Swiftwater body recovery: Evidence based considerations for practitioners

Steve Glassey MEmergMgt CEM® FEPS

Director – Public Safety Studies

University of Canterbury

Geoff Bray DipHypOps

New Zealand Police National Dive Squad

Presented by/Primary Contact: Steve Glassey, University of Canterbury, New Zealand

Email steve.glassey@canterbury.ac.nz

Abstract

Effective body recovery operations from the swiftwater environment require more than just good technical skills. Understanding a wide range of influencing factors from decomposition, management of affected families, to evidential processes is important to ensure a professional response is provided for. This article provides a synopsis of a range of factors that swiftwater body recovery personnel should be cognisant of; and introduces new approaches to on-site management structures and practical recovery techniques. A range of primarily open source references are used to allow recovery personnel to further their understanding of the key points covered.

KEY WORDS: *water, body, recovery, fatality.*

Introduction

Swiftwater practitioners who respond to a body recovery play an important part in the process by providing a professional, compassionate and competent response beyond the rescue phase. During the recovery, the on-scene mood is more subdued than the previous rescue phase, time has passed giving changes to the body's appearance and the media and victim's family have often moved into the area of operation. As time passes, from hours to months, the body decomposes and the range of recovery techniques need to be modified to ensure they are appropriate (Glassey, 2013, p. 7). Despite the sometimes grizzly task of recovering a body, when done professionally, it can be of great comfort and closure to the affected family – it is indeed a privileged role to play; one that comes with great expectations, pressure and scrutiny. This article explores the science and practice behind a number of factors which influence the outcome of body recoveries from swiftwater environments and intends to add to the wider underpinning knowledge held by swiftwater rescue professionals.

Practical Considerations

Search operations

Body behaviour after drowning

One of the most common errors by swiftwater recovery teams is to search too far downstream assuming the body has been carried some distance by the river. Always start the search at the Point Last Seen. Recent research by Hunsucker and Davison (2013) states that "A victim may be on the surface and then be on the bottom less than 10 seconds later. Search and rescue professionals need to be trained to understand the short time during which a victim can sink and drown and the need for immediate search and rescue from the bottom starting at the last point the victim was seen".

Water Search Dogs

Water Search Dogs (also known as Drowned Victim Search Dogs) are another tool to assist with the search phase of the recovery. There is anecdotal evidence to suggest that even live scent trained dogs may be able to indicate a submerged victim up to 36 hours post-mortem, albeit the dogs indication may be different from normal (Powell, 2012). Research carried out by Hardy (1988, p. 15) found at least an 82% success rate of using water search dogs in rivers at normal flow.

Determining the mode

Once a body has been found the decision to cease rescue operations and transition to recovery is that of the Incident Commander. It is encouraged that Swiftwater Recovery Specialists are actively involved in the decision making of this call. There are no set criteria as to when this transition should occur, but the below offers a number of considerations for the Incident Commander:

Mammalian Reflex

Cold water immersion can give effect to the mammalian response (or diving reflex) in which, in response to the face being immersed in cold water (<21°C/70°F), the heart slows (bradycardia) and blood flow is restricted to the extremities (peripheral vasoconstriction) leaving more blood for critical organs. Children have a stronger mammalian reflex than adults which increases their survival rate when immersed in cold water (Golden, et al., 1997; Hooper & Hockings, 2011). Conversely, warmer rivers (<21°C/70°F) may only offer a short window of several minutes for resuscitation success, if a drowning victim has been submerged when this protective instinct is considered in conjunction with the Orlowski predictors of survival (see below).

Hypothermia Survival Rates

As a guide, the below information from the Oregon State Marine Board (2003) provides a graph illustrating survival times in hours against varying temperatures for an adult male, wearing a life vest and light clothes. Even if the victim had been able to have their head out of the water (which would then not trigger the mammalian reflex), their survival rate in cold water is limited to less than two hours. However, one small benefit of hypothermia is that it generally creates a neurological protective state (cerebral hypothermia) which is more pronounced in children, reducing the incidence of vegetative brain injuries of resuscitated hypothermic drowning victims (Golden, et al., 1997; Hooper & Hockings, 2011).

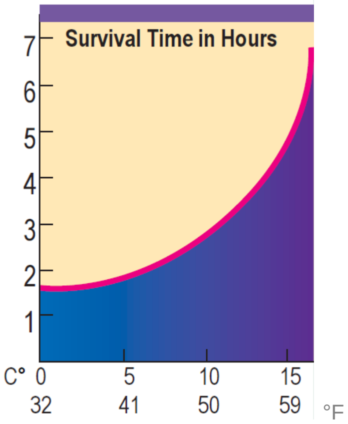

Figure 1: Survival times in varying water temperatures (Oregon State Marine Board, 2003).

Orlowski predictors of survival

The Orlowski (1979) predicators of survival also provides indicators that may aid in the decision making process to move the rescue to the recovery phase.

- The less indicators the patient has, the greater the chance of survival.
- If three or more indicators are present, the chance of survival is only 5%.
- Only the first three indicators are relevant to the first responder as they are pre-hospital

  Indicators:

  - Patient is three years or older
  - Patient submerged great than 5 minutes
  - CPR did not commence for more than 10 minutes after the rescue
  - Patient is comatose on delivery to Hospital Emergency Department
  - Patients arterial blood is very acidic (pH less than 7.10)

Simply put, the longer the patient is submerged, the older the patient is, the longer CPR is delayed - the chance of survival is reduced.

Air pockets

Faster, whitewater (aerated) water has the ability to create air-pockets. A kayaker with a brimmed helmet may in fact be under the fast flowing water in a survival position that has created a void to maintain breathing. Slower moving water is more effective in filling such voids and reduces the chance of air pocket creation. Other features in the water may give effect to air pockets too in fast flowing water, such as debris, rocks, strainers and the like.

Legal authority

During the rescue phase, it is common that response legislation enables emergency responders with numerous powers, such as those found in New Zealand under the Fire Service Act 1975 (s.28 Powers of Chief Fire Officer) or Civil Defence Emergency Management Act 2002 (during a declared state of emergency). As the incident transitions from rescue to recovery, response legislation generally ceases and coronial legislation (such as the Coroners Act 2006 in New Zealand) provides the legal authority for body recovery, notification of fatality and subsequent investigation. The privileges and powers may differ in each mode (rescue or recovery) and likewise, the lead agency may also change (for example from Fire Service or Civil Defence to Police, who assist the Coroner in New Zealand). It is important that as part of pre-planning, that teams involved in recovery operations are familiar with the legal requirements around such tasks. There is often other legislation that affects the recovery such as the protection of an accident scene and notification of serious harm under health and safety legislation (Health & Safety in Employment Act 1992 in New Zealand).

Recovery management

Pre-planning

Swiftwater recovery operations are often successful when there is good multi-agency pre-planning, involving law enforcement, fire/rescue, emergency medical service, search and rescue, kayak clubs, commercial rafting guides, coastguard, air rescue operators, military, surf life savers and commercial divers. The key is having a common operating model so that all parties understand the incident management structure and their roles and responsibilities before arriving at the scene. This can be achieved with good pre-planning, reinforced with joint training and exercising. No one agency will ever have the entire suite of skill sets to carry out an effective recovery, so it is important that an inclusive approach is taken. The swiftwater recovery programme should be integrated into existing local search and rescue arrangements and may even be led by a specialist sub-committee for swiftwater rescue.

Incident Command

The Incident Commander will initially assume command of the rescue operation and such authority will determine whether the operation continues in the rescue mode or needs to transition to the recovery mode. The Incident Commander may retain the responsibility for the role of Recovery Coordinator, or they may hand the incident over to a more specialized group such as a Swiftwater Recovery Specialist team. The Incident Command System (ICS) (or derivatives thereof in, other countries), is intended for the response phase of comprehensive emergency management. However, as body recovery may be part of a wider operation where response activities are continuing, the structure for managing body recoveries should be compatible. As part of pre-planning, an acceptable structure should be agreed upon with the agencies likely to be involved, such as the structure illustration in figure 2. It is important that the recovery cell (figure 2) has a Family Liaison Officer (FLO) to ensure the affected family are supported and informed. The recovery cell may be used stand alone or as a group reporting to the Operations Chief (ICS) or Operations Manager (CIMS).

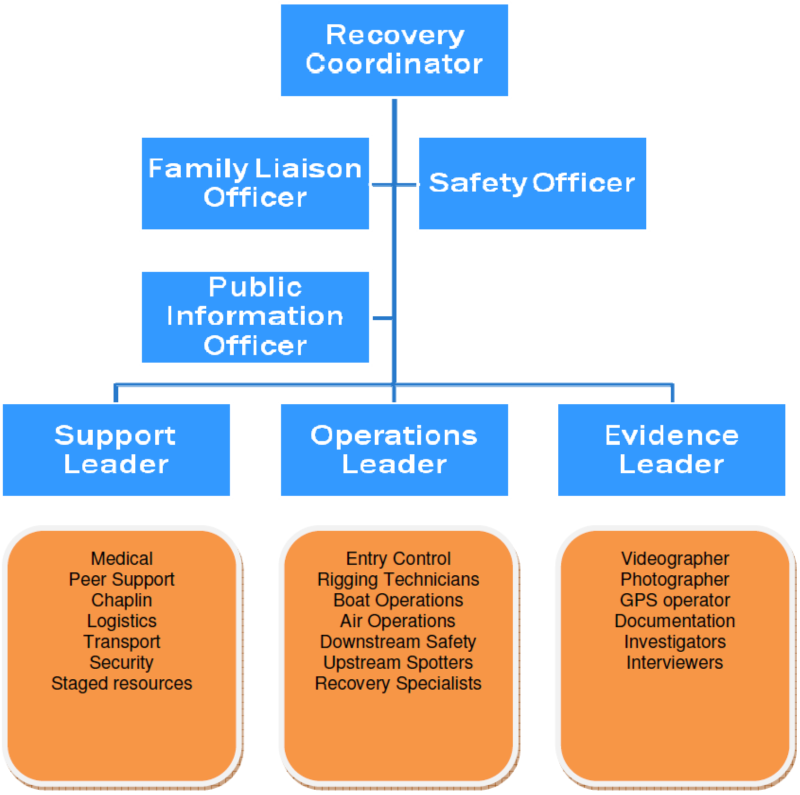

Figure 2: *Recovery Management Model (Glassey, 2013, p. 18)*

Restart Process

To force the mindset shift from rescue to recovery, it is recommended to "Restart" the incident using the 4R process developed by Rescue 3 International (Glassey, 2013):

1. *Recall:* Recall all on-scene personnel for an update. Ensure there is a spotter and/or security at the body location if required.
2. *Review:* Review the information from the incident to date to confirm the change from rescue to recovery. Ensure everyone understands that the rescue phase has stopped and recovery phase is now in effect. This will change the scene tempo and focus. A Recovery Action Plan should be developed.
3. *Reassign:* Using the Recovery Management structure (previous page), reallocate roles and responsibilities. Ideally, every new assignment should provide a different vest, badge etc. to ensure people mentally and visually mark the change in their role. This may also include the former rescue mode Incident Commander being moved to support role, as the demands of continuing in a lead role from the rescue phase may not be appropriate.
4. *Redeploy:* Personnel are redeployed to carry out the new Recovery Action Plan in their newly reassigned roles. Regular situation reporting continues, based on the Recovery Action Plan. Ensure a Personnel Accountability System is in place. This process ensures everyone reduces the tempo, become more focused on safety and recovery.

Decomposition factors

One of the factors which influence body recovery techniques is decomposition state of the victim. As time goes on, the further the body will have progressed through decomposition; this may limit or change the techniques required for an effective and appropriate recovery. The stage of decomposition may also have an effect on the family of the deceased, as well as recovery personnel, in terms of their psychological reaction.

There is little research in regards to decomposition of human bodies in swiftwater. Much of the research to date (Alley, 2007; Ayers, 2010a; Haglund, 1993) focuses on static water comparisons between salt, chlorinated and/or freshwater.

The stages of body decomposition are (adapted from Payne, 1965):

1. Fresh
    a. *Pallor mortis* – paleness of skin
    b. *Rigor mortis* – rigidity of body
    c. *Livor mortis* (Post mortem lividity) – skin black and blue (commonly absent in submerged bodies)
2. Bloat
3. Putrefication and decay
    a. May include *Adipocere*, formation of body fats creating preservative wax.

There are many factors which influence decomposition of bodies in swiftwater. In general, the faster velocity and cooler temperature of swiftwater mean that the rate of decomposition can be significantly slower than in surface conditions or open seawater. In addition, the lack of insects and scavengers is likely to lessen the deterioration of the submerged body in swiftwater too. Where a body is not submerged in cool swiftwater, especially in, or near, a static flow environment, it is likely to decompose faster than when left on the ground (i.e. resting on soil out of the water) (Ayers, 2010a).

The long held generalization that two weeks of surface decomposition is equal to one week of decomposition in water was challenged by Ayers (2010) who found that decomposition in dead pigs occurred fastest in freshwater, followed by ground/surface and then saltwater. The osmotic effect of the body in freshwater also leads to protrusions of organs which accelerates decomposition (Ayers, 2010b).

Influence of decomposition on recovery operations

The longer the body is in the water, the more it will change as it progresses through (albeit partially sometimes due to cold water) the stages of decomposition. This will have two key impacts on recovery operations: 1) As the body starts to decompose and break down, the body is less cohesive and more prone to separation – so recovery techniques in later stages need to ensure a gentle and appropriate technique is considered, and; 2) The visual appearance of the body as it deteriorates may become more graphic and upsetting not only for the victim's families, but recovery personnel too. Discreet retrieval of the body should be undertaken and the Recovery Coordinator needs to ensure personnel involved in the recovery operation have the right mental disposition to work in these emotionally demanding activities.

Refloat Factors

According to Armstrong and Erskine (2011), the factors affecting refloat are last meal, temperature, water depth, body mass and health. *Last meal:* Meals high in carbohydrates and carbonated beverages produce gases very quickly. *Temperature:* Bacterial action is increased in warmer temperatures, which will cause refloat sooner than in cooler water. *Water depth:* In depths of 200ft/61m or greater, bodies may not refloat at all due to compression. *Body mass:* Bodies containing a higher quantity of body fat will refloat more quickly than leaner ones under similar conditions due to the greater buoyancy of body fat. *Health:* An individual with a bacterial infection, sepsis, or high fever prior to death will tend to decompose at a faster rate.

Infectious diseases and personal safety

Infectious diseases

Most infectious organisms do not survive beyond 48 hours in a dead body, the exception is HIV which has been found six days post-mortem (Pan American Health Organization, 2009, p. 5). There is potential (but as yet undocumented) risk of drinking water supplies contaminated by faecal material released by dead bodies. As dead bodies often leak faeces after death, or blood from traumatic injuries, there is a small risk of contact with (including ingestion of) such fluids. Body recovery personnel who have contact with the deceased's blood and faeces have a small risk from: Hepatitis B and C; HIV; Tuberculosis; and Diarrheal disease. Tetanus may also be a particular problem in unvaccinated personnel.

Personal safety

When handling the recovered body out of the water, standard body substance isolation techniques should apply. When in the water, the following can assist in reducing the risk of infection:

- Have a dedicated (low cost/disposable) personal swiftwater cache for recovery work
- Wear:
    - dry suit (noting that the suit may need to be destroyed if soiled) or
    - disposable coverall over wet suit and under PFD
    - altered disposable coverall over PFD (ensuring holes are cut for quick release, knife etc)
- Wear goggles/mask
- Wear examination gloves under dive gloves
- Wear ear plugs to avoid fluids entering ears
- Avoid wiping face or mouth with hands

- Establish decontamination unit upon exit of hot zone, if water is contaminated
- Wash hot zone personnel and their equipment down after exiting hot zone
- Cover any cuts with fully sealing adhesive bandages
- Wash hands with soap after handing bodies and before eating
- Bloated bodies may contain hazardous gases - be cautious handling these
- Ensure personnel have the following vaccinations (adapted from Ministry of Health, 2011, p. 25) in addition to any set by their local medical authority. Rescue teams should develop a policy (including provisions for financial assistance) for Hepatitis A, Hepatitis B and Tetanus and other diseases based on local health organisation advice.

Working with the family

The most important aspect behind safety, is working with the affected family. The hours or days of good work can be easily undone within seconds, if the needs of the family are not considered. Although there are differing approaches to how the victim's family are engaged, it is crucial that they feel acknowledged and treated with compassion. Encouraging the family to appoint a spokesperson will assist with communication and coordination of the family's wishes and enquiries. The cultural aspects of body recovery need to be carefully considered too. Once the body is located and secured, the family should be engaged to notify them of the find and seek their advice on how the body will be received on shore. This is also the time to ensure the family understand the state of the body; provide advice such as "He has been decomposing some time; he is not the David you remember". Preparation of the body before it is taken ashore is important, such as protecting it in a mesh or recovery bag to ensure the dignity of the body in particular when public and media are present. The family may wish to say a prayer or have certain family members carry the body from the shore to the means of transportation. As most bodies will require a post-mortem examination, the family should be briefed about the process and whether a family member can accompany the body, as may be culturally required. In addition to direct counselling services, there are numerous online support groups and information websites which the family can be directed to, including the Drowning Support Network (Yahoo group and Facebook) and Higgins & Langley Memorial and Education Fund (website and Facebook) respectively.

Professional image and distance

It is important that personnel display a professional image throughout the recovery operation. Arriving and departing in uniform is part of providing a professional and credible presence to reassure the affected family. Families will often want to interact with those who are actively involved in the *hot zone* recovery operation; and this should be facilitated as much as it is safe and practical to do so. This is where having a Family Liaison Office that has intimate knowledge of body recovery operations is important, so that the process and challenges can be conveyed effectively. The Recovery Coordinator should ensure that all personnel are briefed on professional image and distancing as part of the

Restart process. Maintaining a professional image and distance is not confined to the recovery operation, but extends to after the operation too.

Recording of evidence

In most cases of body recovery, the operation will be part of a wider legal investigation to explain the death. Though the responsibility of body recovery is generally that of local law enforcement, there will be occasions that non-law enforcement personnel such as SAR volunteers may carry out the recovery and associated evidence collection under the law enforcement agencies authority. In New Zealand, 22% of drowning incidents are related to suicide, homicide and vehicle accidents (Water Safety New Zealand, 2012, p. 9). In an abnormal trend, "in Ireland more people die by drowning as a result of suicide than they do as a result of accident. In 2003, 51 drowning deaths in Ireland were classified as accidental, but almost twice as many classified as suicide (n=90)" (International Life Saving Federation, 2007, p. 13). These examples clearly illustrate that drowning incidents are likely to be closely examined by criminal or coronial investigations and consequently, Swiftwater Recovery Specialists need to protect and collect evidence for such inquiries. As the collectors of evidence, recovery personnel are likely to be required to give evidence in the form of a statement or summoned to court.

Swiftwater recovery training and techniques

It is important from a safety and credibility perspective that personnel seeking to develop their swiftwater recovery skills undertake accredited training. Such training should include: determining the mode (rescue or recovery), legal authority and roles, disaster victim identification, recovery incident management, decomposition factors, health and safety of recovery operations, psychological considerations for recovery personnel, managing the family and media, recording and presenting evidence for law enforcement and specialist recovery techniques. Specialist techniques may include the use of underwater cameras, catch poles, sonar and ROV systems, tow trucks and contact recovery methods such as the Kiwi recovery V lower (figure 3). The flexible *hula-hoop* also known as *Mr Flexi* (figure 4) used as part of the Kiwi recovery V lower technique was developed by the late Jim Segerstrom (J. Mutlow, personal communication, 2013).

Figure 3: *Kiwi Recovery V Lower rigging*

Figure 4: *Mr Flexi (photo by J. Mutlow)*

Another recently developed improvised tool is known as Captain Hook (figure 5) and was developed by Glassey and Bray in 2013 as part the development of the Rescue 3 International Swiftwater Recovery Specialist programme. It comprises of an animal control catch pole, a window punch and seat-belt cutter. Captain Hook is designed for surface water rescue personnel to safety extricate a body from a car submerged in swallow water. The operator from the safety of a raft or other water platform, can penetrate the automotive glass, cut the seatbelt of the victim and use the catch pool noose to secure and remove the body safely. All these components can be assembled without the need of a proprietary pole and connected using radiator hose clamps (or even duct tape or cable ties). Additional payload such as underwater inspection cameras and lights can also be fitted if needed. Other recent developments in shallow swiftwater search include side-scan sonar and other similar system integrated with quarter-size electric jet boats, fitted with high precision GPS and auto-pilot/auto-search grid programmes such as those being developed by the University of Canterbury, further research on their effectiveness is required.

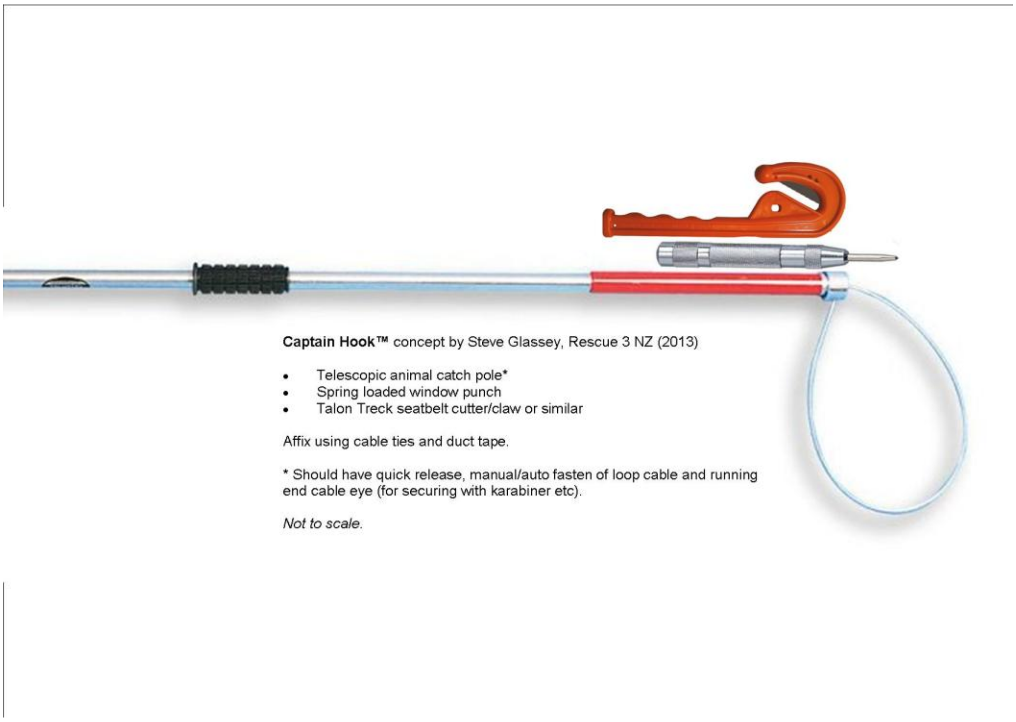

Figure 5: *Captain Hook*

Conclusion

The process of body recovery from the swiftwater environment is a challenging one, not generally because of the technical approach as time is no longer a major concern, but the emotion of recovering a lost family member creates its own unique pressures and operational considerations. As the adrenaline of the response fades, recovery personnel need to consider a wide range of factors from confirming the change to the mode of operation, restarting the on-scene management of the operation, changing tactical methods that are compatible with decomposing state of the body, protecting the recovery personnel from infectious diseases and from mental harm, preserving and collecting evidence for the inquiry into the fatality and providing a culturally and emotionally appropriate response to the family of the deceased. An improved understanding of these factors which influence body recovery operations will improve the response to future incidents when coupled with accredited swiftwater body recovery training.

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About the authors

Steve Glassey is the Director of Public Safety Studies at the University of Canterbury, New Zealand. He is the lead author of the Rescue 3 International *Swiftwater Recovery Specialist* manual and training package and has been active in technical rescue instruction for over 15 years. In 2004 and 2013, he was presented international awards for championing swiftwater rescue capacity development in New Zealand by Rescue 3 International. He holds a *Masters in Emergency Management* from Charles Sturt University (NSW), *National Certificate in Specialist Rescue* and is a *Fellow of the Emergency Planning Society* and *Certified Emergency Manager* (CEM®).

Geoff Bray is a Constable with the New Zealand Police. Geoff is an operational police diver and dive supervisor with over 10 years' experience as a qualified commercial diver. Over this time, as part of the Police National Dive Squad, Geoff has recovered hundreds of bodies from a range of aquatic environments that have resulted from accidents, homicides and suicides. He holds a *Diploma in Hypobaric Operations (Dive Supervision)* from ADAS and is a Rescue 3 International Swiftwater Recovery Specialist Instructor.

Abbreviations

CIMS	Coordinated Incident Management System
CPR	Cardio Pulmonary Resuscitation
DVSD	Drowned Victim Search Dog
FLO	Family Liaison Officer
HIV	Human Immunodeficiency Virus
ICS	Incident Command System
PFD	Personal Floatation Device

SAR	Search and Rescue
SRS	Swiftwater Recovery Specialist

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