TO INVESTIGATE THE UTILISATION OF HELICOPTERS FOR FLOOD RESCUES AND RECONNAISSANCE.

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Signed: Shannon Crofton .................................. Date:........26/9/2012..........
# Executive Summary

The aim of this report is to research the utilisation of helicopters for flood rescue and reconnaissance. The report is divided into four main sections: **Introduction**, **Executive Summary**, **Programme**, and **Main Body**. Each section is further divided into detailed topics to cover various aspects of helicopter usage in flood scenarios.

## Introduction

The introduction section provides an overview of the research objectives and the importance of helicopter deployment in flood rescue operations. It sets the stage for the subsequent analysis and discussion.

## Programme

The programme section outlines the structure of the research, including the main activities and objectives. It is divided into several sub-sections focusing on different aspects of helicopter operation in flood situations.

## Main Body

The main body of the report delves into the detailed capabilities of helicopters in flood scenarios, cross training requirements, deployment strategies, and specific aspects such as flood victim considerations, crew composition, resource management, and more.

### Capabilities of a Helicopter in Flood

This section discusses the various capabilities of helicopters in flood rescue and reconnaissance operations, highlighting their advantages in such environments.

### Cross Training

The cross training section covers the necessary training requirements for personnel involved in helicopter operations during floods, including skills transfer and specialization.

### Deployment

The deployment section focuses on the logistics and planning involved in deploying helicopters for flood rescue, including resource management and operational strategies.

### Floods

This section examines the different types of floods and their impact on helicopter operations, including two main types of river flows.

### Pilot Considerations in Flood Rescues

The pilot considerations section deals with the specific considerations pilots need to take into account when operating helicopters in flood scenarios.

### Crew Composition

This section discusses the composition of crews deployed for flood rescue operations, including the roles and responsibilities of different team members.

### Crew Resource Management (CRM)

The crew resource management section focuses on the management of crew resources during flood rescues, emphasizing teamwork and effective communication.

### The Flood Victim

The flood victim section covers the considerations and actions required when dealing with flood victims during rescue operations.

### Short Hauling and Hoisting

This section focuses on short hauling and hoisting techniques, including short haul and hoist procedures.

### Hoist Rescue Capture Strap Procedures

The hoist rescue capture strap procedures section details the procedures for capturing and rescuing flood victims using hoists.

### Water Rescues

The water rescues section addresses the specific challenges and procedures involved in rescuing flood victims in open water environments.

### Swift Water Rescues

This section focuses on swift water rescues, detailing specific procedures and considerations for dealing with high-speed water conditions.

### Swift Water Rescue Hoist Procedures

The swift water rescue hoist procedures section covers the procedures for performing hoist rescues in swift water conditions.

### Rescuer

The rescuer section outlines the responsibilities and considerations for rescuers involved in flood rescue operations, emphasizing safety and effectiveness.

### Hoist Operator Responsibilities

This section details the responsibilities of hoist operators during flood rescues, including safety considerations and procedural adherence.

### Variation ‘GO’ Rescue and Pickup by Helicopter

The variation ‘GO’ rescue and pickup section covers the procedures and considerations for performing rescue operations under various weather and operational conditions.

### Safety Person’s Responsibilities

This section focuses on the responsibilities of safety persons involved in flood rescue operations, including their role in ensuring safety and coordination.

### Rescuer Responsibilities

The rescuer responsibilities section outlines the specific duties and responsibilities of rescuers in flood rescue scenarios, ensuring effective and safe operations.

### Safety Considerations

The safety considerations section highlights the critical safety measures and considerations that must be maintained during flood rescue operations to ensure the safety of all involved.

### Open Water Rescue

This section addresses the challenges and procedures involved in rescuing flood victims from open water bodies.

### Night Hoisting

The night hoisting section covers the procedures and considerations for performing hoist rescues during nighttime operations, emphasizing the need for increased vigilance and specialized equipment.

The Winston Churchill Memorial Trust Report by Shannon Crofton – 2011 Fellow

To research the utilisation of helicopters for flood rescue and reconnaissance

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I. **INTRODUCTION**

My Churchill Fellowship was to investigate the utilization of helicopters for flood rescues and reconnaissance.

‘Of Droughts and flooding rains’ as written by Dorothea Mackellar at age 19 in 1904, Australia has a long and colorful history of flooding, both flash and riverine. Through our topographical diversity and geography, floods have always had a considerable impact on our economy and population.

The devastating 2010-11 floods in Queensland still haunt most Australian’s memories with the loss of over 38 lives and the graphic images that were brought to us live. Floods continue to be one of the largest natural disasters, both in Australia and worldwide.

Flooded in NSW alone from 23/11/11 to 30/2/12 saw the NSW SES undertake over 3604 aviation tasks.

No State is immune and whilst not as graphic as bushfires, quite often this quiet killer will claim lives and devastate communities and national economies.

Floods are a very unique environment. The hazards that exist are due to a changing landscape and are difficult to train for.

The use of helicopters for flood and swiftwater rescues in Australia is increasing at a rapid pace, however overseas the use of these assets, for these forms of rescues, has been in existence for over 30 years. Fire and Sheriff Agencies in the United States, especially in Southern California, have specifically developed techniques and equipment whilst using helicopters. On the EAST coast of the United States, agencies such as the National Guard and the United States Coast Guard (USCG) have extensive experience in flood rescue from events such as Hurricane Floyd and Katrina.

Australia is still developing the requirements for the effective, efficient and safe usage of helicopters for flood rescue. A common perception exists where a helicopter crew can conduct all manner of rescues. The reality is that many flood rescues require many hours of training, an intricate knowledge of hydrology in the flood environment, significant cross training in helicopters, flood rescue, hazmat, swiftwater rescue, physical and mental preparedness as well as maintenance and preparation of the helicopter. Even simple rescues of persons off roofs can be significantly improved not only in safety, but dramatic increases in efficiency. The use of short hauls and simple ‘lilly pad’ techniques enable the resource to return faster and save further lives. These techniques are not currently used in Australia and it is my aim to bring this knowledge to our shores.

My sincerest gratitude is given to the Winston Churchill Memorial Trust for the opportunity to learn the current best-practice from those around the world and bring this information back to Australia. The experiences and people in this field are a credit to their organizations and helped make this the experience of a lifetime.
This fellowship would have not been possible without the support of my two referees, Commissioner Murray Kear, NSW State Emergency Service and Mr. Stephen Leahy, Chief Executive Officer, Westpac Life Saver Rescue Helicopters.

Their words of encouragement and support assisted both my application and travels. I also extend thanks to Commissioner Greg Mullins, Fire and Rescue NSW. A past fellow himself, he also afforded me support and encouragement for my travels.

To all the people I visited, to single any individual out would be unfair. You are all a credit to your organizations, your country and the overall preservation and saving of lives.

Finally I am dedicating this report to Nancy Rigg of California USA, who has dedicated her life to not only preserving life from drowning, but assisting those rescuers worldwide who study and seek to find faster, safer and better ways of doing this. There is no other person I know who has indirectly saved so many lives worldwide.

Figure 2 - Ventura County Rescue Helicopter. Combined Sheriff and Fire
II. EXECUTIVE SUMMARY

NAME: Shannon Crofton
ADDRESS: 22 Soldiers Rd Jannali, NSW 2226
OCCUPATION: Firefighter/Aviation Officer, Fire and Rescue NSW
TELEPHONE: 0414 825 640
PROJECT: To investigate the utilization of helicopters for flood rescues and reconnaissance.

HIGHLIGHTS:

- Observing, training and learning the world’s best practises for helicopter usage for flood rescue’s from LAFD, LACoFD, LA Sheriff’s Dept, USCG and North Carolina Helicopter Aquatic Rescue Team.
- Taking advantage to further learn and gather information with invites from Fresno County Sheriff, National Association for Search and Rescue, Whistler Fire Dept, San Diego Fire Dept, San Diego Lifeguards, Travis County Star flight, Raleigh Fire Dept, Charlotte Fire Dept, North Carolina National Guard and North Carolina Dept of Public Safety.
- Visiting ‘Swiftwater Rescue’ Author Fred Ray, and swiftwater rescue advocate, Nancy Rigg, about developing trends and the future for helicopters in flood rescue.
- Attending the NASAR annual conference and receiving the Higgins and Langley award for Outstanding Achievement in the field of Flood and Swiftwater rescue.(First time ever awarded outside the United States)

RECOMMENDATIONS:

- Educate and disseminate knowledge and information on how helicopters and crews are equipped and tasked for flood rescues to Australian helicopter rescue agencies
- Educate flood combat agencies about effective utilisation and preparedness of helicopters
- Evaluate equipment and techniques used overseas in the Australian environment
- Develop further procedures and train helicopter providers in rescue and search techniques
- Encourage ongoing networks between Australian and overseas agencies

IMPLEMENTATION AND DISSEMINATION:

- Generate interest with wide publicity and dissemination of this report Australia wide
- Provide NSW SES with the information, knowledge and tools to further build their aviation flood rescue capability. NSW SES to disseminate to other flood combat agencies nationally
- Address directly FRNSW (FIREAIR 1) and NSW Police (POLAIR) my findings for consideration of further development and implementation and interstate dissemination
- Use media to encourage Australian agencies to learn and understand that flood rescue is a specific discipline requiring specific training
III. PROGRAMME
(6th June 2012 – 15th July 2012)

6th – 7th June 2012
Fresno County Sheriff’s Dept
Air Support Unit
Sgt Kathy Curtis

7th – 10th June 2012
National Association for Search and Rescue
Conference, Lake Tahoe, Nevada.
Nany Rigg

13th – 16th June 2012
Priority Air 1 Rescue, Canada
Bob Watson

Whistler Fire Department
Brian Buchholz

16th June – 4th July 2012
Los Angeles County Fire Department
Air Operations
Batallion Chief Larry Collins

Los Angeles Fire Department
Air Operations
Crew Chief Greg Sanderson

Los Angeles County Sheriff’s Department
Air Rescue 5
Sgt Rod Kubly

Ventura County Sheriff’s Office
Air Unit

San Diego Fire Rescue Department
Copter 2
Chief of Air Operations Perry Esquer

San Diego Lifeguards
Headquarters
Sgt Jon Vipond

5th – 10th July 2012
Travis County Starflight, Texas
Program Manager Casey Ping

Texas National Guard

United States Coast Guard
Air Base Houston
Cmdr Brian Seekatz

11th – 15th July 2012
North Carolina National Guard

North Carolina Helicopter Aquatic Rescue Team
North Carolina Fire Department
Batallion Chief Tim Rogers

Raleigh Fire department
Batallion Chief Frank McLaurin

North Carolina Dept of Public Safety
Brian Barnes

Asheville, North Carolina
Author Fred Ray

USGC Water Resources Division
Jerald Robinson

Mecklenburg County Govt Flood Mitigation
Robert Billings
Helicopters are undoubtedly one of the most effective and efficient rescue tools ever invented. Constant evolution and experience has seen many a dramatic rescue undertaken. However there have been many cases where a helicopter called to rescue someone has crashed.

Helicopters cover ground that vehicles and boats can’t. With this comes increased probability of saving life as well as a decreased cost.

Too often, the inappropriate helicopter and crew is called upon to make a technical aquatic rescue—finding themselves taking unacceptable risks in response to the pressure of the event. Many times attempting things they would never try under ordinary circumstances.

‘First do no harm’. If anything, a helicopter should only make a situation better and not worse. Bringing a helicopter to a rescue scene can cause noise; air turbulence and can make rescuers lose focus on the rescue at hand. They can blow away objects and have been known to blow people off the very structures they are rescuing them from.

Inexperienced site controllers and inexperienced pilots and crew will significantly hamper, hinder and make significantly more dangerous a rescue scene. Too often incident commanders feel forced to use a helicopter to undertake a rescue if they have been called. Too often the helicopter crew feels like they must attempt ‘something’ if they have been called. Evidence to this is the number of videos showing incorrectly kitted rescuers attempting a rescue in water. A good result of these rescues is termed ‘brave’ by the media. However ‘lucky this time’ should be more attributed.

Helicopters are often seen by managers as the tool to actually conduct the rescue. An experienced manager will understand that a helicopter is just one resource, one tool in their toolbox for undertaking a rescue. The actual rescue technique itself may not be done by the helicopter, yet there are many areas where the helicopter will indirectly assist in the rescue of persons in floods.

**CAPABILITIES OF A HELICOPTER IN FLOOD**

Helicopter rescues are often safer for people on the ground. They are faster, do not run the risk of being caught up in snags and have a dramatically heightened search ability. Helicopters are perfect for that ‘middle ground’ where floodwater is too deep or boggy for vehicles but still shallow enough that boats cannot operate properly and thus often sustain damage. Helicopters stop other rescuers having to enter the water. They help free up other resources, can search large areas quickly and have a faster initial deployment time. They contain then scene of a missing person faster. They can access confined and remote areas, be used in the day and night, and often the rescue is over before other services get to the scene.
A helicopter can be used during a flood for:

1. Fast movement of rescuers to a rescue site
2. Overhead search platform (also may have FLIR, NVG, Infra Red)
3. Initial search area containment
4. Upstream spotter
5. Downstream pickup/safety
6. Aerial management and communication platform
7. Equipment movement (including boats, jet skis etc.)
8. Direction/guidance/information to trapped persons (i.e. PA system)
9. Mass evacuations
10. Rescue

Immediately we see the significant knowledge, training and skill require by a competent flood rescue helicopter crew. This is in addition to other duties these crews may undertake in the normal course of their work such as medical, law enforcement, aviation duties, and other rescue tasks such as surf, cliff, canyon, remote area etc.

A flood and swiftwater rescue using a helicopter is possibly the most dangerous type of rescue to be attempted. The patient is often in a moving water environment and may only have a short time to live. The environment for the crew could be anywhere, city streets or remote deserts. Flood rescues can occur at any time, day or night and require an immediate yet coordinated and controlled response. Flood rescues can occur in dry periods from broken levee’s or water mains.

A blunt realization should be made by emergency managers. We don’t send untrained, ill equipped rescuers to motor vehicle accidents simply because the ‘rescuers’ have a vehicle. Neither too should we send helicopters to a rescue simply because they have a helicopter. Helicopters used for flood rescue should be qualified, trained, equipped and experienced for flood rescue. It is a very specific discipline. Even a standard rescue helicopter often falls short on the necessary training and qualifications needed to be used for flood rescue.

Helicopters respond and conduct rescues faster. They also keep persons, including rescuers out of the water more. This is of significant benefit when we understand the hazmat and equipment deterioration aspects of floods. Floods break down drysuits and inflatable rescue boats. They create HAZMAT decontamination issues and often long term health issues for rescuers.

The response to natural disasters in the United States is very structured. Resources are managed and allocated on a local, state and federal level. Many of these resources are ‘typed’ into specific categories and within these categories is the type of emergency response (i.e. floods, fire etc.).

State and federal agencies have typed their assets for flood work. This allows fast and easier allocation of resources and an understanding of the capabilities and assets emergency managers are receiving when deployed.
Below is an example of this resource typing from North Carolina. They have researched and tested the most appropriate types of helicopters to be used for flood rescue.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Component</th>
<th>1 (Heavy)</th>
<th>2 (Medium)</th>
<th>3 (Light)</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helicopter</td>
<td>Seats w/pilot</td>
<td>16</td>
<td>10</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Useful Load</td>
<td>Min 5000 lbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min 2500 lbs</td>
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<td></td>
<td>Min 1200 lbs</td>
<td></td>
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<td></td>
<td>Min 600 lbs</td>
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<tr>
<td>Examples</td>
<td>UH-60</td>
<td>Bell 205</td>
<td>Bell 206</td>
<td>Bell 47</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>412</td>
<td>MD 500E</td>
<td>MD 105</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Does not meet mission requirements for external live load</td>
</tr>
</tbody>
</table>

**Figure 6 - Helicopter typing North Carolina**

These helicopters may be called upon for single one off rescues or, as they have been, significant large scale flood events requiring the rescue of large amounts of people both in the water and on roof tops.

The typing allows further back of house management of these resources when and even before they arrive. Fuel types and amounts, hangarage, security, landing zone areas and size, engineer requirements, pre-rigging and lifting capacities.

There is no use sending a small helicopter to rescue 50 people whilst sending a large helicopter into a canyon for one victim.

Managers are also informed about equipment carried, crew skilling and aircraft ability such as the ability to perform external live loads.

**Figure 7 - Light Medium and Heavy typed helicopters**
Whilst not applicable to Australian standards and AAIMS (Australasian Inter-Service Incident Management System), the overseas standards provide a great starting point and introduction to developing a similar asset typing structure here in Australia.

The NFPA (US National Fire Protection Association) standards are used as a reference standard. The US National Incident Management Structure (NIMS) search and rescue credentialing is linked to the US Federal Emergency Management Agency capability and team typing. This FEMA typing is then further linked to the internal and external statewide deployable assets.

**Helicopter Assets**

*Type 4 Through Type 1 Teams*

**Assignments**

- One aircraft assigned to support Type 4 or Type 3 Teams
- Two aircraft assigned specifically to a Type 2 or Type 1 Team
- Minimum of four aircraft assigned to an area of operation

**Air Operations Group/Branch**

*(Assigned to TFL, Area, or Division)*

<table>
<thead>
<tr>
<th>Helicopter 1</th>
<th>7 Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3 Rescuers</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Helicopter 2</th>
<th>7 Personnel</th>
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</thead>
<tbody>
<tr>
<td>- 3 Rescuers</td>
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<table>
<thead>
<tr>
<th>Helicopter 3</th>
<th>7 Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3 Rescuers</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>Helicopter 4</th>
<th>7 Personnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 3 Rescuers</td>
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**Figure 8 - Air assets typing capability - North Carolina**

There are many reasons why aircraft are considered under the typing configuration. Possibly the largest reason a particular aircraft is listed is because that is what is currently available.

Some considerations when choosing an aircraft for flood rescue are:

1. Skids or wheels. Wheels can bog and penetrate mud.
2. Size and lift capability. Be aware, bigger is not always better. Apart from cost, a large aircraft will bring down branches around a victim, it may blow them off the roof of a house or car and they may take longer to get airborne.
3. EMS/medical, Law enforcement, utility. Ideally the most suitable aircraft is one not weighed down with and EMS fit out or law enforcement equipment. A basic rescue utility aircraft is great for flood work and rescue.

*Remember, during a flood though, law enforcement and medical helicopters may be the only means of getting this capability to the scene. That ‘scene’ may be hundreds of square kilometers where normal medical emergencies*
will occur and laws will still be required to be enforced. Always remember floods are long duration and often large scale events.

4. Twin engine
5. High skid area
6. Enclosed tail rotor. An enclosed tail rotor increases safety but also increase the winds effect on the aircraft whilst trying to position for a flood rescue.
7. External lighting
8. Wire strike protection
9. Provision for extra crew
10. Pilot and crew training and standards/currencies
11. IFR/VFR (night flight capability)
12. Communication systems, ability to communicate with rescuers on the ground
13. Public Address system
14. Siren and emergency lighting (blue and reds)
15. ‘One is none and two is one’. Helicopters are an expensive and logistically demanding tool. At any one time a helicopter can be grounded for numerous reasons including regular scheduled maintenance. Having two machines counted as one can ensure there is at least one machine ready to go at any time.
16. Similar machines. Utilising the same type of helicopter in an agency or event allows cross matching of parts, engineers and pilot and crew endorsements.

CROSS TRAINING

As discussed earlier, helicopter crews require cross training in swiftwater rescue, search techniques etc. This not makes them work more efficiently but allows them to recognize a fatal situation before they deploy, such as a low head dam.
Many agencies in the United States also cross train and cross-crew. There are many reasons for this; however the most obvious is cost and abilities. NCHART (North Carolina Helicopter Aquatic Rescue Team) cross crew with the United States National Guard (USNG). In short, the USNG have the assets, ability and logistics to keep very expensive machinery flying. The NC Fire Department has firefighters skilled in all avenues of swiftwater rescue. Some cross training negates the need to train all persons in every facet of flood rescue. This typing may only be able to be conducted in larger helicopters. Smaller helicopters may not have the ability to carry as many people and still have power to conduct a rescue.

This multi-agency approach enables a community to have a response capability where before no single agency could undertake it. It also reduces cost to agencies as well as generating mutual partnerships and benefits.

**DEPLOYMENT**

Today in Los Angeles the fire departments and sheriff department deploy a helicopter on initial call. For many reasons this aircraft can be used as discussed above. But most importantly, these agencies have the training and knowledge, the communication and incident planning to use the helicopters in a very safe manner. No longer are helicopters viewed as a high risk alternative. Their crews train specifically and often as we will see later. The time saved by deploying the helicopters often leads to a faster rescue, not only saving the lives of the victim, but rescuers whom may have had to attempt a ‘go’ rescue.
FLOODS

Floods are a unique area with many dangers where multiple forms of rescues may take place. Often rescues are time critical and the victim may even be moving.

Debris and chemicals will always be found in floodwater whether it’s an overtopped river bed or a flash flood through and urban environment.

Whatever the flooding, we should always remember the 4 absolutes of floods,

- Floods are multi-agency events.
- Floods are multi-jurisdictional events.
- Floods are haz-mat and public health events.
- Floods are long term events that can exhaust emergency personnel and community members emotionally, mentally, and physically.

Our understanding of moving water gives us three characteristics we can use to our advantage. They are that water is;

- **Powerful**: Water has volume and weight. The force of this water depends on the speed at which the water is moving. This power can hold people against objects or move the vehicles and houses in which they are located. The force exerted on a rescuer being deployed by a helicopter must be taken into consideration with the aircrafts Centre of Gravity (COG) and power curves.

- **Relentless**: Swiftwater will push against an object continuously. Unlike surf conditions where waves generate power and recede, swiftwater will hold the victim continuously. Rescuers have to factor this into the equation when persons are being held by the water.

- **Predictable**: Our greatest asset with swiftwater is that a trained person can read the water extremely efficiently. Safe and dangerous hydraulics are spotted and used to their advantage. Helicopter crews should never lower a rescuer into a dangerous hydraulic.
TWO MAIN TYPES OF RIVER FLOWS

- **Laminar Flow** due to friction from the banks and the riverbed, water flows at different speeds at the surface and bottom. Water will flow faster at the surface.


- **Helical Flow.** The helical flow tends to push objects toward the center of the river.

In order to provide for the safety of both the rescuer and victim, a low to high risk algorithm has evolved for the implementation of various rescue methods in swift water and flood rescue. Under times of stress, the implementation of this algorithm helps to prevent a rescuer from endangering himself and the victim, thus providing a sound, step by step approach when affecting a rescue. As the algorithm progresses, the danger and threat to rescuer and victim increases. The algorithm initially was:


Then with an increase in helicopter safety and skills and the increased deaths of rescuers in boats and the water this can be changed to:


Even now, many agencies, specifically those in California, now have “Helo” at the start as they are on a first response with the initial call for help. With helicopters crews becoming better trained, agencies realize the importance and benefits of having a helicopter quickly deployed in the first stage of a call.

When a person is being swept away in the flood control channels of Los Angeles, emergency services now use multiple helicopters to stage at pre determined points along the river to facilitate a quick rescue. This has two benefits. Firstly the patient is
quickly rescued, but also it stops rescuers and would be rescuers from entering the water after the victim. Too often in floodwater we see rescuers also dying whilst attempting a rescue.

Just because a helicopter rescue is taking place, all safety precautions should still be implemented. This includes the positioning of upstream spotters and downstream safeties. These downstream safeties are rescuers whom are positioned to catch the rescuer and victim should the initial rescue not be successful. Due to the geography and rapid deployment downstream safeties may not always be in position as a helicopter starts a rescue. However should time permit, and especially during training, adequate downstream rescuers should be in position. For remote areas consider the deployment of a second aircraft to conduct this role. Either from the aircraft or deploy a team from the aircraft at a suitable location.

When considering the integration of helicopters into a flood response plan the incident controller should consider the following attributes:

- Capabilities – of the aircraft and crew
- Experience – flight experience and flood experience
- Mission Tasking – resupply, search/rescue, transport or evacuation.

Agencies involved in utilizing helicopters during flood rescues need to recognize the requirement and logistics of their usage. Issues to take into account include air operations (including flight following procedures), landing zone management, fuel availability and quantity, crew rest requirements and specific weather briefings.

PILOT CONSIDERATIONS IN FLOOD RESCUES

Piloting a helicopter requires significant concentration, coordination and mental inputs. During a rescue procedure, the pilot is under considerable more pressure to control the aircraft. This may be due to weather, communications with crew(s), operational geography, referencing (holding a position), power and weight considerations and hoist operations.

Piloting a helicopter for a moving flood or swiftwater rescue may in fact be the most challenging of aviation rescue environments. Adding to the considerations above, the pilot now has a moving target which may have limited survival time left, and a rescuer hanging below the aircraft whilst it is moving. The pilots references are constantly changing, they will be receiving constant command inputs from the crew, whilst they all remain a lookout for structures and wires.

Another issue which sets a flood rescue apart from other water rescues such as lakes and dams is the aircraft orientation. In a non moving rescue the pilot may be able to gain a reference. Even in an open ocean a buoy can be deployed as a reference for the pilot to use. The pilot can also orientate the aircraft into the wind, or any other most comfortable position to their benefit (ie to reduce sun glare, sea spray, maintain a visual on wires etc).

Unfortunately the aircraft ‘chasing’ a flood victim quite often cannot do this. The terrain may be that which has overflowed a rivers natural banks or indeed be an urban
streetscape with large volumes of water flowing through. Orientations, references and clearances are a fast paced communication between pilots and crew. Certain aircraft with large tails (such as the EC135’s fenestron tail) do not like being positioned in certain orientations with certain winds.

All these factors are before the rescuer enters the water or makes contact with the victim. Often these attributes place some shock load and further external forces on the aircraft, requiring further control inputs from the pilot.

Experience and training for these conditions will give the aircrews significant judgement for the real thing. This judgement however may extend from a ‘HELO’ rescue to a ‘NO’ rescue. It is then back to their toolbox approach of techniques to further identify possibilities for the safe rescue of the victim.

Everyone has a responsibility to cancel a flight for reasons of concern for personal safety.

CREW COMPOSITION

Understanding that different aircraft have different crew carrying capabilities, it was noted that many agencies used a ‘safety’ crew person. This person was often termed the crew chief. This is in addition to the pilot, the rescuer (down the wire person) and the hoist operator.

The safety/crew chief handles radio communications. They also double checked all attachments and persons before entering and exiting the aircraft. The allowed another set of eyes for lookout for wires, obstructions etc. This was inherently valuable in the moving water environment where the pilot is required to maintain references and the hoist operator maintaining attention on the hoist and the person down the wire.

CREW RESOURCE MANAGEMENT (CRM)

CRM is a management system which makes use of all resources at hand. Often used in the aviation environment where human error can have devastating effects.

To the flood rescue helicopter crew, a good understanding of situational awareness, communication, skills and knowledge of both the aircraft and the rescue required will increase significantly the safety and efficiency of the mission.
All available resources and equipment together with teamwork, problems solving and decision making shall work in unison to carry out a speedy rescue.

It must be stated that there may be situations where the final part of the rescue acronym “NO” is reached. This is where a decision has been made, through training, skills, experience and judgment that a rescue attempt is far too dangerous at that point. Here, alternatives in the crews ‘toolbox’ of techniques and knowledge can be discussed immediately.

It is imperative that all personnel shall participate in pre-launch and in-flight mission planning, site recon including best approach and equipment methods and mission debriefings.

THE FLOOD VICTIM

To fully understand the most beneficial and safest method of rescue we should understand our victim.

Flood rescue victims are quite different to most water rescue victims. Most flood victims never start their day thinking they will end up in the water or on a roof. They dress in normal often loose fitting clothes, they have no Personal Flotation Device (PFD), and they may be in a vehicle or walking on a street. They may not know how to swim or be weighted down by their clothing. Their jewellery will catch on debris, they may have swallowed water, they may have oils and pesticides on their clothing and skin. Often a victim has had their clothing ripped off, they have abrasions and cuts from being dragged along the ground. Victims may be trapped in a vehicle or suffering trauma from an initial impact prior to your arrival. They will be panicking and may not adhere to simple instructions from rescuers.

Flood rescues have occurred underground in shopping malls. Often they involve the elderly or young children and infants. Victims may walk toward the helicopters working area, they may jump at the rescuer as they approach or worse, jump into the water to get closer to the rescuer. Helicopter crews may find a range of these people and be prepared for their handling, rescue and transport.

A victim in floods will always be cold. Even in summer, water temperature never reaches that above the core body temperature. The wind and downdraught from a helicopter adds a wind-chill factor. The cold patient is weak and slow to react. They may also be incoherent.

In moving water environments, the rescuer should remain attached to the hoist or short haul line. They should make survivor contact and secure the person in an expedited fashion. Detaching from the aircraft is not advised. Persons in vehicles and structure should be assisted out from outside the vehicle.

The hoist shall have just enough slack to allow the rescuer to undertake their role. Too much slack in the moving water environment can tangle, wrap around the rescuer/victim or form a loop and catch passing debris which can pull the rescuer into the water.
If the rescuer falls into the water, the aircraft shall immediately be ‘conned’ or ‘slid’ downstream to minimalise shock loading to the hoist and aircraft.

The reality of floods is that victims do not last long in the water. Whilst there are cases such as those in the Los Angeles canals where victims have been followed for many kilometers by rescuers, flood victims will generally be rescued from roofs, trees and vehicles.

Victims may often be sharing areas of refuge with other animals from the small such as snakes and spiders to the larger animals such as horse and cows attempting to get to higher ground. Always be prepared for a victim with a secondary complaint such as anaphylaxis or trauma.

**SHORT HAULING AND HOISTING**

Both short hauling and hoisting are methods used by helicopters to safely rescue people.

Both methods carry advantages and disadvantages. Throughout the agencies seen, there is often debate about which methods are best for flood rescues. Of course, those with smaller aircraft (and without a hoist) will side with the short haul.

**SHORT HAUL**

Short hauling can be use to insert and extract rescuers, victims or both. The patient can be attended or unattended depending on device. The short haul needs to be attached to the aircraft with a pilot/crew chief release. It can be in the form of a constructed cargo hook or a simple ‘belly band’ type sling around the airframe. A back up system is incorporated.

The short haul rope is more forgiving than cable and can handle more than one victim at a time (see mass rescue). The rope is ½” rescue rope and can be of 50ft, 75ft or 100ft lengths. The cost of a damaged rope is significantly less than a hoist and cable. However, a short hauls requires all movement to be conducted by the aircraft (horizontal and vertical positioning). This places added stress onto the crew and pilot. Pilots can sometimes see the load themselves, often through a bubble type window, however often the conning of the aircraft comes from the crew.

Rescue devices used with a short haul include a cinch collar, rescue sling, water litter, stokes wire basket and a Baughman bag.

The short haul can be used on suitable aircraft that don’t have a hoist.
HOIST

Most rescue aircraft are fitted with hoists. The most common is Goodrich. The obvious benefit of a hoist is the fine vertical adjustments that can be made by the hoist operator. The length of the hoist can be adjusted to suit the mission and conditions. The vertical operation of the hoist relieves the pilot from one of their many duties. The disadvantage of the hoist is the unforgiving cable. Hoists are not designed for shock loading. A hoist can fail because of overheating from long winches, loss of power or a runaway. The hoist generally limits the helicopter to removing one victim at a time, however the hoist enables the victim to be brought into the aircraft or rescuers to be deployed to the ground without landing. A hoist can be used immediately without the need to rig the aircraft but hoists are expensive, require maintenance and add weight to the helicopter. The hoist uses many of the same equipment as the short haul.

HOIST RESCUE CAPTURE STRAP PROCEDURES

VICTIM STATIONARY ON A VEHICLE OR ROOF

These rescue techniques may differ to Australian techniques as the rescuer faces the victim and has the capture strap ready to secure them. They can be attached to the rear of the rescuer (sometimes referred to as a ‘Peter Pan’ or ‘dorsal’ attachment). Traditionally in Australia a rescuer is attached by a front attachment point on their harness and carries a strap down.

A capture strap is a strap used to secure a victim to a rescuers harness during a rescue procedure. It is designed for fast attachment and catching of victims in imminent danger. The strap is held by the rescuer and can be quickly attached in one motion. Rescues using the capture strap are for persons trapped in hazardous locations. The capture strap can also be used for other situations such as cliff rescues and high rise rescues.

PROCEDURES

1. The pilot positions the aircraft over the pre-determined pick up area.

2. The hoist operator will ask for permission to open the door and for hoist power. The hoist operator will open the door and move to the appropriate position.
3. The rescuer will disconnect the ICS (Internal Communication System) cord and connect to the VHF hand held radio.

4. The hoist operator extends the cable into the cabin and gives the hook to the rescuer. The rescuer connects the rescue hook to the ring on the hoist harness.

5. The safety makes sure the rescuer and the capture strap is secured to the hook. Upon mutual acknowledgement the rescuer will then disconnect his/her seat belt.

6. The rescuer will proceed to sit on the cabin floor as the hoist operator removes slack from the cable. The hoist operator will then lift the rescuer off the cabin floor, and onto the skids facing the hoist operator.

7. The rescuer places their hands through the draw loops and puts the ring in one hand and snap hook in the other hand.

8. The hoist operator guides the pilot to the exact position and requests permission to start lowering the rescuer. As the rescuer is lowered the hoist operator keeps the pilot informed of the rescuer’s location and any position corrections needed. The rescuer will be moving about five feet per second.

   (Goodrich)

9. When the rescuer reaches the level of the victim, a signal will be given to the hoist operator to stop by sweeping their arm horizontally.

10. The hoist operator must carefully guide the pilot to a position from which the rescuer can capture the victim without knocking them from their position.

11. When the rescuer reaches the victim they should try to stabilize themselves in that location. If this cannot be accomplished, then the rescue will have to be made from a suspended position.
As the rescuer nears the victim he should establish contact with the victim and very briefly explain how the rescue will take place. Operationally this may reduce the risk of the victim panicking and jumping to the rescuer.

12. While facing the victim, the rescuer reaches around the victim with the capture strap. Connect the snap hook to the ring, and draws the straps tight. When the victim is secure, signal the hoist operator that you are ready by tapping the top of your helmet, or making large head movements from left to right.

13. The hoist operator informs the pilot and retracts the cable. The hoist operator will guide the pilot away from any hazard.

Once in the clear, the pilot may elect to decrease altitude as the cable is retracted to keep the rescuer and victim near the ground in case of a problem. The pilot may also choose to short haul the rescuer and victim to a safe location nearby and set them down.

14. When the hoist cable is fully retracted, the victim and Rescuer are assisted into the helicopter by the safety and the hoist operator.

If it is needed, the "Orca strap" may be used to assist in pulling. Attach the strap to the rappel rings on the opposite side of the cabin and to the hoist hook. The end of the strap is pulled on as the rescued are brought in.

15. After the rescuer and victim are in the cabin, the safety and the rescuer will coordinate securing the victim into a seat belt or med deck.

16. Once the victim and rescuer are secured, the hook will be bedded and the right cabin door closed and locked.

17. The hoist operator will notify the pilot he is "Free to go" when all personnel are seat belted.

Figure 16 - Ventura County
WATER RESCUES

Water rescues come in two categories:

1. Swift water (fast moving water; i.e. streams, canals, and rivers).
2. Open water (calm water; i.e. lakes, oceans, and flood plains).

Depending on the dispatch information received, the crew will have to decide what equipment will best suit the particular type of rescue to be performed.

SWIFT WATER RESCUES

NOTE: Whilst every attempt to ensure the victim is lifted clear of the water to safety, there may be occasions where a victim, and rescuer are simply dragged through the water for a short period to a safer place such as a bank or an eddy. This may be required with a very exhausted patient and the ability and time to secure the patient extends beyond the time it would take to simply ‘ferry’ the patient to a safer area. Ideally this area would have downstream safeties or other qualified rescuers in this vicinity.

The majority of swift water rescues in the City of Los Angeles have been made by Air Operations. The swift water rescue is a dynamic hoist rescue made over water with a few exceptions.

SWIFT WATER RESCUE HOIST PROCEDURES

RESCUER

Figure 17 - LAFD. Rescuer in position leaving a ‘wake’. Note ‘H’ on helmet to denote helo qualified rescuer.
The Rescuer’s hoist harness can be rigged with the rescue hook attached at the rear of the harness (Peter Pan or Dorsal). This puts the Rescuer in approximately a 30-degree heads up altitude above the water. This position allows the Rescuer to see the victim coming down river, and also enables he/she to control some lateral movements with their feet in the water. The Rescuer also has the option of going down vertically off the strap on the rear of the harness. When this position is used, be aware that the vertical strap will force you head down until your feet are in the water.

The procedures for swift water operations mimic the hoist operation except the operation will be moving with the water’s movement and the victim.

HOIST OPERATOR RESPONSIBILITIES

1. Give the Pilot continual positioning updates during the entire rescue.
2. Take extreme care in preventing any situation where the rescuer or helicopter would become entangled in debris or trees
3. Lower the Rescuer knee deep into the water. This allows the Rescuer to have some control of lateral movement.

*By dipping their toes in the water, the rescuer creates a ‘wake’ and allows themselves some lateral movement. This wake also aids in the hoist operators depth perception and flow speed of the water.*

*In a true flood situation there may be occasions where the rescuer is positioned above the water to clear debris flowing down past them.*

4. Make sure the Rescuer is lined up with the victim.

5. Lower the Rescuer completely into the water simultaneously as the victim arrives.

*Figure 18 - Lining up the victim, capture strap ready*
2. Figure 19 - Rescuers locks victim into capture strap

3. Inform the Pilot to start pacing down river.

4. Figure 20 - Pilot pace matching and rescuer signals ready to lift

5. Adjust the pace by informing the Pilot to “slow the pace”, “increase your pace”, or “this is a good pace”.

6. Maintain minimal slack above the water at all times.

7. After the hoist signal is given, raise the Rescuer and victim while still pacing the river. (Do not stop the aircraft before the Rescuer and the victim are above the water).
VARIATION ‘GO’ RESCUE AND PICKUP BY HELICOPTER

There may be circumstances where the helicopter is used to pick up the rescuer after they have already made contact with the victim. The entry point may not have been conducive with a helicopter rescue but the victim may require immediate assistance and thus a ‘go’ rescue was performed.

This can also be an example of helicopters being used as part of downstream safety. Los Angeles County Fire Department call this evolution the ‘dynamic free swimmer’ evolution.

1. The helicopter is positioned downstream of the victim and rescuer. The crew lowers the short haul rope or hoist cable with a capture ball attached to the end. The capture ball is a high floatation, high visibility, multi ring attachment point that the rescuer can attach the caribiner from his harness to.
2. Whilst watching for hazards, and on hot mike, the crew guide the pilot to position in line with the oncoming rescuer and victim.
3. The rescuer has secured the victim with a cinch strap and now has his attachment caribiner ready for the upcoming capture ball as he approaches.
4. As the rescuer approaches the capture ball the crew ready the pilot to move downstream and pace match the aircraft with the rescuer and victim in the water.
5. Once the rescuer has grabbed the capture ball the aircraft is directed by the crew to match the downstream speed of the rescuer and victim. Only once the rescuer has signalled that they have secured themselves and the victim to the capture ball does the pilot gradually lift them both slowly from the water. Downstream speed in continued and once clear of any obstacles the rescuer is short hauled to a safe area on the river.
bank. The rescuer disconnects the victim from the aircraft which is free to continue duties or land appropriately.

NOTE: Whilst the rescuer and victim can also be hoisted into the aircraft, generally the time to lift them 2 metres clear of the water and haul them the short distance to the side of the river negates the risk of a continued hoist and reduces the time for the patient in the air and on cinch strap. Keeping the height low reduces any injury should there be a fall whilst conducting the evolution.

Some operators utilized the aircraft to lift the victim and rescuer clear of the water whilst some use hoist power to lift them clear of the water. If a short haul line is used then the aircraft is used to lift them clear of the water.

A short haul line used in dynamic water pickups required the pilot to make further input adjustments in the vertical plane.

SAFETY PERSON'S RESPONSIBILITIES

(LAFD)
1. Oversee the operation and assist the hoist operator when needed.

2. Watch for obstacles above the water or submerged

3. Monitor the cable for fouling and slack.

RESCUER RESPONSIBILITIES

1. Have the capture strap ready and adjusted for use before leaving the cabin

2. Have legs spread apart for stability in the water
3. Make a positive hook up with the capture strap and ensure there is no cable entanglements prior signaling to be hoisted.

SAFETY CONSIDERATIONS

1. All crewmembers shall wear PFD’S with HEEDS.

2. Rescuer shall wear a dry suit and a swift water helmet.

3. Be aware of adequate distance for helicopters to perform rescues; the distance may change depending on the water’s speed.

4. Be aware of any obstacles showing or submerged.

5. When lifting Rescuer and/or victim make sure the helicopter is directly over the load to prevent any possibility of swinging.

6. Lift the Rescuer and victim high enough to clear the channel wall or fence.

7. During the rescue, be aware of the 15-degree maximum “fleet” angle of the Breeze Eastern Hoist on H-2. The Goodrich Hoist have no restrictions on fleet angle.

8. If the cable becomes entangled, immediately let out slack and notify the Pilot to shear the cable, if necessary.

9. The Safety’s priority is to monitor the cable and watch for debris or hazards in the water.

10. Attention should be given when reeling the cable in with slack. The cable may miss wind back onto the spool. This is more likely to occur on the Breeze-Eastern hoist.

11. All crewmembers will stay alert for telephone wires, cables poles, and trees that are extending into the flight path.

*If an excessive amount of slack is allowed to droop below the water level, serious injury to the Rescuer can occur during hoist retraction. The Safety may need to assist the Hoist*
operator by manually retrieving excess slack. The manual retrieval of slack is only required if the hoist cannot catch up to the excess slack quick enough. This manual technique of controlling slack may also be required if a hoist failure occurs during operations.

OPEN WATER RESCUE

The standard hoist and swift water procedures can be applied. These rescues will be incident driven and Pilots and crewmembers will adjust their operations and equipment as needed.

The Rescuer during water rescues must wear protective clothing during all flight operations. The type and quantity of clothing worn is determined by mission needs. Regardless of the ensemble chosen, the Rescuer must wear an Aircrew protective helmet during take-off and landing. (LAFD)

The donning of the flight helmet for rescuers during take off and landing is also a requirement of the USCG. A flight helmet provides a much higher level of protection and less flammability than a swiftwater helmet. The flight helmet also provides ICS.

NIGHT HOISTING

Chemical lights (cyalume sticks) are often attached to the ring or hook of the hoist. Some operators even attach a small LED light in a downward facing direction to aid in shadowing and depth perception as well as lighting the scene.

Utilize a chemical light strap instead of zip ties or cable ties.

Some rescuers activate their strobe light, however wait until outside the aircraft before this is activated.

A rescuer should take additional chemical lights to leave on the vehicle or roof should a return trip be necessary.

NIGHT VISION GOGGLES

Night vision goggles (NVGs) have become more readily available and cost efficient for rescue agencies in past years. However as with any technology, their significant benefits come from training, understanding and proficient use of this piece of equipment.

In general, all crew will be wearing NVG’s and the aircraft will be equipped with NVG cabin lighting. The crew co-ordinate with the pilot to position the Night Sun, Searchlight, or landing light for the most appropriate lighting.
It was noted that some hoist operators would peek below their NVG’s whilst hoisting as NVG’s can alter your depth perception.

<table>
<thead>
<tr>
<th>INFORMATION TO PILOT</th>
<th>HOIST ICS TERMINOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Direction of movement----straight ahead.</td>
<td>FORWARD</td>
</tr>
<tr>
<td>2. Direction of movement----to the rear.</td>
<td>REAR</td>
</tr>
<tr>
<td>3. Direction of movement---slide to the right, maintain present heading.</td>
<td>RIGHT</td>
</tr>
<tr>
<td>4. Direction of movement--- slide to the left, maintain present heading.</td>
<td>LEFT</td>
</tr>
<tr>
<td>5. Direction of movement--- up, maintain relative position.</td>
<td>UP</td>
</tr>
<tr>
<td>6. Direction of movement--- down, maintain relative position.</td>
<td>DOWN</td>
</tr>
<tr>
<td>7. Hold present position.</td>
<td>HOLD</td>
</tr>
<tr>
<td>8. An indication of slow rate of movement---precedes the basic command.</td>
<td>EASY</td>
</tr>
<tr>
<td>9. Self explanatory--- precedes direction movement.</td>
<td>STOP</td>
</tr>
</tbody>
</table>

**NOTE:** The preceding lists of terms are in relation to helicopter axis.
Whilst the terminology, sometimes called ‘verbage’ in the US is slightly different, I did notice that Australian ‘patter’ is quite more complicated. The US crews would guide or ‘con’ their aircraft into position with significantly less words and conversation.

Another term used to speed match a person in the water was ‘slide’. This term indicated to the pilot that there was an attachment taking place on the hook whilst he was moving the aircraft downstream.

In Australia the prefix ‘go’ indicates to the pilot that the next command will be in the vertical plane (ie up or down). The prefix ‘move’ indicates to the pilot the next command will be in the horizontal plane (ie left or right).

Below is an example of a hoist sequence from Los Angeles Fire Department.

**HOIST SEQUENCE**

En Route to the scene notify the pilot, which Aircrew members will be in each position.

Once on scene, the PIC (Pilot in Command) will notify the crew when it is safe to open the cabin door and begin the hoist operation.

- **Right Door coming open**
- **Main and tail rotor is clear** (You MUST visually assure this is true)
- Hoist operator/Crew chief moving to the skids

- **Hooks coming in**
- **Rescuer hooking up**

At this point you may want to start positioning the helicopter close to the desired location.

- **Rescuer coming to the cabin floor**
- **Rescuer on the skids, Final check**
Rescuer going down
Rescuer below the skids
Rescuer 5’ below the skids (10, 20, ½ way down)
Rescuer 20’ from the ground (notice the reference change) (15, 10, 5, 4, 3, 2, 1)

During the lowering operation you will also be moving the helicopter into position over the desired location.

Right 20 (notice no reference to feet)
15, 10, 5, 4, 3, 2, 1, hold

Forward 20
15, 10, 5, 4, 3, 2, 1, hold

Rescuer on the ground
Rescuer disconnecting
Rescuer disconnected
Hooks coming up
Hooks 10’ off the ground, etc
Hooks clear of ALL OBSTRUCTIONS
Hooks halfway up
Hooks 40’ below the skids, etc
Hooks skid level
I have the hook
Hooks bedded

Figure 25 - UH60 can be fitted with internal or external hoist

Safeties in the cabin
Hoist operator/Crew chief in the cabin
You are CLEAR TO MOVE OFF STATION (The helicopter may transition into a slow forward flight for safety)
Right door is closed
You are FREE TO GO (all members are in their seats and strapped in ready for flight)
The aircraft is clear for normal forward flight
Standardization of Vernacular and Syntax (Verbage or Patter) is important to safe and efficient hoist operations. It is the Aircrew member’s responsibility to have a thorough knowledge of these terms.

MASS EVACUATIONS

Agencies responding to floods in the United States have developed methods for moving a number of patients per trip as compared with a single patient per evolution.

Traditionally, a helicopter would locate above an area, hover above, hoist a rescuer down, secure the patient and then hover as they hoist them up to the aircraft. Once secure inside they then move to a safe location where they land and unload the patient.

As we have seen, time is crucial for flood victims. Often they may have congregated on one remaining structure.

A rescue of multiple persons off a vehicle also lends itself to a mass rescue where the sudden unweighting of the vehicle often causes a change in the hydrology and the vehicle to be swept away.

There are many stories from around the world where helicopter crews hoisted a patient to safety only to return to find the other survivors missing.

Note: Live short hauls can only be conducted on certain aircraft and with under certain federal aviation regulations.

Travis County Star flight is one agency where they have studied and documented the hoist v’s short haul comparison.

The photo’s below show a single hoist evolution. The rescuer is deployed and the victims placed in a PMI Hasty Harness. All the victims are tended for the hoist into the aircraft; they are then moved into the cabin and secured. The aircraft is then landed fully.

A second drill involved inserting a rescuer and 3 bags onto the rooftop. Four victims were short hauled utilizing a spider rig. The next group of victims is on the roof being prepared by the rescuer donning harnesses as the aircraft returns.
The lessons learned from this study are;

1. Hoisting victims took 30 minutes for 7 victims. (15/Hr)
2. Short hauling victims took 30 victims in 30 minutes. (60/Hr)

The differences are significant. Apart from aircraft capability and crew training there are little differences.

Understandably victims with severe injuries may need alternate methods, but in this instance we are looking at fast movement for victims stranded in floods.

This technique has been so successful that agencies are now using this method to quickly move firefighters and other emergency services personnel.
In my opinion it is a very simple and effective method which requires little changing of equipment or added training.

RESCUE FROM TREES

The flood rescue helicopter will discover many unique survival sites with a flood victim. Apart from cars the most common is trees. Persons whom have been swept into the water often find themselves clinging onto, or climbing into trees.

During the search phase it is important that searchers always look into the canopy of trees. Victims will climb trunks to get clear of the water but may be obscured by foliage.

*Helicopter rotor wash can be used to look into thick trees.*

Trees present a challenging rescue environment. Apart from the usual entanglement and water problems, a tree will sway violently with the downwash of the helicopter. Training and knowledge will lead the crew to a height to reduce this to a minimum. Experienced crews will even use the downwash of the helicopter to open up the foliage of the tree to allow further space for hoisting.

Procedure for rescue from trees (Travis County Star flight)

- Conduct a Full Recon
- Watch the effect of rotor wash on tree canopy
- Hover (at hoist altitude) to determine
  - Access Route
  - Power Requirements
- Victim and Rescuer may both be in precarious, unbalanced positions
- Tree limbs may break
- Cable management CRITICAL
- Once rescuer enters tree aircraft drift MUST be addressed immediately
- Victim size - power management should have been considered before commencing operations
- Once you pick them up there is no putting them back
- Rescuer clears the cable and creates a streamline profile
- Hoist Operator should extract the rescuer/victim to allow for immediate corrective action
- Rescuer should be allowed time to clear overhead branches
RESCUE FROM CARS

Cars present the rescuer with unique challenges. However it is the knowledge of the reaction of vehicles in floodwater which decides the best rescue options for the victims.

Often people are rescued from cars during small to medium flood events. People often disregard flood warning signs or are simply caught in a flood situation. It is not the job of the rescuer to judge. The victim though will be ill equipped for the situation they are now in. The benefit of persons trapped in or on vehicles is that they are often able to call and guide in the emergency services themselves via mobile phone.

Helicopters are quite often used for vehicle rescues where drivers go for long distances to get through floodwater, or their vehicle has been swept a long distance downstream.

Always encourage people to remain with their vehicle. The modern motor car will float for a long period of time. A vehicle is significantly easier to spot from the air.

During a search phase, the helicopter rescue crew should note all license plates and vehicle descriptions of vehicles being swept away in floodwater and their locations. On board cameras can assist in this information recording.

Cars will generally orientate with the heaviest end (the engine) towards upstream. Most people will wait inside the car or if able to, get out and sit on the bonnet or roof.
Rescuing a single person from a vehicle is a straightforward task for the helicopter rescuer.

When multiple persons require rescue, the helicopter crew needs to decide its course of action. A vehicle with three people on it will unweight itself if one or two of those people are removed. The lighter vehicle may move and be swept downstream and it can roll over. Whatever the movement, the rescue will now be a running rescue with people in the water. To avoid this situation, an ‘all or nothing’ approach should be undertaken. In the rescue toolbox, if the helicopter is to be used, it would be best to remove all the victims in one go. Here we would be looking at a mass rescue scenario. If the helicopter is equipped with a hoist, and there are two victims on the roof then the rescuer can be hoisted down. Two victims can be hoisted back to the helicopter. This keeps the rescuer on the vehicle with the last victim, keeping the two person weight on the car. The rescuer dons a PFD to the victim whilst the first two are being hoisted into the aircraft or short hauled to the side on the hoist cable. When the aircraft returns the rescuer and victim are hoisted together to safety, watching that the vehicle does not roll in their direction. Ideally the rescuer should not come off the hoist cable, but secondary safeties would be implemented should they find themselves in the water.

Rescuer should treat a flood vehicle rescue as they would any other. Ideally the vehicle should be stabilised and safeties implemented. The rescuer should carry a glass punch and seatbelt cutter to access the victim. Do not enter the vehicle, especially whilst attached to the helicopter. On the recon orbit look for signs of children or the elderly.

Consider marking the vehicle or USAR marking techniques to denote that the vehicle has been search to other rescuers.

A strainer is an obstacle that allows water to pass through but pins solid objects against the upstream side. Strainers can take the form of natural or manmade objects. Commonly they are debris screens, trees and fencing. These areas are high probability of detection especially if they are located near a point last seen.

A person caught in a strainer will most often be trapped on the upstream side of the object and have the water pinning them to the object. Helicopter crews must assess the situation and rescue the person using the least force possible. Simply attaching them to the helicopter and attempting to drag them against the force of the water can have catastrophic effects. Remember hydrology, and ways to divert or diminish the water.
effects on the victim’s body. Turn their body sideways and reduce their surface area or assist them over the strainer.

EDDIES

Eddies occurs when water is forced to go around an obstacle instead of over it. This narrows the river causing an increase in speed. As this occurs, areas of low and high pressure occur. The low pressure occurs on the downstream side of the obstacle. Water from downstream is drawn upstream to fill the area of low pressure. Eddies are an area where people and bodies may be held and have distinguishing features that can be seen from the air. They often hold floating rubbish that is being sent downstream.

LOW HEAD DAMS

Low head dams (LHDs) are referred to as drowning machines, keepers or stoppers. The result of water pouring over an object whether a rock or a man made dam where a depression in the water level is created. The depression is then filled by the surrounding water, this action traps victims or debris. They are extremely difficult to float in, due to aeration of the water. LHD’s have resulted in many drowning deaths even when an area is not in flood. Their unique and often silent hydrology keep a person circulating endlessly.

The ‘Boil Line’ is found downstream of the hydraulic. Objects upstream of line will be caught in reversal, objects downstream will be flushed downstream.

- Victims may be recirculation or holding on to something that floats. The hydraulic is the IMMEDIATE life threat. Often passer by
rescuers and even professional rescuers have drowned attempting to rescue or recover victims from a LHD.

- The helicopter rescue needs to immediately identify that a low head dam exists and that all precautions are taken. Downstream safeties must be implemented. The victim down past the boil line is the first and most savable priority. Any victim caught in the recirculation should be rescued via a throw or reach device. Obvious caution must be display using a reach or throw device from a helicopter or rescuer.

Remember Hydrology

- If conditions allow approach over the dam and face down stream
- Allows aircraft to immediately head down stream
- Primary focus is the victim out of hydraulic
- Attempting to strap the victim in aerated water is not ideal
- Rescuer may simply grab victim attempting to keep themselves out of the water as much as possible
- The rescuer will not require significant force to pull over boil line
- Rescuer may elect use a throw bag in case victim surfaces outside of their reach
- Assuming downstream is free of immediate threats
- Rescuer grabs victim and is pulled downstream by aircraft across boil line
- Because of aeration not much physical force is necessary
- Once downstream of boil line the helicopter based rescuer may:
  - Place victim in appropriate rescue device and proceed with extraction
  - Hand off victim to boat based rescue team
  - Swim victim to shore
- Aircraft should be prepared to move dynamically to allow rescuer to prepare victim for extrication

Figure 32 - Low head dams hold items and victims in their hydraulics
RESCUES FROM ROOVES

Hurricanes have showed us the true meaning of mass rescues. Hurricane Floyd and Katrina stranded thousands of people on rooftops of buildings. The logistical and prioritization aspects aside, people on rooftops, whilst generally quite safe most of the time, require simple safeguards for their extrication.

The recon orbit should always include looking for obstructions and emergency fly away options. It should also include your final approach line. Whether hoisting or conducting a short haul, the final approach should be smooth without significant flaring. People on wet and pitched rooftops can be blown into the water. They often stand up when a helicopter passes or approaches and may not be aware of the power of a helicopter’s downwash. This is especially relevant for larger aircraft. If possible, approach from the side with the lowest part of the roof, that way if they fall they will fall ‘up’ the roof. Alternatively use the public address system to advise them to shelter together, facing away from the helicopter as it approaches. Once again a lily pad technique may be used to reduce circuit times.

Chainsaws have been carried by boat and helicopter crews to access houses through rooftops to conduct searches.

Consider the USAR marking techniques to signify the house or structure has been searched and by whom.

In addition to rescues from rooftops NCHART practice rescues through windows to remove persons from inside multi story buildings.

LILY PAD

A lily pad is a term for a temporary assembly point for survivors or rescuers during rescue operations that does not require landing. Typically used during large scale flood operations when people must be immediately removed from harm’s way and to a safer, temporary, area.

The lily pad can be hard ground or a boat. Boats can be deployed to areas to capture victims from helicopters that have removed them from areas too dangerous or inaccessible by boats. Multiple boats can raft together to form one large lily pad and break away when full to return the people to further safety. Often a large flat hulled vessel is the best form of lily pad. It should lower all aerials as provide guidance for the helicopter. It should remain at
anchor and allow other rescue craft to approach and transport the people to further care.

Lily pad techniques allow shorter turnaround times for helicopters, allowing more rescues and minimizing fuel wastage. Multiple helicopters can work in a circuit, much in the same way as fighting a bushfire. If multiple aircraft are used, a common radio channel is denoted, or a air supervisor employed.

SEARCHING FLOODS AND SWIFTWATER ENVIRONMENTS WITH HELICOPTERS

Helicopters undoubtedly can be classed as one of the fastest and most efficient search tools.

Helicopters should again be on the initial first call for persons requiring locating or rescuing in a flood. Time is critical. The best chance to find anyone is in the first few critical minutes. The longer a person is missing in a flood environment, their probability of detection decreases significantly. Dirty water, debris and a fast moving environment all work against the searcher.

As discussed earlier, the flood victim will may present quite differently to what rescuers are used to seeing. More importantly, the rescuers must allow hat their missing person may be covered in mud and the reported clothing may not resemble that of the witnesses’ description.

NOTE: sending in a helicopter to conduct a search without proper training and knowledge in floods and swiftwater is not only inefficient; it is leaving an organization open to litigation. Just because an operator has a helicopter does not mean they know what they are looking for, how to look, where to look, what pattern, what height, upstream, downstream etc. This is of critical concern with contracted, non emergency aircraft. It is not the time during a search to be asking what a strainer or low head dam is. By using these inefficient resources, a search area may be crossed off the search plan incorrectly.

Aircrews need to be bluntly honest about their effectiveness of their search and overlaps. If a crew experienced airsickness, poor visibility, missed a search leg or conducted poor spacing’s they need to notify the search co-ordinator upon their return.

A helicopter brings noise, downdrafts, chops up the water surface and generally distracts all the searches on the land when it enters a search area. Helicopters need to search appropriate for the area. Searching directly over the river is often inefficient. Searching 20ft above the

Figure 35 - Sgt Kathy Curtis co-ordinating a search for a missing female whom was rescued by California Highway Patrol Helicopter. Fresno County USA.
Kevin Means is a San Diego police officer whom specializes in Tactical Flight Officer (TFO) training. Whilst his computer modeling of aircraft position for searches is generally reserved for locating bad guys, it does hold considerable merit for effective aircraft positioning for any search. It considers the airframe structure such as pillars and location of windows, aircrew comfort, aircraft safety (faster is safer for a helicopter and hovering is most dangerous). Kevin shows how a helicopter at 1000ft AGL at 60 knots conducts the same orbit as a helicopter at 500ft AGL and 30 knots. Whilst these figures are examples and a pilot and crew should know their own for their aircraft they dispel a common myth of ‘low and slow’. Often when asked why did a helicopter crew search at that speed/height they respond ‘we just do’? He recommends the higher and faster. This is because of the Height Velocity (HV) curve of helicopters. Basically maintaining height and speed dramatically increases the safety of the aircraft. Also the increased height gives fewer downdrafts and less noise to the ground crews. A higher speed allows a greater angle of bank (Kevin recommends 15 degrees) allowing optimum visibility for aircraft and comfort for aircrew.

The HV curve is a graph charting the safe/unsafe flight profiles relevant to a specific helicopter. Operation outside the safe area can be fatal in the event of a power or transmission failure.

Pilots should resist the urge to search ‘low and slow’. Being low and slow places the aircraft in a high risk in the HV curve. Being slow with a tailwind can also induces a Loss of Tail rotor Effect (LTE) (That is, the tail rotor is exposed to winds that prevent it from carrying out its function).

Large aircraft can be somewhat more difficult to search out of. Aircraft such as the Bell 412 is wide and difficult to search from due to its window configuration. It generates a large amount of noise and turbulence and its agility is somewhat different to other smaller aircraft.

Helicopter should also resist the urge to ‘stop and hover’ to search an area or if they spot something. Once again this places the aircraft in the highest risk in a HV curve, but also lifts the nose restricting view and cover the area below in downdraft.

Consider – ‘Does this scenario justify a hover?’

Kevin maintains that we must search and not watch out windows. He also recommends that an aircraft orbit for the aircrew rather than for the pilot’s best view (ie orbit to the left with a right seat pilot). In this orbit the pilot still has an effective view for piloting but it is the aircrew (front and rear) whom are concentrating solely on an effective search.

As with any search, the information received from the initial call or witness will fundamentally mould the effectiveness of the search phase. As soon as the need for a search is recognized then a formal search planning process should be started.

Night searches can increase the workload on crews by over 30%. Aircraft equipped with FLIR will not pick up a person in the water. Instead use a Night Sun searchlight which can
even penetrate water. Also NVG's can be used with a night sun.

Figure 36 - Fresno County Sheriff MD500E
In non dynamic water look for disturbed water rather than just a person. This may indicate where a person is.

Figure 37 - LAFD Bell 412 with nitesun and FLIR

Remember to saccade (direct and purposeful movements of the eyes over areas rather than fixating on one spot). Look where animals are looking.

Always keep in mind your flood rescue principles. Remember hydraulics and what and where persons can be held. Holes, low head dams, eddies and strainers all are areas of high probability for locating a person. Flows of rivers can hold people for long periods of time. People will reach out to any object, often a tree to get out of the water.

A public address system is paramount in communicating with those on the ground. A PA system can be used to notify the community of missing children, and that they should contact the police if that child is seen. This co-ordinated approach with the police and aircrews greatly increases the possibility of finding a lost person as well as reducing the search time.

The PA system can give hope to those holding onto life in the water or a tree. It can direct them to rescuers or vice versa. It can be used to notify mass casualty incidents that rescuers have seen them, to remain in their position and that helicopters or boats are on their way.
SEARCH MANAGEMENT PROCEDURE

Paul O’Sullivan of rescue 3 Europe states there are defining steps in a search management procedure. For the helicopter operator and search manager these may take the following steps.

Step 1 – Pre Planning
  Who can provide a search management procedure?
  How can I access them?
  What are the major water related hazards?

Step 2 – First notice
  Identify the PLS (Point Last Seen)
  River conditions
  CONTAIN THE SEARCH AREA
  Hasty team deployment
  Investigate hazardous areas and likely spots as a priority (knowledge from pre plan)
  Begin the formal search management process

Step 3 – Formal Planning Process
  Identify the PLS on a map
  Identify the containment point
  Draw segments

Step 4 – Determine how likely the subject will be found within the area.
  Overhead team should access and make use of an informal network of local knowledge
  Prioritize each segment based on knowledge and experience
  Reach a consensus
  Segments assigned numeric value of likelihood POA (Probability Of Area)

The probability of area (POA) is determined by, water velocity (speed and direction), retentive hydrological features, river state, lost person behavior, equipment on person (ie PPE)

Step 6 – Consider how hard or easy it is to find the subject in each segment (Probability of Detection – POD)
  Prediction of coverage
  Preplan information
  Local area knowledge
  Use expert help
Probability of Detection (POD) is determined by the buoyancy of the victim, colour of clothing, type of assets deployed and physical condition.

Step 7 – Consider the POA and POD for each segment and deploy assets accordingly.

Step 8 – As the resources are deployed and return the road map changes based on field team debrief and clues

- POD field determinations conducted in the field
- Further resources are deployed (including further helicopters)

GPS tracking overlay data can help quantify coverage.

Flight following should occur for all search aircraft.

Step 9 – Plan for the next phase

- Document all decisions
- Chronology
- Deployment map
- Brief incoming overhead team
- Get some rest and ensure flight hour regulations

Step 10 – Suspending the search

- If a find is made the search shifts to a rescue/recovery
- Or evidence suggest the subject is not in the search area

AIRBORNE SEARCH TACTICS

The United States Coast Guard (USCG) estimates that a properly selected and flown search pattern should be able to find the subject 90% of the time, provided that there is accurate and timely information as to where the person was last seen. The point last seen is the most critical piece of information; this gives crews an accurate starting point. Without this information the search is likely relying on luck. When responding to a search, such as a lost hiker, lost child or possible drowning, the most beneficial piece of information the crew can request is where the person was last seen by a reliable and credible witness. It is important to quickly have ground resources locate and interview any eyewitness that can actually offer sound and solid information.

Search and rescue missions present a variety of challenges. There is no single technique or search pattern that will work for all missions.

Examples of Air Search Patterns
Figure 38 - Line and grid search techniques
THE USE OF DYES

The use of sea marker dyes is something that surf rescue helicopters use well in Australia. By deploying a dye into the PLS (point last seen) of a victim, the dye show the rescuers where the water currents may have led the victim.

Dyes, beacons and strobes are used by agencies in the US during floods and searches. The hydrology of a flood is very different to surf, yet the principles and reasoning for using dyes, beacons and strobe remain the same. They allow the rescuers to see currents, eddies and flows which may not be visible to the naked eye, or is hampered by daylight, weather or spray. Multiple items can be deployed. Ground crews and incident controllers should always be informed of the deployment dyes and beacons.

ANIMALS

The rescue of animals during floods can range from small cats and dogs to large horses. During recent floods in Australia, helicopters were used to move large amounts of sheep with short haul lines and cargo nets.

Pets can accompany their owners when being rescued or evacuated from flood areas. Any animal brought into the cabin of a helicopter should be in a cage or alternatively, appropriately restrained and muzzled for safety.
HUET / DUNKER TRAINING

Helicopter Underwater Escape Training (HUET) is referred to as Dunker training in the US. It refers to the training required to safely exit an aircraft should it crash into water.

Dunker training was a requirement in every organization visited and for every person whom may work in an aircraft.

The US agencies did not draw a division between ‘inland’ and ‘water’ operations. This is because Dunker training may be needed over ponds, dams etc just as much as an ocean.

SWIFTWATER IN 3RD DIMENSION

Swiftwater courses teach us bout hydrology. However it is important for aircrews to gain experience on how these features look from above. Of good example is the low head dam. The identification of the boil line is paramount to the rescuers safety. On the conclusion of this report, my next aim is to gather significant aerial photographs of flood and swiftwater hydraulic features from above to educate pilots and crews.
PRE INCIDENT PLANNING

Pre incident planning is now very common for all emergency services and their relative jurisdictions. The same should be said about helicopters and flood rescues. Whilst acknowledging that many flood rescue take place in remote areas or, areas which have significantly changed geography because of the flood. This should not deter agencies and crews from formulating pre incident plans, especially for known hot spots.

Again, in the Los Angeles areas I saw significant and in depth plans from the fire departments regarding potential and past rescues from the canals and American River.

These plans highlighted dangers such as power lines, towers, and buildings. They also showed areas where water flow was potentially slower and with fewer hydraulics to make a running rescue easier. These spots were often near areas where ground crews have placed hard anchor points to tether land based rescuers.

For rural areas, again power lines were the main consideration as well as known strainers and even the locality of landing sites and refueling depots.

EQUIPMENT

AIRCREW

Below is the flight ensemble used by aircrew in the USCG. It answers a common question amongst Australian crews regarding when to don wetsuits/drysuits and when to wear flightsuits. Often there are concerns about the flammability safety of wetsuits and drysuits compared to nomex (flame retardant) flight suits.

(1) Normal aircrew protective clothing includes the following:
   (a) Flight suit or dry suit
   (b) Flight gloves
   (c) Flight boots
   (d) Aircrew survival vest/RS harness (with SEAS bottle while flying over water)
   (e) Aircrew flight helmet

(2) The flight ensemble should be worn on all flights in which a water deployment is not likely to occur within the first 30 minutes.

(1) Water ensembles include the following:
(a) Wet suit or dry suit
(b) RS harness
(c) Fins and booties/rock boots/water boots
(d) Mask and snorkel

Water deployment ensemble chosen will be at the discretion of the RS based on air and water temperature variables. A dry suit is required to be worn if water temperature is 55 °F or below.

(2) The RS shall wear a wet/dry suit hood or surf-cap with Safety of Life at Sea (SOLAS) grade retroreflective tape in conjunction with the dry suit whenever the water temperature is 55 °F or below, and during all night operations regardless of water/air temperature.

Figure 41 - Kitted Up. Travis County Star Flight’s EC145 with Goodrich hoist, nitesun and wire strike kit
(3) The RS protective helmet with SOLAS grade retroreflective tape shall be worn during operations conducted in surf, cave, rock, whitewater areas, or areas of debris. The RS protective helmet may be worn in conjunction with the wet/dry suit hood, surf-cap, or by itself if water temperature is above 55 °F.

(4) Wet suit ensembles are not specifically designed for flame resistance and can cause heat stress to the RS, thus the flight ensemble shall be worn on all flights in which a water deployment is not likely to occur within the first 30 minutes. Aircraft Commanders must consider the risks of performance degradation and lack of flame protection versus practicality.

Travis County Star Flight also have the following uniform requirements. The crew shall wear fire retardant flight suits and flight boots when engaged in all ground and in-flight operations. To provide maximum fire protection, sleeves should not be rolled up.

Synthetic fabrics under flight gear may cause severe burns during a fire. Underwear and socks shall be either 100% cotton or Nomex blend. Socks may also be at least 80% cotton or at least 80% wool.

The use of flight gloves is not mandatory but is highly encouraged. In addition, while within close proximity to a turning rotor system, the crew shall wear a helmet with the visor down.

The Crew will take environmental conditions into consideration and wear additional clothing as permitted by Travis County Helicopter Operations Manual. It is understood that during water rescue missions the HRS will not be able to comply with the flight suit policy.

**Pilot**

- Aerial Vest with Floatation Collar
- Spare Air
- Flight Helmet
- Flight Gloves (optional)
- Jacket (weather dependant)
- Aerial Crew Vest with Floatation Collar
- Knife
- Flight/hoist Gloves
- Spare Air
- Flight Helmet with Maxillofacial shield
- Knee board (optional)
NOTE: During significant rainfall events, missions with multiple victim potential and when crew configuration allows, Crew Chiefs may elect to dress out water PPE as well to allow for rotation of the HRS position.

**HRS (Helicopter Rescue Specialist)**
- Water Helmet/ Flight Helmet with Maxillofacial shield
- Dive mask and snorkel
- Water Gloves (optional)
- Neoprene Hood (weather dependant)
- Water boots with Fins
- Knife

Low water flow- Floatation- Force 6, Thermal Protection- As required by water temp. Downstream of Austin-It is preferable to be in drysuit if single event, environment and mission duration is not anticipated to be of heat stress to rescuer. Drysuit offers increased protection to the rescue swimmer over wetsuits.

High water flow- Floatation- Force 6, Thermal Protection- Drysuit

**Lake Georgetown/Lake Travis/Hamilton Pool/Lake Belton/Lake Marble Falls** etc in areas widely known for recreational motor/sail boat activity: Floatation- TriSAR, Thermal Protection- As required by water temp

**Swiftwater**- Floatation- Force 6, Thermal Protection- Drysuit. Should circumstances exist in which thermal protection is creating substantial heat stress that will impact the rescuers ability to continue to function crews should (assuming ability and time allows) contact SF management for guidance. If time does not allow then they have the authority to deviate from the SOG’s but should realize they are exposing the rescuer to potentially hazardous environments. This would generally expected to occur with OAT >90 degrees in flood operations.

**Flood**- Floatation- TriSAR, Thermal Protection- Drysuit. NOTE- this is confirmation of flood conditions with NO potential for swiftwater. Not generally seen in Central Texas. If there is still water flooding in Central Texas there is generally concurrent swiftwater.

Refer equipment from travis county starflight
Land Based Operations

NC HART Equipment List:

- HGU-56 Flight Helmet
- Black Nomex Flight Suit
- Nomex Flight Gloves or all leather gloves
- Black Leather Boots
- Tru-Link ICS / Radio System
- LSC TRI-SAR Harness
Water Based Operations – Static Water / Wide Area Flooding

NC HART Equipment List:

- Protec Water Rescue Helmet
- Mustang Dry Suit (long underwear must be worn under the dry suit)
- Water Rescue Gloves
- Mask and Snorkel
- LSC TRI-SAR Harness with PFD installed / Inflation Device Armed
- Strobe Light
- NRS River Work Boots
- US Divers Fins
Equipment carried by HSART personnel during rescue operations has been approved and standardized by North Carolina Emergency Management, North Carolina National Guard, and the NCHART Air Operations Branch Manager. This equipment has demonstrated high reliability and safety when properly utilized in the helicopter rescue environment. Equipment not listed in the Training Manual or Standard Operating Guidelines, must have joint agency approval prior to use.
HELICOPTER EQUIPMENT

Gentex HGU-56 Helicopter Helmet

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<th>Description / Specification</th>
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<tbody>
<tr>
<td>Head impact protection is absolutely crucial during any helicopter flight operation. The Gentex HGU-56 Helicopter Helmet provides superior user protection in a lightweight graphite and Spectra® composite shell. It adds a dual visor function with molded ear cups for enhanced hearing protection and crew communications.</td>
</tr>
<tr>
<td>o Weight 2.8-3.2 lbs</td>
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<tr>
<td>o Sound attenuation 21 db at 1,000 Hz, 37 dB at 4,000 Hz</td>
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<td>o Visor lens is made of impact resistant polycarbonate with added UV protection</td>
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<tr>
<th>Indications</th>
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<tr>
<td>o General flight operations</td>
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<td>o Rescue operations as outlined in SOG</td>
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<tr>
<th>Care and Inspection</th>
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<tr>
<td>o Inspections: Visual inspection prior to use</td>
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<tr>
<td>o General cleaning of the shell should be done with soft non-abrasive paper or microfiber towels and water or light general purpose cleaner</td>
</tr>
<tr>
<td>o General cleaning of the visors shall be done with soft non-abrasive paper or microfiber towels and aircraft windscreen approved cleaner</td>
</tr>
<tr>
<td>o Maintenance of helmet functions and/or communications parts should only be accomplished by trained and certified personnel</td>
</tr>
<tr>
<td>o Routine washing of the headliner with water with light detergent will extend the life and use of the interior of the helmet. The liner should be patted flat with a towel and placed flat for drying</td>
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**NOTE:** The headliner shall not be wrung out or twisted during washing

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<tr>
<th>Considerations</th>
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<tr>
<td><strong>NOTE:</strong> During rescue operations, the user shall use the clear visor to enhance visibility</td>
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![Figure 42 - Gentex Helmet, nomex flight suit and gloves](image-url)
## Nomex IIIa Flight Suit

### Description / Specification

NOMEX® IIIA is a blend of NOMEX® meta-aramid and KEVLAR® para-aramid fiber. It is inherently resistant to flames, dissipates static, and is resistant to many chemicals including organics, acids, and bases. The fire-resistance does not wash out during laundering. NOMEX® IIIA is widely used for clothing for the military, fire fighters, auto racers and industrial workers. The 6.5-ounce fabric offers a crisp appearance and is longer wearing. We make our uniforms with fabric, zippers, and thread all made from NOMEX®.

### Indications
- General flight operations
- Rescue operations as outlined in SOG

### Care and Inspection
- Inspections: Visual inspection prior to use
- NOMEX® can be laundered or dry cleaned. When laundering, the front main zipper should be completely closed. Detergents should not contain bleach or bleaching products.

### Cautions / Warnings
- Synthetic fabrics under flight gear may cause severe burns during a fire. Underwear and socks shall be either 100% cotton or Nomex blend.
- Socks may also be at least 80% cotton or at least 80% wool.

### Considerations

**NOTE:** During general flight or rescue operations, the sleeves on flight suit shall be rolled down to full length of the sleeve to enhance protection.
### Mustang Survival Dry Suit

<table>
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<th>Description / Specification</th>
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<tr>
<td>The MSD575 dry suit is for swift water and still water missions. It is specifically designed for water operations such as vertical insertion and swift water rescue. It is constructed with an abrasion resistant, durable nylon with strategically reinforced leg, arm and seat patches. It also has cushioned patches on the knees and elbows to add additional protection and comfort during tactical maneuvers. The neck pad protects the adjustable neck seal and reduces chafing and discomfort. The adjustable neck seal and neoprene wrist seals provide a comfortable fit for surface or over water operations. During water entry, the adjustable neck seal can be drawn tight to prevent water entering the suit. Thermal performance of the MSD575, as with any dry suit, is dependent on the type of thickness of the undergarment worn.</td>
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<tr>
<td>- Rescue operations that involve direct contact with water as outlined in SOG</td>
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<tr>
<td>- Inspections: Visual inspection prior to use</td>
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<tr>
<td>- Cleaning your dry suit should be done with mild soap, a soft brush and large amounts of water. Clean both the outside then inside of the dry suit. After thorough rinsing, hang the dry suit inside out until completely dry. Then hang the suit to allow the outside of the suit to dry. A fan will greatly reduce drying times. Be sure the dry suit is completely dry before storing</td>
</tr>
<tr>
<td>- The latex seals of the dry suit should be treated with 303 Protectant</td>
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<tr>
<td>- Neoprene seals of the dry suit should be dusted with talc</td>
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<tr>
<td>- The zippers should be cleaned and lubricated with paraffin, beeswax or dry suit zip-wax</td>
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<tr>
<td>- Relief zippers should be stored closed</td>
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<tr>
<td>- The main entry zipper should be stored unzipped with the first two inches zipped closed</td>
</tr>
<tr>
<td>- Dry suits should be stored loosely rolled in a bag that protects it from abrasion/puncture/UV and exhaust fumes</td>
</tr>
<tr>
<td>- Do not store the dry suit in a plastic bag</td>
</tr>
<tr>
<td>- To store the dry suit, place it face down and fold the legs and arms in. Roll the dry suit once above the relief zipper and then a second time. This allows for a gradual bend for the zipper</td>
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## Survival Crew Vest

### Description / Specification

The Crew Vest features:
- A modular system
- Made with horizontal webbing to allow for user placement of accessory pockets
- Full integrated extraction harness
- Over-water package of flotation
- Accessory pockets designed for radios, emergency breathing systems and gear
- Mesh construction for comfort and to minimize heat stress in warm climates

### Indications

- General flight operations
- Rescue operations that do not involve direct contact with water as outlined in SOG

### Care and Inspection

- Inspections: Visual inspection prior to use and periodic CO2 inflation test
- Cleaning: Fresh water rinse with mild detergent as needed

### Considerations

The complete Crew Vest includes the following standard issue equipment:
- Tri-link
- D-ring attachment
- Leg loops
- Emergency strobe
### Force 6 PFD

#### Description / Specification

The Force 6 PFD features:
- Inherently buoyant PFD providing 27 lbs of buoyancy.
- Integrated blow-out belt.
- Accessory pockets designed for radios and gear.

#### Indications

- Rescue operations that involve direct contact with water as outlined in SOG

#### Care and Inspection

- Inspections: Visual inspection prior to use and periodic CO2 inflation test
- Cleaning: Fresh water rinse with mild detergent as needed

#### Considerations

The complete PFD includes the following standard issue equipment:
- Emergency strobe
- Flashlight
- Water rescue knife
- Whistle

![Figure 43 - Force 6 PFD with built in harness. Fore and aft attachment points](image-url)
Figure 44 - Force 6 harness / PFD, NCHART
**HEED / HABD Bottle**

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<tbody>
<tr>
<td>The Helicopter Emergency Egress Device (HEED) is designed to enhance the survivability of crew members in the event of a water landing. The bottle provides approximately 30 breaths to give the user the needed time to exit a submerged aircraft. It may be refilled from a scuba tank and has an external PSI gauge.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Indications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>o Emergency Egress</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Care and Inspection</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>o Inspections: Visual inspection prior to use and periodic cylinder test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Procedures</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>o Refer to Helicopter Emergency Escape Device section in Training Manual</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Cautions / Warnings</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>o Intended as an emergency device to assist egress from submerged aircraft; training required</td>
</tr>
<tr>
<td>o Not to be used by HSART for underwater searches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Considerations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>o The HEED/HABD does not negate the need for routine practice and discussion of emergency water egress</td>
</tr>
</tbody>
</table>
### LSC Tri-SAR Harness

#### Description / Specification

The TRI-SAR is LSC’s professional grade helicopter hoistable rescue harness with dual recovery capability.
- Sized by Height: S(61-65") M(64-69") L(68-73") XL(72-78") XX(74-80").
- Integrated flotation vest (inflated manually with CO2 or orally with air) features a low profile, easy to swim in design, with user variable buoyancy up to 35 lbs.
- This full body harness is constructed primarily of MIL-SPEC Types 10 and 13 nylon webbing, and features quick adjusting stainless steel hardware.

#### Indications

- Approved for use with hoist or Short-Haul.

#### Care and Inspection

- Inspections: Visual inspection prior to use
- Cleaning: Fresh water rinse with mild detergent after each use

#### Procedures

- Don harness and secure all buckles.
- Use integrated flotation device as required.
- Ensure manual inflation device is stowed and operating properly.
- Ensure that the center attachment point is free and clear and not obstructed.

#### Cautions / Warnings

- The equipment attachment point is not to be used as the HSART or survivor lifting point.
- In order for the flotation device to automatically inflate upon activation, the CO2 cartridge must be charged, properly installed, and seated.

#### Considerations

- HSART must ensure that he is properly secured in the harness.
- HSART must ensure that he has no loose and improperly secured equipment attached to the harness.
### General Equipment

#### CMC Screw-Lok Steel Carabineer (CMC Part No. 300110)

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CMC Screw-Lok steel carabineer is used for all short-haul attachment points and is the primary carabineer for HSART and survivor attachment points.</td>
</tr>
<tr>
<td>- Major axis 16,196 lbf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Short haul line attachment points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Care and Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Inspections: Visual inspection prior to use and after each use</td>
</tr>
<tr>
<td>- Cleaning: Fresh water rinse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Refer to Rescue Operations Section of the Training Manual</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cautions / Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Be aware of load limitations, manner used, and proper technique</td>
</tr>
<tr>
<td>- Do not over load a Carabineer</td>
</tr>
<tr>
<td>- Carabineers can fail under improper use conditions such as cross loading, gate open loading, loading other than major axis, applying a sheer or torsion load to the carabineer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Steel Carabineers will be used for multiple person loads</td>
</tr>
</tbody>
</table>
## CMC Pro-Series Aluminum Auto-locking D Carabineers (CMC Part No. 300221)

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMC Pro-Series aluminum carabineers meet the NFPA strength requirements for General Use. The carabineer is an auto-locking aluminum carabineer which provides a 2-stage auto-locking gate that can be easily opened with one hand. Using an auto-locking carabineer decreases the possibility that the gate will vibrate unlocked if kept in the right position.</td>
</tr>
<tr>
<td>- Major axis 3σ MBS: 9869 lbf</td>
</tr>
</tbody>
</table>

### Indications
- General rescue use

### Care and Inspection
- Inspections: Visual inspection prior to use and after each use
- Cleaning: Fresh water rinse

### Procedures
- To be used by HSART for tethering to the aircraft.

### Cautions / Warnings
- Be aware of load limitations, manner used, and proper technique. Do not over load a carabineer
- Carabineers can fail under improper use conditions such as cross loading, gate open loading, loading other than major axis, applying a sheer or torsion load to the carabineer

### Considerations
- Aluminum carabineers are for single person loads only
**Omega Pacific  HMS Jake Carabineers  (CMC Part No. 370073)**

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omega Pacific aluminum carabineers meet the NFPA strength requirements for General Use. The carabineer is an auto-locking aluminum carabineer which provides a 2-stage auto-locking gate that can be easily opened with one hand. Using an auto-locking carabineer decreases the possibility that the gate will vibrate unlocked if kept in the right position.</td>
</tr>
<tr>
<td>- <strong>Major axis 3σ MBS:</strong> 5170 lbf</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>- General rescue use and belay of single person loads</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Care and Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Inspections: Visual inspection prior to use and after each use</td>
</tr>
<tr>
<td>- Cleaning: Fresh water rinse</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>- To be used by HSART for general rescue use and as a backup or spare</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cautions / Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Be aware of load limitations, manner used, and proper technique. Do not overload a carabineer</td>
</tr>
<tr>
<td>- Carabineers can fail under improper use conditions such as cross loading, gate open loading, loading other than major axis, applying a sheer or torsion load to the carabineer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Aluminum carabineers are for single person loads only</td>
</tr>
</tbody>
</table>
Extraction Litters

HSART may utilize extraction litters during rescue operations of survivors who have sustained serious or critical injuries. Currently there are three approved extraction litters for rescue operations.

**LITTER BASKET/BAUMAN BAG**

In rescue situations where the survivor is non ambulatory on a vessel, the Litter basket or Bauman bag should be used. Due to the dynamics of open water rescue, a constant point of contact tag line method will have to be used with the Litter basket or Bauman bag. The Litter basket and Bauman bag have large sail areas and are vulnerable to getting caught up in the vessels rigging.

<table>
<thead>
<tr>
<th>Bauman Bag</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description / Specification</strong></td>
</tr>
<tr>
<td>The Bauman Bag provides:</td>
</tr>
<tr>
<td>o A single-point suspension system for lifting a survivor during hoist or short-haul extraction</td>
</tr>
<tr>
<td>o The hoist model has adjustable length straps allowing the bag to be configured to our aircraft</td>
</tr>
<tr>
<td>o Bags can be used with backboards, litters, or by itself</td>
</tr>
<tr>
<td>o Approximate weight 13 lbs</td>
</tr>
<tr>
<td>o The bag includes reflective tape and a pocket for a chemical light for low light and night operations</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
</tr>
<tr>
<td>o The Bauman Bag is approved for use with the short haul or hoist</td>
</tr>
<tr>
<td><strong>Care and Inspection</strong></td>
</tr>
<tr>
<td>o Inspections: Every 30 days and visual inspection prior to use</td>
</tr>
<tr>
<td>o Cleaning: Fresh water rinse with mild detergent after as needed</td>
</tr>
<tr>
<td><strong>Procedures</strong></td>
</tr>
<tr>
<td>o The HSART should lift the survivor into the Bauman Bag and attach the interior securing straps</td>
</tr>
<tr>
<td>o The short-haul line or hoist hook should be attached to the Bauman Bag lifting attachment point</td>
</tr>
<tr>
<td>o The HSART should attach themselves so that they are level with the survivor</td>
</tr>
<tr>
<td><strong>Cautions / Warnings</strong></td>
</tr>
<tr>
<td>o Rotation from down wash may be arrested by increased airspeed</td>
</tr>
<tr>
<td><strong>Considerations</strong></td>
</tr>
<tr>
<td>o Tag lines may be used by HSART or appropriately briefed ground personnel</td>
</tr>
</tbody>
</table>
The Bauman Bag is a nylon extraction sleeve that will accommodate a long-spine board and is used for short hauling or hoisting survivors who are unable to tolerate an upright extraction position or collar. The front consists of a combination of Velcro and fast clip buckles providing easy access to the survivor compartment. Securing straps are located inside of the device for securing the spine board and survivor to the interior of the bag. The lifting points are external and consist of four adjustable straps on each side that terminate on a tri-link.

**CAUTION:** The HSART should verify all connections are complete and positioned correctly (gates closed, no cross-loading present, survivor is not negatively affected by the device, etc) before signaling “ready for pickup”.
## LSC Medevac Litter

### Description / Specification

The Medevac litter has been designed and engineered to withstand the conditions encountered in remote rescue operations, such as in-water rescue. The Medevac litter is self-righting in water, and floats with the survivor's head slightly inclined to provide maximum freeboard. The Medevac litter can be hoisted in either vertical or horizontal positions.

- Dimensions: 16½" W x 7½" D x 80" L
- Weight: 32 lbs.

### Indications

- The LSC Medevac Litter is the preferred device for extricating injured survivors from a still water environment
- May also be used to extricate land based survivors
- Approved for use with the short haul or hoist

### Care and Inspection

- Inspections: Visual inspection prior to use
- Cleaning: Fresh water rinse with mild detergent after each use

### Procedures

- The survivor will be placed in the device attaching the chest flotation first
- The HSART will then begin to attach the color coded straps from the feet working their way toward the survivor’s head
- The pre-attached lifting strap rings will then be joined together above of the survivor
- The HSART will then secure themselves to the lifting strap

### Cautions / Warnings

- Crew Chief and HSART **MUST** use extreme caution to assure there is very little movement (horizontally) when short-hauling or hoisting survivors secured in the LSC water litter
- The water litter may spin or submerge if moved rapidly across the surface
- The load must be centered under the aircraft slowly prior to extraction

### Considerations

- Should be attended by qualified HSART
The LSC water litter is an aluminum/titanium frame floating extraction litter designed to be directly deployed into the water and extracted via short haul or hoist. It provides a by-design head-up floating position and allows a single rescue the ability to secure an unconscious or severely injured survivor in still or slow moving water. All securing straps are colored coded and the lifting points consist of a webbing bridle that terminates at two solid aluminum rings to be directly attached to the hook/carabiner. The HSART should approach the survivor with the device at the survivor’s back and secure the chest pad first. This will position and maintain the survivor in a heads-up position out of the water. The HSART should then start at the foot end of the device and secure the color-coded straps in sequence. In situations where the survivor has potentially sustained a cervical spine injury, the HSART can secure the survivor’s head utilizing the cushions and straps provided. To decrease the amount of swing and assist the Crew Chief in aircraft positioning, the HSART should keep their legs extended during extraction and drag their fins until the litter comes in-line with the aircraft.

**CAUTION:** The HSART should verify all connections are complete and positioned correctly (gates closed, no cross-loading present, survivor is not negatively affected by the device, etc) before signaling “ready for pickup”.
LSC Collapsible Rescue Basket

The rescue basket is a device commonly used by the USCG. It is primarily used when a person can assist themselves into the basket. It can be lowered next to them on a rooftop, vehicle or lowered into the water if they are in the water. It is not ideal for fast moving water.

The rescue basket has not traditionally been used in Australia. It can be seen as cumbersome, large and awkward. It may not fit in some aircraft and some rescuers have concerns that the patient is not assisted or is untethered whilst being hoisted up to the aircraft.

Once again we must look at the rescues in the flood environment. We will be moving a person from a dangerous place to a safer place. That may mean a short haul of only a few meters. There is often no need to bring every victim into the aircraft.

### Description / Specification

The Collapsible Rescue Basket combines the compact stow ability of the rescue net systems with the ruggedness, rigidity and safety of the field proven tubular frame rescue basket. Additionally the basket features a more open internal volume.

- **Dimensions:** 25” W x 44½” L.
- **Height:** 41” (9½” stowed).
- **Weight:** 39 lbs.
- **Weight Limit:** 600 lbs. Working load limit

### Indications

- The LSC Rescue basket is to be used for the extraction of survivors who are able to assist in their own extraction. The basket is intended for a single survivor that will be hoisted into the aircraft unattended
- Approved for hoist only

### Care and Inspection

- Inspections: Every 30 days and visual inspection prior to use
- Cleaning: Fresh water rinse with Mild detergent after each use

### Procedures

- The bail assemblies fold into the rescue basket, and each side collapses for compact stowage.
- The basket is erected by lifting the bails and top rail assembly up, and then rotating the side supports down.
- Supports are secured in place by simple spring locks, and provide a rigid structure that aids handling and entry into the basket

### Cautions / Warnings

- **HSART MUST** make sure that the survivor is able to follow commands and assist in their rescue when making the decision to utilize this rescue basket

### Considerations

- This device is best suited for still water and rooftop extractions
The rescue basket is a titanium frame basket with integrated flotation to be used during hoist extraction. Its collapsible versatility allows it to be easily transported in the aircraft during wide area flood operations or other still or slow moving water events. The rescue basket is designed to be an unattended extraction device.

**CAUTION:** The HSART should inform the survivor to keep their extremities inside the frame of the basket during extraction and at no time should they reach out toward the aircraft or Crew Chief.
**SCREAMER SUIT**
The rescue triangle can be as an adjunct to the rescue basket. It can be used in places where the rescue basket cannot be deployed. The rescue triangle works well with multiple ambulatory victims.

**CAPTURE STRAP**
The capture strap is used in emergent conditions when the survivor is in a precarious position and requires immediate removal.
**LSC Quick Strop**

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Quick Strop is the primary hoist extraction device. Constructed of MIL-SPEC webbing and stainless steel hardware, the Quick Strop provides a quick, safe means of hoisting uninjured personnel. The Quick Strop can be placed over the head and under the arms of the survivor in one quick motion.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>o The LSC Quick Strop is the rescue device of choice when utilizing the hoist</td>
</tr>
<tr>
<td>o May be used for both land and water applications with an uninjured survivor</td>
</tr>
<tr>
<td>o Approved for use with the rescue hoist ONLY!!!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Care and Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Inspections: Visual inspection prior and post use</td>
</tr>
<tr>
<td>o Cleaning: Fresh water rinse with mild detergent after each use</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Appropriately place the strop on the survivor</td>
</tr>
<tr>
<td>o To prevent the survivor from slipping out, the groin strap should be attached to the retention hardware at the survivor’s chest</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cautions / Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>o The quick strop may limit the expansion of the survivor’s chest causing or increasing respiratory distress</td>
</tr>
<tr>
<td>o Should be used with caution in survivors with potential hypothermia</td>
</tr>
<tr>
<td>o This device is not to be used when conducting short-haul operations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>o HSART must ensure that survivors are adequately secured in the device</td>
</tr>
<tr>
<td>o Should normally be attended by qualified HSART</td>
</tr>
</tbody>
</table>

The Rescue STROP is a quick application extraction collar that is designed to fit around the circumference of the chest of most survivors, excluding small children. The STROP is not designed to be utilized on survivors who have sustained potential significant spinal injury unless the situation does not allow time to appropriately secure the survivor’s spine in a more appropriate device. The device is placed either over the survivors head and shoulders or around the survivor’s chest with the pad centered in the mid-thoracic spine area and the lifting straps coming together from the center of the chest. The sliding buckle is placed as close to the survivor’s chest as possible. The groin strap is brought from the back pad, under the crotch and secured to the sliding buckle. It is then tensioned to prevent shifting during extraction. Survivors should be instructed to keep their hands below shoulder level during extraction.
**WARNING:** The quick strop is only for use during hoist operations.

**CAUTION:** The HSART must confirm that both lifting straps are through the sliding buckle and secure to the hook/carabineer prior to signaling “ready for extraction”.
LSP Cinch Collar

**Description / Specification**

Used by helicopter rescue agencies for years as a primary extraction device, the Cinch collar is a proven rescue tool for short haul operations. The Cinch Collar can be placed over the head and under the arms of the survivor in one quick motion. To prevent the survivor from slipping out the survivor’s weight releases the connector, allowing the collar to “cinch” around the survivor during extraction.

- Inside diameter when open is 20 inches.

**Indications**

- Approved for use with the short haul only

**Care and Inspection**

- Inspections: Visual inspection prior to use
- Cleaning: Fresh water rinse with mild detergent after each use

**Procedures**

- Appropriately place the collar on the survivor
- Ensure the collar is centered with the lift point coming from the survivor’s mid-chest

**Cautions / Warnings**

- The cinch collar may limit the expansion of the survivor’s chest causing or increasing respiratory distress
- Should be used with caution in survivors with potential hypothermia
- This device is not to be used when conducting rescue hoist operations.

**Considerations**

- HSART must ensure that survivors are adequately secured in the device
- Should normally be attended by qualified HSART

The cinch collar is a quick application extraction collar that is designed to fit around the circumference of the chest of most survivors, excluding small children. The cinch collar is not designed to be utilized on survivors who have sustained potential significant spinal injury unless the situation does not allow time to appropriately secure the survivor’s spine in a more appropriate device. The device is placed over the survivors head and shoulders then around the survivor’s chest with the pad centered in the mid-thoracic spine area. The lifting strap comes together from the center of the chest and the quick fit release buckle should be placed as close to the center of the survivor’s chest as possible. Survivors should be instructed to keep their hands below shoulder level during extraction.
WARNING: The cinch collar is to be used during short haul extraction only.

CAUTION: The HSART must confirm that the lifting strap is secured to the carabineer prior to signaling “ready for extraction”.
## CMC Life Saver Harness

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The CMC Life Saver Harness is a quick application extraction seat that is designed to fit around the waist and legs of most survivors, excluding small children.</td>
</tr>
</tbody>
</table>

### Indications
- Approved for use with hoist or short haul not in water environments

### Care and Inspection
- Inspections: Visual inspection prior to use
- Cleaning: Fresh water rinse with mild detergent after each use

### Procedures
- The first strap is placed around the survivor’s waist and connected to the front
- The two color coded crotch straps are both under the crotch and to the survivor’s front

### Cautions / Warnings
- Should be used with caution in survivors with potential hypothermia
- The harness is not designed to be utilized on survivors who have sustained potential significant spinal injury unless the situation does not allow time to appropriately secure the survivor’s spine in a more appropriate device
- Survivors should also be informed not to lean backward during extraction

### Considerations
- HSART must ensure that survivors are adequately secured in the device
- If needed the HSART may utilize the chest harness
- Should normally be attended by qualified HSART
**Petzl Hasty Harness**

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Petzl Hasty Harness is a quick application extraction seat that is designed to fit around the waist and legs of most survivors, excluding small children.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Approved for use with hoist or short haul not in water environments</td>
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</tbody>
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<tbody>
<tr>
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</tr>
<tr>
<td>o Cleaning: Fresh water rinse with mild detergent after each use</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>o The device is placed behind the survivor’s back with the red sewn straps facing out</td>
</tr>
<tr>
<td>o The top of the device should rest at the lower thoracic/upper lumbar spine area</td>
</tr>
<tr>
<td>o The two crotch straps are both under the crotch and to the survivor’s front</td>
</tr>
<tr>
<td>o All four lifting straps should be brought together at the lower portion of the sternum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cautions / Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Survivors should be instructed to keep their knees bent and feet away from the HRS during extraction</td>
</tr>
<tr>
<td>o Should be used with caution in survivors with potential hypothermia</td>
</tr>
<tr>
<td>o The harness is not designed to be utilized on survivors who have sustained potential significant spinal injury unless the situation does not allow time to appropriately secure the survivor’s spine in a more appropriate device</td>
</tr>
<tr>
<td>o They should also be informed not to lean backward during extraction</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>o HSART must ensure that survivors are adequately secured in the device</td>
</tr>
<tr>
<td>o If needed for small survivors, the HSART may reduce the size of the device with the red sewn lifting straps following the same connection process described above.</td>
</tr>
<tr>
<td>o Should normally be attended by qualified HSART</td>
</tr>
</tbody>
</table>
# Personal Restraint Tether (PRT)

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PRT is designed to provide mobility while preventing the user from inadvertently exiting the aircraft while in flight. The PRT should be adjusted so that the user can work near an exposed area without being at risk of falling out of the aircraft.</td>
</tr>
</tbody>
</table>

## Indications

- Used by HSART during public safety missions

## Care and Inspection

- The PRT will be inspected after each use and at monthly intervals
- Record the date of the inspection and the results in the equipment log
- When inspecting the PRT:
  - Check the webbing for cuts, worn or frayed areas, broken fibers, soft or hard spots, discoloration, or melted fibers
  - Check the stitching for pulled threads, abrasion, or breaks.
  - Check the hardware for damage, sharp edges, and improper operation.
- If any of the above are noted, or if the PRT has been subjected to shock loads, fall loads, or abuse other than normal use, remove the PRT from service and destroy it
- If there is any doubt about the serviceability of the PRT, remove the PRT from service and destroy it

## Procedures

- A carabineer attaches to a load bearing attachment point on the user’s harness, belt or strap and a carabineer attaches to an anchorage connector inside the aircraft
- The PRT should be adjusted so that there is no slack in the system

## Cautions / Warnings

- Crewmembers shall not attempt to make any repairs to life safety equipment. Defects should be reported to their supervisor and equipment replaced until proper repairs/inspections can be completed

## Considerations

- To be used by HSART and survivors only
The CMC Rescue Short Haul Line’s synthetic fibers deliver an increased strength to weight ratio compared to metallic cable or conventional kern mantle rope. Unlike metallic cables, the Short Haul line is non-conductive and can be stuffed and stored in a rope bag without risk of kinking or otherwise damaging the rope. These characteristics combined with low volume storage, a high visibility sheath, and extremely low stretch (less than 0.5% at 600 lbs); make the CMC Short Haul Line ideal for all types of short haul operations. The line comes with 1.5 inch diameter stainless steel thimbles spliced at both ends. It has a tensile strength of 14,000 lbs.

Indications
- Short Haul Operations

Care and Inspection
- The rope should be inspected after each use and at monthly intervals
- Record the date of the inspection and the results in the equipment log
- When inspecting the rope:
  - Check the rope for cuts, worn or frayed areas, broken fibers, soft or hard spots, discoloration, or melted fibers
  - Check the stitching for pulled threads, abrasion, or breaks.
  - Check the hardware for damage, sharp edges, and improper operation.
- If any of the above are noted, or if the rope has been subjected to shock loads, fall loads, or abuse other than normal use, remove the rope from service and destroy it
- If there is any doubt about the serviceability of the rope, remove the rope from service and destroy it
- Cleaning: Fresh water rinse with mild detergent after as needed, do not dry in direct sunlight

Procedures
- Refer to Rescue Operations Section of Training Manual

Cautions / Warnings
- Tag lines are contraindicated during Short Haul operations

Considerations
### Survivor Restraint Belt

<table>
<thead>
<tr>
<th>Description / Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Aircrew Restraint Belt is designed to accommodate both aircrew and passengers who require immediate travel restraint to prevent a fall out of the aircraft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Should be used to secure survivors in the aircraft immediately following hoist extraction or when placing them in a seat is not possible or practical</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Care and Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Inspections: Visual inspection prior to use and once per year for defects</td>
</tr>
<tr>
<td>o Cleaning: Fresh water rinse with mild detergent as needed</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Ensure the strap is attached to a secure anchor point.</td>
</tr>
<tr>
<td>o Pull the yellow tab.</td>
</tr>
<tr>
<td>o Pull the entire strap from the storage container.</td>
</tr>
<tr>
<td>o Loop the survivor restraint belt around the survivor and tighten prior to detaching the rescue hoist hook from the harness</td>
</tr>
<tr>
<td>o The survivor restraint belt should be adjusted so that there is no slack in the system and will prevent a survivor from falling out of the aircraft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cautions / Warnings</th>
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</thead>
<tbody>
<tr>
<td>o Not to be used for lifting</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>o It is the Crew Chiefs responsibility to determine an adequate level of compatibility between the Survivor Restraint Belt and the anchorage connector inside the aircraft. The belt is designed for travel restraint and is not meant to suspend the user.</td>
</tr>
</tbody>
</table>
CMC Spider Multi-Survivor Short Haul Rig

**Description / Specification**

The Spider Rig is a custom designed device to be used during short haul operations in circumstances that involve the pressing need to move multiple persons from one area to another. It consists of a steel ring with six attachment points that terminates with auto-locking aluminum Carabiners. The attachment points may be secured to multiple Petzl Hasty Harnesses or seat harnesses depending on the situation.

**Indications**

- Approved for use with the short haul only

**Care and Inspection**

- Inspections: Visual inspection prior to use and once per year for defects
- Cleaning: Fresh water rinse with mild detergent as needed

**Procedures**

**Cautions / Warnings**

**Considerations**

These are will typically be located in the Helicopter Rescue Equipment Bag. In situations where there are large numbers of survivors that must be moved, such as high rise structure fires, the crew may request multiple kits at both the pick-up and drop-off points to expedite turnaround time. Each complete contains:

- One Spider Rig
- 6 Petzl Hasty Harnesses

This equipment is not standard during aircraft configuration for rescue missions, and the crew will have to determine based on the information available if the equipment may be necessary to complete the mission.
AIRCRAFT REGULATIONS

One noticeable difference between Australian helicopter usage and the United States was the differences in aircraft regulation(s). Any new technique or equipment must first be approved by Australian aviation regulators.
AGENCIES

This study tour enable me to witness firsthand how agencies have adapted and evolved around their specific risks to become world experts at using helicopters in often the most dangerous of circumstances.

All agencies presented in a highly professional manner, and it was interesting to note how different sides of the United States prepares and trains.

The west coast, in particular the Los Angeles component of LAFD, LACoFD and LA Sheriffs have been training in fast flowing moving patient techniques since the 1980’s. Their terrain is often that of the flood canal. These departments have extensive pre incident plans and initial call procedures. There victims often travel long distances and require a swift and calculated response.

In Texas I was proud to ride and witness the team from Travis County Star Flight. This emergency response provider is continually at the forefront of techniques and product development. Their Program Manager, Casey Ping is also heavily involved in the
continued development of aviation safety and the HRRA (Helicopter Rescue and Response Association). This association actively promotes education, training and information sharing to improve safety and efficiency/effectiveness. ‘STAR Flight is the only 24/7 aerial emergency medical service in Texas that performs highly specialized emergency response services, including, emergency medical transport, still and swift-water rescue, search and rescue, high angle rescue, fire suppression/aerial reconnaissance, and law safety assistance’.

Figure 46 - Full body inertia reel restraint enabling aircrew to move throughout the aircraft restrained

Possibly the closest aligned to the flood rescue preparedness (both in the air and on the ground) to what Australia is striving for, would be North Carolina and their HART (Helicopter Aquatic Rescue Team). A revolutionary approach to an area requiring specific equipment and skillsets. The training given to these members, under the tutelage of Battalion Chief Tim Rogers is remarkable. ‘Train Hard, Work Easy’ certainly shone through as members are required to train in all aspects of flood rescue. Discussions to start this program started in 1992.

North Carolina Emergency Management (NCEM), a division of the NC Department of Crime Control and Public Safety (NCCPS), is the primary state agency responsible for coordinating search and rescue efforts under the NC Emergency Management Act- GS 166A. During responses to disasters and other emergencies, NCEM; in cooperation with the North Carolina Army National Guard (NCARNG), North Carolina State Highway Patrol (NCSHP), and local emergency services agencies; staff military and agency aircraft with trained Helicopter Search and Rescue Technicians (HSART). These personnel are considered deployable assets during local, state, and national emergencies under the auspices of NCEM. These personnel, when combined with a rotary wing aircraft and aircrew from either the NCARNG or NCSHP, form the NC-HART asset.
My thanks especially is extended to these organizations and allowing the use of their resources for the safety of those worldwide.

**PUBLICITY**

From the announcement of the Fellowship I have been able to promote my study and the Winston Churchill Memorial Trust through a number of avenues:

- The Leader newspaper (St George and Sutherland Shire). Story on receiving the fellowship and the study.
- Radio 2GB. Live talkback radio regarding flood safety and my Churchill Fellowship
- Sunrise program CH7. Weather presenter James Tobin joined the NSW SES on a flood rescue training day. Here I was interviewed regarding my Churchill Fellowship and flood rescue.
- Fire and Rescue NSW magazine article on my Fellowship study
- NSW SES magazine
- NSW SES website article
Amongst these official promotions of the Churchill Trust, people from every agency would often talk and ask about the Churchill Fellowship program.

V. CONCLUSION

Australians have already witnessed helicopters undertake rescues from floodwaters throughout the country. This has been done well. The aim of this research was to discover and introduce to Australian rescuers, the vast wealth of knowledge and skills that our counterparts have across the globe in this field. They have responded to a need for fast water rescue’s in California to the widespread devastating floods from Hurricanes on the east coast of the United States. It is because of this requirement that they have developed so strongly in this area. Flying skills, practices, equipment and techniques are now entrenched into the helicopter rescue agencies, regardless of uniform or helicopter size.

In Australia, we can learn from this. They have undoubtedly done the hard work for us. I admire their dedication and willingness to develop and experiment with new practices and equipment. This dedication has saved thousands of lives. Whether it was a one off rescue from water, or a long duration event pulling hundreds of people off roofs after a hurricane, the emergency services of the United States lead the way in the use of helicopters for flood rescue.
For Australian agencies, we first need to recognize this specific discipline. No longer should we send a helicopter just because it can fly there. Crews require training, equipment and a number of rescue options in their ‘tool box’ approach to any flood rescue. As we have already discussed, flood rescues may by the most dangerous any helicopter can be involved in. The victim may be drowning or in a tree above fast flowing water. There is a perception that helicopter crews will do the job when in fact many helicopter crews have no or minimal swiftwater and flood rescue training.

I once again wish to thank all of the people I had the great fortune of meeting. The list of ‘extra’ invites I received and visits I undertook really goes to show the camaraderie and friendship amongst emergency services worldwide. I returned home with hundreds of pages of notes and bags of operations manuals and reference material. All of which was freely given. This report really only scratches the surface of a sizable and wide ranging topic.

If there is one highlight of good for Australian’s coming out of this study, it would be that we already have most of the hardware in place. Australia is fortunate that we have (mostly) sufficient and well staffed rescue helicopters. The change required to bring us up to world standard is knowledge and skills based. Apart from equipment purchases there are no significant costs for new or different aircraft. We have seen how alternate approaches and typing has allowed different aircraft to be used for flood rescues and reconnaissance.

The rescue helicopter is an embedded, first call tool used by emergency managers in the United States. Hopefully, soon, we too will have this capability amongst our rescue aircraft.

It is always difficult for emergency services to budget for safety. Large budgets bring education, pre incident planning, good staffing and training programs. This in turn brings a lesser burden on emergency services during an event. They work faster and smarter. Sometimes this lesser burden, lesser victims and lesser calls can be wrongly seen as a lesser requirement. By actively promoting our roles and capabilities to the community and government, emergency services can promote the effectiveness and cost benefits of such training and capabilities. The loss of one life is too many. All emergency personnel should take this opportunity to further their skills in this field in the recognition that the lives it saves may also be yours.

VI. RECOMMENDATIONS

1. Emergency managers are trained in the capabilities of helicopters and their requirements for flood rescues.
2. Helicopter providers recognize that flood rescue is a specific discipline which requires awareness of its dangers.
3. Emergency services whom use helicopters for flood rescue undertake specific training and equipping of their crews and aircraft for flood rescue taskings. Techniques such as ‘Lilly Pad’, can dramatically increase the rescue capability of a single helicopter.

4. Combat agencies for flood rescue actively promote and encourage helicopter providers to undertake training and education in the flood environment. After such training helicopters can be responded on the first call as is done overseas.

5. Training sites shall be sought and interagency training days encouraged

6. Investigate the Australian aviation regulations with regard to short hauls, mass casualty loads and equipment such as rear attachment harnesses.

7. Flood agencies to develop helicopter typing standards for Australian aircraft

8. Cross training and education between flood responders (Swiftwater Rescue Technicians) and helicopter crews.

9. Australian emergency services investigate alternate hoisting harnesses and baskets and the studies that have been undertaken in the United States regarding lifting victims out of the water.

Fortunately, we are already somewhat on our way. "The Sydney based Westpac Life Saver Rescue Helicopter has been saving lives along the rugged east coast of Australia since 1973. With close links to the Surf Lifesaving clubs, they are arguably the world's best at rescuing people from heavy surf conditions. But even after hundreds of hours over the past two years responding to the flood emergencies in NSW Australia, they have recognised the need for continued specific training in flood rescue". Chief Executive Officer Stephen Leahy adds, "Our crews conducted numerous rescues in flood conditions from the devastating flood events in NSW. The swiftwater training they undertake is vital to their safety and the mission's success. We look forward to continuing to develop our capability in this area to provide the best service to the people of NSW"
Australia is the perfect environment for utilising helicopters for flood rescue. Indeed we have for many years. But we can do it better. Managing our resources, understanding our resources and better trained crews will surely assist in the direct saving of more lives.

‘You can lead a horse to water but you can’t make him drink’

Possibly the most humbling thought is the realization that the dedication, hard work and experiences of those in the helicopter and flood rescue communities worldwide is already being welcomed by those whom can champion it here back home.

Commissioner of the New South Wales State Emergency Service (NSW SES) Mr Murray Kear AFSM, welcomes this report to assist his already established Flood Rescue Working Group and Aviation Working Group.

"As the NSW SES is the combat / lead agency for floods in the state, I as Commissioner am focused on continually improving our capability. I am proud of what we are achieving, and realise that it is necessary to build into this capability the function of continuous improvement. This will include reviewing and implementing the use of helicopters into the way we deliver flood rescue services. As such I am currently looking at how this capability is used across the world, and will consider how we can benefit from the learning of others"

Our country is vast, open and rugged. This is the exact terrain where a helicopter shines.

We’re looking in the right direction.

One ought never to turn one’s back on a threatened danger and try to run away from it. If you do that, you will double the danger. But if you meet it promptly and without flinching, you will reduce the danger by half. Sir Winston Churchill.