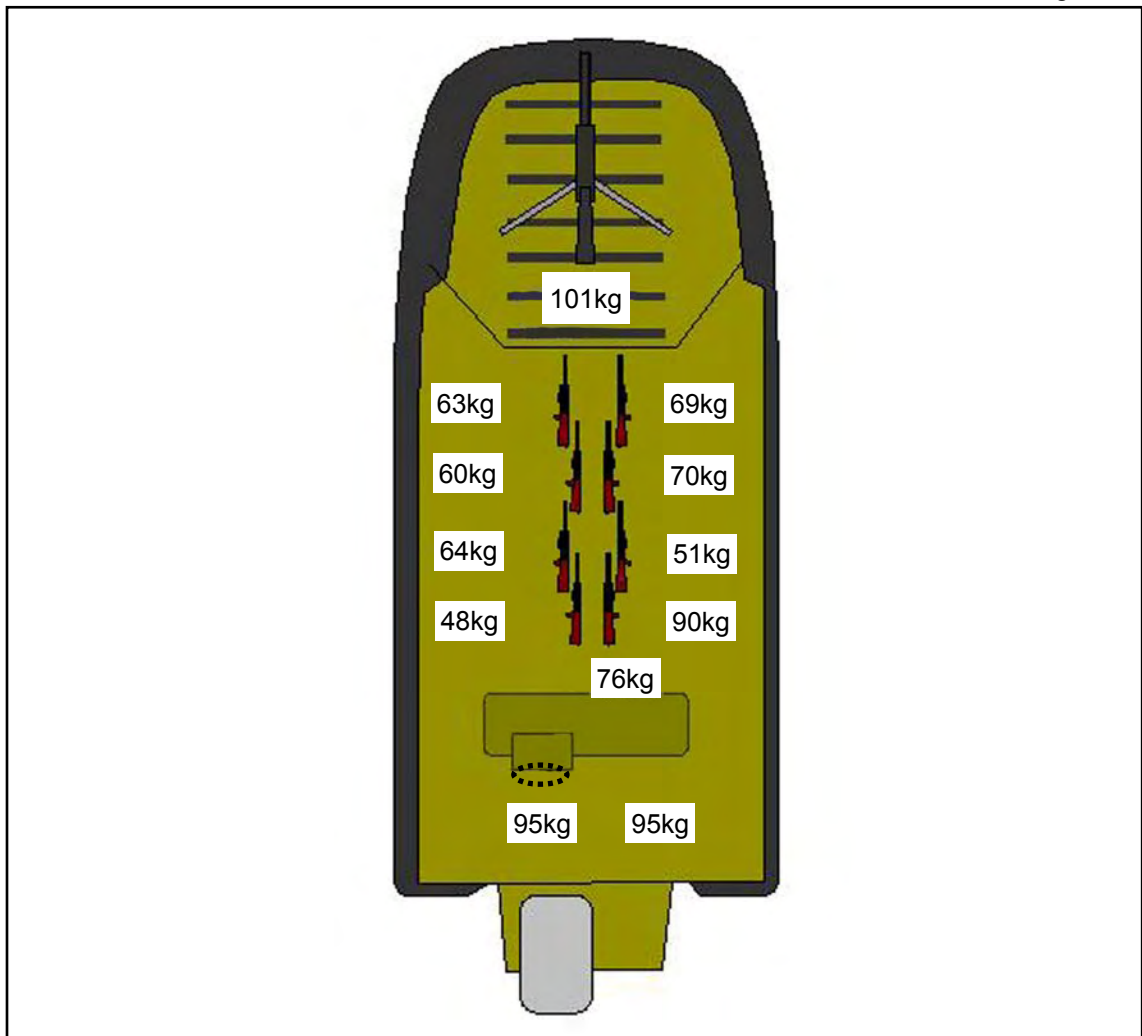
2.3 THE CAPSIZE

There were 12 persons on board the RRC2 at the time of capsize, which exceeded the craft's stipulated capacity. However, calculation of the weights carried (**Figure 13**) indicates that the total load on board the boat, excluding fuel, was below 900kg and therefore considerably less than the maximum limit of 1580kg (the limit assumes a maximum of 10 military personnel plus equipment).

As the RRC2 proceeded eastwards through the buoyed channel it started to take water over its bow and sides. This was largely due to the choppiest seas experienced as the craft entered more exposed waters and the boat's low freeboard forward due to the positioning of the adult instructor adjacent to the GPMG on the bow ramp.

After the water entered the RRC2, it became trapped on the deck because the trouser leg drains had not been lowered and there was no alternative means of escape. In view of the offset position of the single outboard engine (**Figure 4**), it is likely that the vessel was listing to port to some degree. The list increased as the water naturally flowed to, and collected, on the lower side.

Figure 13



Boat weight distribution

The trigger for capsizing was the movement of the cadets seated on the port side towards the starboard side. This transfer of weight induced a heeling moment to starboard, which resulted in the accumulated water flowing across the deck. It is evident that the combined weights of the cadets and water were then sufficient to cause the craft to capsize. This is supported by trials conducted following the accident (**Figure 11**). However, unlike the trials, it is probable that capsizing could not be prevented by the cadet's return to the centre of the craft as the rate of capsizing is likely to have been greater due to the vessel's turn to starboard and the environmental conditions.

The minor damage to the hull of the RRC2 observed following the accident could have adversely affected the buoyancy of the craft to some degree. However, it is not known whether the damage occurred before or after the capsizing and, in view of the results of the trials conducted, it is not considered to have been a contributory factor.

2.4 ENTRAPMENT

Following capsizing, of the four persons who surfaced under the upturned hull, only Cadet M was unable to swim clear. When recovered from the RRC2, her ATLJ lifejacket was inflated and, as this had to be achieved manually, it is evident that Cadet M took this action at some point during her ordeal. In the absence of any instructions regarding what to do in the event of capsizing, this was probably an instinctive reaction to help keep her afloat. However, the ATLJ was not approved for use by children, and its buoyancy was over three times that of the SOLAS approved lifejackets supplied by the MoD for cadet force adventurous training activities. Consequently, once inflated, it would have pinned Cadet M under the craft and prevented her escape as demonstrated by the Fleet Landing Craft and Raiding Craft Trials Authority (**Figure 12**).

2.5 INITIAL ACTIONS AND MUSTER

The broadcast of the "Mayday" by the instructors in the lead RRC was made soon after the RRC2 was seen to be in difficulty. Although the position initially passed was incorrect, the use of "Mayday" in this situation was appropriate. However, no attempt was made to contact the third RRC by VHF radio or by the use of flares. The use of flares might have alerted the coxswain in the rear RRC. It might also have alerted small vessels employed in local fish farms. More craft at the scene would have enabled all of the occupants of the RRC2 to be transported to shore at the same time, and would have increased the likelihood of identifying that Cadet M was missing.

It is evident that the headcount carried out soon after the capsizing was inaccurate. It is possible that, in the ensuing confusion, the female instructor, who was young and not wearing a dry suit or helmet like other instructors, was counted as a cadet, or even counted twice. As the cadets came from different detachments across the county and were seated in the boats on a first come first served basis, this would also have reduced the possibility of the cadets and instructors realising that 'a friend' was missing.

A consequence of the inaccurate headcount, along with the absence of a record of the cadets and instructors on the water, and the lack of a safety organisation ashore to monitor this activity, was that it took 1 hour and 30 minutes to determine that Cadet M was missing. By that time, the coastguard had been stood down and valuable time had been lost. Cadet M was not found until approximately 3 hours and 28 minutes after the RRC2 capsized. Although it is not certain when Cadet M drowned, the delay in recognising the fact that she was missing undoubtedly reduced her chances of survival.

2.6 LIFEJACKETS – OPERATION AND MAINTENANCE

Although the cadets were briefed on the operation of their lifejackets on two occasions before departure, not all cadets operated their lifejackets on entering the water. It is possible that some cadets did not understand the briefs, or were unable to find the lifejacket activation toggle once in the water as access might have been obstructed by the pouches of their webbing belts. It is also highly likely that several were adversely affected by the shock of entering the water.

The adult instructors were under the impression that the LCLJ would activate automatically. However, the female instructor's LCLJ did not because a blanking cap was fitted over its activation head. This was extremely fortunate on this occasion. Had the lifejacket inflated with the instructor under the upturned craft, the 260N buoyancy provided would have made it extremely difficult for her to swim clear. However, the outcome of the blanking caps being fitted could have been extremely serious in differing circumstances.

The random fitting of blanking caps to the LCLJs and the lack of records of maintenance and inspection, indicate that the battalion's lifejackets and buoyancy aids had not been maintained or scrutinised in accordance with MoD requirements.

2.7 NAVIGATION

The RRCs were ill-prepared and ill-equipped to safely navigate between Loch Carnan and Loch Skipport. The lack of consensus among the coxswains of the route, and the lack of knowledge regarding the distances involved indicates the passage had not been properly considered or briefed. Without the aid of a nautical chart, the coxswains were unaware of potential underwater hazards or the significance of navigational marks. Also, without a GPS and the lack of navigation lights on the lead boat, the coxswains would have had difficulty in navigating in the poor visibility which was forecast. Although the transmission of the incorrect location for the capsized RRC2 during the "Mayday" was probably mainly due to the stress of the situation at the time, the carriage of a nautical chart and GPS would probably have prevented this unfortunate error from being made.

2.8 ACTIONS OF THE CEO

The CEO's assessment of the environmental conditions was made from the jetty, which was relatively sheltered from the prevailing wind. No consideration was given to the weather forecast with regard to the more exposed areas of the intended passage. However, although the conditions experienced were worse than the CEO anticipated, they probably did not exceed the operational limits of the RRC2 at the time of capsizing.

A number of actions and decisions taken by the CEO as coxswain influenced the circumstances which caused his craft to capsize. In particular, the positioning of an adult instructor with the GPMG, the failure to lower the trouser legs on setting off, the decision to delay the boat's return, and the movement of the cadets, were all significant. Although the CEO had little opportunity to familiarise himself with the operation of the RRC2, these actions and omissions, along with the lack of preparation highlighted in paragraph 2.7, indicate a lack of proficiency as a powerboat coxswain rather than unfamiliarity with a specific craft. This is supported by the CEO's failure to

re-secure the boat's kill cord, which was found attached to the engine cut off switch after the RRC2 had been recovered. In view of the CEO's rest pattern during the week before the accident, it is unlikely that his performance or decision-making was adversely affected by fatigue.

The CEO was familiar with the use of trouser leg drains, which were also fitted to the RRC1. The use of nautical charts, GPS and kill cords, together with the importance of obtaining the latest weather forecast and the effect of the weather on sea conditions, had also been included in the syllabi of the RYA courses he had completed when gaining his powerboat qualifications (**Table 3**). However, it is evident that the CEO was not fully aware, or did not understand the danger of the accumulated water in his boat and its 'free surface effect'²¹. Basic stability, including 'free surface effect' is not included in the RYA powerboat training syllabi or its Powerboat Handbook.

2.9 CONTROL AND AUTHORISATION OF ACTIVITIES

The MoD, Army and ACF have well documented safety procedures and technical guidance that, if implemented, should enable exciting and challenging activities such as powerboating to be undertaken by cadets in a safe and controlled manner. In this case, the information, instructions and guidance included in BR 7887 (general information on the RRC2), JSP 375 (requirements of the safe system of training), JSP 535 (cadet training safety), AGAI Volume 1 chapter 18 (water hazards) and DIN 04-060 (suitability of lifejackets) were not followed. This was demonstrated by:

- The lack of a risk assessment specific to the activity conducted
- The failure to implement control measures detailed on the generic risk assessment such as the provision of a safety boat and the fitting of propeller guards
- The lack of safety orders for training on water
- The use of lifejackets unsuitable for children and civilians
- The lack of communications with shore personnel
- The failure to keep a record of persons on the water
- The lack of provision for non-swimmers
- The lack of awareness of all of the coxswains with regard to the intended passage plan
- The number of persons on board the RRC2
- The condition of the RRCs and the equipment carried (engine configuration, the lack of nautical charts and other navigational equipment, the condition of flares and fire extinguishers and the lack of navigation lights on one of the craft).

It is evident from the number and nature of the shortcomings identified above that the verification and authorisation procedures in place with regard to an activity outside the approved training syllabus were not robust. The CEO had a keen interest in waterborne activities, and had steadily increased the battalion's holding of craft and associated

²¹ "Free surface effect" is one of the mechanisms that can cause a ship or boat to become unstable and capsize. It describes the tendency of liquids and of aggregates of small solid objects, like seeds, gravel, or crushed ore which can act as liquids, to move in response to changes in the attitude of a vessel.

equipment from various sources since his arrival in 2005. The Comdt did not have access to many of the guidance documents, or to a point of contact within the ACF who was able to provide advice with regard to waterborne activities. Therefore, he was reliant on the advice offered by the CEO, who was a persuasive character keen to use the equipment he had obtained.

The mounting of the GPMG indicated that the CEO saw the activity as part of the military exercise, rather than a means of transportation. Checks which should have been in place to control the increasing ambitions of the CEO, such as the involvement of the brigade TSA and the battalion's training team, were not undertaken due to the late arrival of the TSA and the diminished numbers of the training team. However, even had the TSA and the training team been involved in the decision making process, it is doubtful whether their knowledge of the activity to be conducted would have been sufficient to identify some of the shortcomings. Furthermore, as the RRCs and lifejackets had been acquired without reference to 51 Brigade, the battalion's ability to maintain and operate them was not subject to external verification.

Adventurous and other training activities which fall outside cadet forces' approved syllabi are naturally appealing to the children participating. However, the planning, preparations and conduct of such activities is likely to require access to, or oversight of, specialists. Although a degree of expertise might be available at battalion level, this accident raises doubts on the part time Comdt's ability to effectively verify such an activity's compliance with relevant guidance and instructions. In this case, the effectiveness of the verification and approval procedures for the ferrying activity would have probably been more effective if undertaken at a higher level in the chain of command, where relevant instructions and guidance and independent expertise could have been more readily accessed.

Furthermore, as the boats were gifted to the battalion, the follow up measures associated with a boat's reallocation within the MoD were bypassed. Although the RRC2 and one of the RRC1s had only been recently acquired, inspection of the battalion's holdings by a team of experts similar to that used by the NCF or by the Army's maritime inspection team would undoubtedly have highlighted the unsuitability of ATLJ for use by cadets and the unsatisfactory state of the flares and fire extinguishers provided. It might also have highlighted the battalion's limited access to applicable written procedures.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT WHICH HAVE RESULTED IN RECOMMENDATIONS

1. Information, instructions and guidance, including numerous MoD publications pertinent to the ferrying of the cadets, were not followed. [2.9]
2. The verification and approval procedures for the ferrying activity were not robust, and would have probably been more effective if undertaken at a higher level in the chain of command, where relevant instructions and guidance and independent expertise could have been more readily accessed. [2.9]

3.2 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. The lifejacket worn by Cadet M was not approved for use by children, and its buoyancy was over three times that of the SOLAS approved lifejackets supplied by the MoD for cadet force adventurous training activities. Consequently, once inflated, it would have pinned Cadet M under the craft and prevented her escape. [2.4]
2. The headcount carried out soon after the capsized was inaccurate, and the delay in identifying that Cadet M was missing undoubtedly reduced her chances of survival. [2.5]
3. The random fitting of blanking caps to the LCLJs, and the lack of records of maintenance and inspection, indicate that the battalion's lifejackets and buoyancy aids had not been maintained or scrutinised in accordance with MoD requirements. [2.6]
4. The RRCs were ill-prepared and ill-equipped to safely navigate between Loch Carnan and Loch Skipport. [2.7]
5. The actions of the CEO immediately before the capsized are indicative of a lack of proficiency as a powerboat coxswain, rather than unfamiliarity with a specific craft. [2.8]
6. The CEO was not fully aware, or did not understand, the danger of the accumulated water in his boat. Basic stability, including 'free surface effect' is not included in the RYA powerboat training syllabi or its Powerboat Handbook. [2.8]
7. In gifting of boats to the battalion, control measures such as inspection by external experts were bypassed. [2.9]

SECTION 4 - ACTION TAKEN

4.1 BY THE MINISTRY OF DEFENCE

1. The Directorate of Reserve Forces and Cadets (DRFC) has started a review of the need to establish a Tri-Service lead authority for all cadet activity on water.
2. All boat gifting activity has been suspended. The MoD boat authority has started to develop a more robust process for transferring/gifting boats to organisations such as cadet forces. The procedures will ensure that the intended purpose for the boats is clearly defined and the user is fully resourced and competent to use them safely.

4.2 BY THE ARMY

1. The Army Land Accident Prevention and Investigation Team (LAIT) has conducted an investigation into the accident and made a number of recommendations to the ACF, including to:
 - Issue a directive that watermanship training on deeper non tidal or tidal waters, within the ACF and CCF, may only be conducted under the direct supervision of appropriately qualified regular and Territorial Army personnel.
 - Review the establishment of TSA to provide dedicated support to every ACF unit. This is particularly critical where the unit is spread over a large area.
 - Produce a template of authorised activities for annual camps. Activities falling outside the template could be undertaken provided they are cleared by the regional Brigade Commander.
2. The Army's Chief Environmental and Safety Officer will consider the lessons learned from this accident in his ongoing review of risk assessment training.
3. A Board of Inquiry has been convened by 51 Brigade, which will sit once all civil investigations have been completed.
4. Headquarters Land Command has issued a letter of instruction to each Army Division HQ advising them of the accident and instructing them to take the following action with immediate effect:
 - Commanding Officers are to ensure that the safe system of training is rigorously applied to all cadet activity.
 - All non-standard activity, regardless of whether a risk assessment has been carried out, must be reviewed by the Training Safety Advisor.
 - All training must be officially authorised by the Commandant.
 - Cadet units are to submit an audit, by 15 December 2007, of all boats held, including those privately purchased or gifted.
 - Units are to ensure that their boats are subject to an inspection regime by qualified personnel.
 - Cadet staff are to be rigorous in carrying out headcounts at appropriate times.
5. LAIT has issued a letter to the ACF instructing them to return all non-authorised lifejackets to central stores.

4.3 BY THE BATTALION

The battalion has suspended all powerboat activities pending the outcome of all military investigations.

4.4 BY THE ROYAL YACHTING ASSOCIATION

The RYA has undertaken to promulgate the lessons learned from this accident with regard to stability to RYA powerboat instructors and to include a reference to its Stability and Buoyancy publication in the RYA Powerboat Handbook.

SECTION 5 - RECOMMENDATIONS

The Director of Reserve Forces and Cadets is recommended to:

- 2008/117 Ensure cadet forces co-ordinate the implementation of initial and ongoing audits of cadet training to identify non-standard activities and to ensure that persons responsible for the conduct and approval of these activities have ready access to nominated centres of relevant expertise.
- 2008/118 Put in place measures to ensure that approval for cadet forces to conduct an activity outside the usual syllabus is subject to its inclusion in an advance training plan submitted through the chain of command, and that approval is given only after compliance with pertinent policies and procedures has been determined.

**Marine Accident Investigation Branch
March 2008**

Safety recommendations shall in no case create a presumption of blame or liability