National Operational Guidance

Guidance

Water rescue

NFCC National Fire Chiefs Council

Developed and maintained by the NFCC

Contents

Introduction

This section of National Operational Guidance sets out the hazard knowledge and control measures that should be considered for the rescue and care of casualties in water. The aim is to integrate the knowledge, understanding and actions required to support the appropriate, safe and efficient resolution of any incident involving rescues from water. Personnel should be made aware of the hazards that exist when responding to a rescue from water. They should also understand how their actions may impact on the environment and other emergency responders. This guidance should be read in conjunction with:

- Search, rescue and casualty care
- Geophysical hazards
- Operations – Infectious diseases

Where applicable, the following document may be considered for water rescue:

- Department for Environment, Food & Rural Affairs (Defra) Flood rescue concept of operations (FRCO)

Terminology

To clarify the position of a casualty or object in relation to the water, the following terminology is used:

- **Underwater or submerged** (also referred to as subsurface by other agencies) - A state where a person's airway is compromised due to their physical position in the water, usually due to their head being under the surface of the water
- **In the water** - A situation where a person is partially submerged, with their head above the surface of the water
- **On the water** - Where the person is in or on a vessel, such as a kayak or inflatable dinghy

Risk management plan

Each fire and rescue authority must develop their strategic direction through their risk management plan. To determine the extent of their services, strategic managers will consider their statutory duties and the foreseeable risk within their area.

Work to identify risk and prepare operational plans should consider all stakeholders, including local emergency planning groups and the fire and rescue service risk management plan.

Risk management planning for water rescue

Risk management plans should consider the foreseeable water-related hazards and events that may result in the need for a water rescue. The community risk profile, along with knowledge of local infrastructure that includes bodies of water should inform risk management planning for water rescue. This should include the identification of sites where people are likely to require being rescued from water.

Water risks should be considered as part of overall risk management planning and consider the foreseeable hazards associated with water rescue. The community risk profile, along with knowledge of local infrastructure that includes bodies of water, should inform risk management planning for water rescue. Community risk profiles provided by responsible bodies will further help to develop risk management plans.

The National Fire Chiefs Council (NFCC) has a water incident dashboard to help fire and rescue services gather information on incidents in their area. It uses live data from the Water Incident Database (WAID), which records vital information from agencies such as the Royal National Lifeboat Institution (RNLI), Maritime and Coastguard Agency (MCA) and the Royal Society for the Prevention of Accidents (RoSPA).

The aim of the dashboard is to help fire and rescue services search for and gather information relating to their area to help with risk management planning.

The impacts of climate change, which includes an increase in rainfall, should be considered in risk management planning for water rescue. It may result in unexpected or unpredictable bodies of water that present hazards.

Water may present a hazard to people through them:

- Using bodies of water, such as:
  - Lakes
  - Rivers and streams
  - Reservoirs
  - Canals
  - Ponds
  - Swimming pools

    - Tidal pools
    - Those created by heavy rainfall, for example, water in disused quarries
- Entering a body of water, such as those:
    - In unlit areas
    - Near to uneven ground, footpaths or cycle paths
    - In parks or playgrounds
    - Near to public houses or nightclubs
- Entering a body of water while in a road vehicle

For information about flood planning refer to Geophysical hazards.

During the risk management planning for water rescue, it should be recognised that most incidents of this nature will require a multi-agency response. Joint training and exercises with other responder agencies should improve the understanding of water search and rescue resources and capabilities. Pre-planning should also consider preferred methods of communication and reinforce use of the JESIP principles for all multi-agency incidents.

[LW1]Add link to other guidance

Submerged casualties

Fire and rescue services need to consider their approach to attending incidents where casualties have been identified as being submerged for a prolonged period, in situations that are not conducive to support life.

Personnel must not be deployed to perform a rescue at an incident where a casualty is submerged that knowingly requires personnel to remove personal protective equipment (PPE). Personnel must not attempt a rescue that cannot be performed from the surface of the water, in the water, from land, or within agreed protocols and parameters.

To reduce the likelihood of personnel being exposed to incidents where they are unable to act, fire and rescue services should gather information, appropriately screen calls and deploy adequately trained personnel. This should result in the most appropriate resources being mobilised to a submerged casualty incident.

When in attendance, if a rescue is deemed outside of the parameters identified in service policies, procedures or tailored guidance, it may still be appropriate for personnel to be tasked to perform

defined functions such as:

- Implementing cordon controls
- Establishing the necessary safety measures
- Gathering risk and resource information and requirements

Pre-planning can reduce the likelihood of personnel being exposed to perform an unnecessary underwater rescue. It should be used to ensure the mobilisation of the most effective resource, to allow rescues to be performed that are within the firefighter's identified capabilities, and the expectations of the role they are undertaking.

Water awareness

All personnel who are likely to be exposed to bodies of water, regardless of their level of competence, need to be aware of the hazards and risks that may be present. They also need to be aware of the hazards and risks associated with a water rescue.

Fire control room role

To ensure that water rescue incidents are dealt with safely, effectively and efficiently, fire and rescue services should train fire control personnel so that they can appropriately screen calls. Fire control personnel should understand how to interrogate callers to gather situational awareness, which would include:

- Information about the risks and hazards
- Access to the incident
- If anyone is currently attempting to rescue the casualty
- If any other emergency responders are in attendance or en route to the incident
- Whether the casualty is on, in or under the water
- Is the water still or moving
- If the casualty is submerged, how long ago were they last seen

Further information is provided in Water survival guidance.

Responsibility of fire and rescue services

Fire and rescue services are responsible, under legislation and regulations, for developing policies and procedures and to provide information, instruction, training and supervision to their personnel about foreseeable hazards and the control measures used to reduce the risks arising from those hazards.

This guidance sets out to provide fire and rescue services with sufficient knowledge about the potential hazards their personnel could encounter when attending incidents. Fire and rescue services should ensure their policies, procedures and training cover all of the hazards and control measures contained within this guidance.

Roles and responsibilities for water rescue

Although there is no specific legislative duty for fire and rescue services in England to respond to flooding or water rescues, the Fire and Rescue Services Act does make provision for rescuing and protecting people in the event of emergencies, other than fires and road traffic accidents.

The Fire and Rescue Services (Emergencies) (Wales) (Amendment) Order contains an amendment to include a duty to prepare for and respond to flooding and rescues from inland waters.

The Fire (Additional Function) (Scotland) Order and The Fire and Rescue Services (Emergencies) Order (Northern Ireland), set out a duty for the Scottish Fire and Rescue Service and the Northern Ireland Fire and Rescue Service to prepare for and respond to serious flooding. This includes any flooding that causes or is likely to cause a person to die, be seriously injured or become seriously ill.

Hazard - Hydrological hazards

Hazard Knowledge

Hydrology is the science concerned with the properties of water, and especially its movement in

relation to land. The study of water movement and its behaviour relating to the topography, allows personnel to assess the hydrological hazards that can exist in moving or static water.

This website provides some descriptions and diagrams of hydrological hazards featured in this guidance. Examples include:

- River characteristics
- Water flow
- Terminology
- River orientation
- Water hazards, including:
    - Strainers
    - Foot entrapments
    - Recirculations
    - Water force
    - Undercuts
    - Siphons

The hazards of water will vary greatly, depending on whether the water is static or flowing, rising or receding, its temperature, speed and depth. To properly assess an appropriate course of action, personnel should understand water hazards and hydrology.

The force of water is directly related to the speed and volume of the flow; doubling the water speed will quadruple the force. Small volumes of water at sufficient velocity may be enough to cause personnel to lose their footing. Standing water will exert an upward pressure against an object, which may cause it to lift, and a lateral pressure that can cause movement of structures, vehicles and people. For more information relating to vehicles in water refer to Casualties in a road vehicle in water.

Micro geography in a water environment can create radically different water movement and hydrological features over very short distances, even less than 1m. The risks to personnel will need to continuously be reviewed by the teams, with team leaders being responsible for decision-making, based on the level of competency of their team members.

Moving water in a channel

It can be useful to consider a moving body of water as a series of connected layers rather than a single body. In flowing water, the layer in the middle of the channel generally moves fastest, with the speed decreasing closer to the edge or bottom of the channel.

Casualties or personnel caught in the flow may be subject to impact, as the water collides with structures or objects in its path. The noise of moving water can affect communication between people, whether in the water or on land.

Recirculations

When water passes over a vertical drop it accelerates and then recirculates downstream of the drop. This can cause a casualty or object to be held by the recirculating water. The strength of the recirculation will vary depending on water levels, angle of descent and speed of flow.

Recirculations may create 'tow back', an area of water that moves back against the direction of the flow, which can be both vertically and horizontally, pulling an object or casualty back towards the hazard. They can aerate the water, which will affect the buoyancy provided by personal protective equipment (PPE) and buoyancy aids. Because the aeration of water reduces the density and makes swimming, boat paddles and propellers less effective, coupled with the strength of the water, it may not be possible to swim, row or navigate a boat out of a recirculation hydrological feature.

Boil line

This is a line of boiling or bubbling water that delineates the water going downstream from the water that is flowing back towards a hydraulic. Usually, the further away a boil line is from the hydraulic, the more hazardous the feature.

Eddies

Where flowing water passes static or slower moving water, it causes the area of static water to rotate in the opposite direction to the main flow. This recirculated water, or eddy, is slower than the main flow. The reduction in speed causes debris to be deposited, reducing water depth around eddies. Areas of slower flow and shallower water, such as those around eddies, can be an area of relative safety in the water.

Eddies form more frequently as water speed increases and may form behind obstacles in flowing water, where channels increase in width suddenly and where a narrow channel of flowing water enters a wider, static body of water.

Undercut riverbanks

Moving water will erode underwater materials, such as mud and stone. This erosion can be unseen, particularly where the substrate beneath the surface is softer than that above it. Areas that are subjected to continuously greater forces generated from the flow, such as a waterfall or bend in a river, are also more prone to erosion.

Erosion or undercutting can make riverbanks unstable, collapsing when a load is applied. Underwater areas that have been subject to undercutting can also generate eddies that pull objects, casualties and personnel into holes and gaps beneath the surface.

Inland waterways

An inland waterway can be termed as any body of water that is not coastal. Artificial waterways may incorporate mechanisms that could present additional hazards.

A casualty who has fallen into an inland waterway may become involved with the features present, such as sluice gates, locks, and debris screens. These features can produce the same hydrological hazards experienced in a natural river environment and the operation of such mechanisms may result in injury or death. For more information refer to On-site machinery: Water management systems.

Floodwater

Floodwater should be considered in a similar way to moving water when considering a water rescue. The principles of operating in moving water apply, even when the conditions appear to be still. As with tidal conditions, water levels can rise rapidly.

An additional hazard is that floodwater is likely to be contaminated by sewage, fuel and other substances. For more information refer to Geophysical hazards - Flood.

Flooded built environments will create entrapment hazards that may not be expected, such as displaced drain covers or submerged street furniture. These items can create hydrological hazards, like those found in the natural environment.

Tidal water

Tidal conditions are usually predictable, which can be anticipated and prepared for. However, tidal water can rise quickly, isolating people and resources, and the depth of water can change rapidly as the tide turns. This represents a significant hazard to those who are unprepared for tidal changes.

Incidents involving tidal water have additional hazards from currents and waves. Some rivers, inlets and estuaries are influenced by tides.

Care should be taken to avoid being cut off or isolated from egress routes. This may occur over a very short space of time, at least twice a day. Where ingress and egress of tidal water is restricted, for example around a tunnel, water levels can change dramatically and unexpected hazards may form quickly, including recirculations. If teams may be made available for mutual aid deployments out of their area, they should be trained and equipped to operate in all foreseeable water environments, including tidal waters.

Sea foam

Sea foam is a common natural occurrence, along the coastline in small quantities, which may result in a fire and rescue service responding to a coastal rescue.

On rare occasions it can accumulate in very large quantities, often due to wind, water currents and

waves pushing the foam towards land features that trap it, for example, coves, gullies, and harbour walls. It has been recorded that foam can reach up to 3m in depth.

There are specific circumstances where it can present significant risks. It is often difficult to assess the level of risk, as the composition of the foam is unknown in the early stages of the incident. This could include health hazards, such as infectious diseases. For more information refer to Operations – Infectious diseases.

The foam may present risks including:

- Low buoyancy compared to water
- Casualties and rescuers will sink through it
- Powered rescue craft will have issues with buoyancy and oxygen starvation to engines
- Restricted visibility in the foam, making it difficult to estimate its depth or see submerged obstacles or hazards
- A lack of visual reference, which increases the risk of slips, trips and falls

Any dynamic wave action or currents below the surface of the foam will be 'dampened'; the surface of the foam may be static while there is water movement below it.

Obstructions in the water

In a moving body of water, hazardous debris and materials including large objects can affect personnel or compromise safe systems of work. Debris may be on the surface, suspended in the water or rolling along the bottom.

Rocks or other debris, such as branches or rubbish, underwater or partially submerged, may present entrapment or entanglement hazards. This is particularly hazardous in flowing water, where the force of water may also cause a loss of balance. Poor water clarity will make it difficult to identify obstructions in the water.

Biosecurity

Fire and rescue services can affect biosecurity if facilitating the transfer of material from one open water source to another. This could be as a result of equipment, vehicles or PPE being contaminated while carrying out a water rescue.

Unless otherwise confirmed by a responsible person, bodies of water should be treated as if they are contaminated, as they may contain biological hazards. This could include harmful substances, such as sewage or industrial chemicals. Bodies of water may also contain invasive species.

For more information refer to Environmental protection – Biosecurity.

Control measure - Check water and tidal conditions

Control measure knowledge

Where available, fire and rescue services should receive notification of strong stream advice, tide predictions and river level warnings. This information can be used to predict likely changes in river levels that may affect tactical plans.

Information regarding river conditions in a fire and rescue service's area may be provided by environmental agencies, the Met Office, the Rivers Agency or local water management groups, such as the Canal Trust or local drainage boards.

Physical observations on the state of the water may provide an accurate assessment of the hazards present and the hydrology of the river, and where best to operate in the water. An assessment will be required before the deployment of personnel in the water; if resources permit, it may be appropriate for a safety officer to be appointed to carry out this assessment. For more information refer to Safety officers: Water rescue.

Tidal changes occur predictably in coastal waters and rivers, but the timings of high and low tides fluctuate. Planning for water rescue incidents should take into account tidal conditions if relevant, by using tide charts or timetables.

Sources of information include beach tide times that are available from the Met Office and tide tables that are available from the BBC.

Local authorities, water management bodies, environmental agencies and the Met Office may be available to provide water temperature charts. Available charts will provide either average, expected or current water temperature information for seas, rivers and other bodies of water. If available, temperature data should be considered when planning for or carrying out a water rescue.

Strategic actions

Fire and rescue services should:

- Establish mechanisms to receive and share notifications of changes in river conditions

- Provide relevant personnel with access to information on tide patterns if appropriate

Tactical actions

Incident commanders should:

- Access all available information sources on river levels and tidal conditions
- Consider contacting environmental agencies or other responsible bodies for information on changes in river conditions and levels
- Use visual assessment of the water to identify hazards, hydrological features and where best to operate for a water rescue
- Consider appointing safety officers to assess water and tidal conditions
- Consider using tide times and temperature charts when planning for or carrying out a water rescue

Control measure - Cordon controls: Water rescue

Control measure knowledge

When working near, on or in water, measures should be taken to establish hazard areas to restrict the movement of personnel, depending on levels of training and available equipment. Where possible, areas should be indicated using physical barriers and access should be controlled. However, if a large geographical area is involved, this may not be feasible.

If cordons for hazard areas are required, access should be controlled by using comprehensive briefings and physical barriers. Personnel should be directed to operate in safe areas, such as guarded edges where possible.

Cordons may also be required to prevent members of the public from entering the hazard area. For

wider cordons outside of the hazard area, it may be necessary to request the assistance of the police.

Hazard areas can be separated into hot, warm and cold zones. It may not always be appropriate to establish zones, or access to the hot zone may be prevented depending on the risk assessment. Known bodies of water, with limited risk, may not require any hazard zones to be established.

The Department for Environment, Food & Rural Affairs (Defra) Flood rescue concept of operations (FRCO) (page 37) provides an illustration and the following information, which may be applied to a water rescue incident:

Zoning

An integral part of managing safety at a flood incident is effective control of the inner and outer cordon. Zoning is required to ensure the appropriate response resources are used and that responders operate in the correct locations.

***Hot Zone** - This is the area that is covered by water and is the high-risk area. Operations in the hot zone should be restricted to trained in-water responders who are appropriately equipped for the environment.*

***Warm Zone** - This is the area adjacent to the water and remains a risk area to responders. A minimum of 3 metres should be maintained from the water. This distance should be increased depending on terrain, e.g. when operating near slopes. Operations in the warm zone should be restricted to responders who are appropriately trained in self-rescue techniques and who are equipped for the environment.*

***Cold Zone** - The cold zone is the safe area located outside the risk zones.*

A risk assessment and situational awareness may dictate the need to adjust the zones based on factors such as:

- Undercut or steep riverbanks
- Fast flowing water
- Underfoot conditions

For more information refer to Situational awareness: Water rescue.

It is important that these zones are established, effectively implemented and communicated to all emergency responders as early as possible, to maintain safe working areas and to assist in defining roles, responsibilities and objectives. Any changes to the hazard area or the zones should be communicated to all emergency responders.

The geographic scale of a water rescue incident can make the management of personnel difficult. To establish greater levels of command and control, incident commanders should consider cordon control gateways that perform the activity of logging and permitting the number of personnel

committed to the hazard area. This should include the times of entry of personnel, assigned tasks and equipment.

It may be necessary to place appropriate limits on durations committed to the hazard area. The duration of commitment will depend on the required tasks and environmental conditions. Regular radio contact with personnel in the hazard area should be maintained.

Appointing a safety officer can assist in controlling a cordon and the zones within it. For more information refer to Safety officers: Water rescue.

Strategic actions

Fire and rescue services should:

- Provide appropriate means of implementing and controlling cordons at incidents involving water

Tactical actions

Incident commanders should:

- Ensure that personnel operate on the safe side of existing guarding near water or surrounding unstable surfaces
- Establish and maintain the water hazard area with hot, warm and cold zones and communicate to all emergency responders, including any changes
- Ensure that entry to the water hazard area is controlled, including the need for appropriate PPE
- Consider using cordon control gateways for water rescue incidents
- Consider appointing a safety officer to control cordons and the zones within it for water rescue incidents
- Request police attendance to manage cordons outside of the water hazard area

Control measure - Effective communications: Water rescue

Control measure knowledge

Using common terminology when conducting briefings, debriefings and operating near water is vital, to ensure messages are understood.

When working near, on or in flowing water, personnel are often facing the opposite direction to spotters and may be working on different riverbanks. Upstream is the area closer to the source of the flow and downstream is the direction of flow of the water. To avoid confusion downstream is always considered to be forward, river right is the right-hand side when facing downstream and river left the left-hand side. This would be especially applicable for tidal rivers where the direction of flow may change.

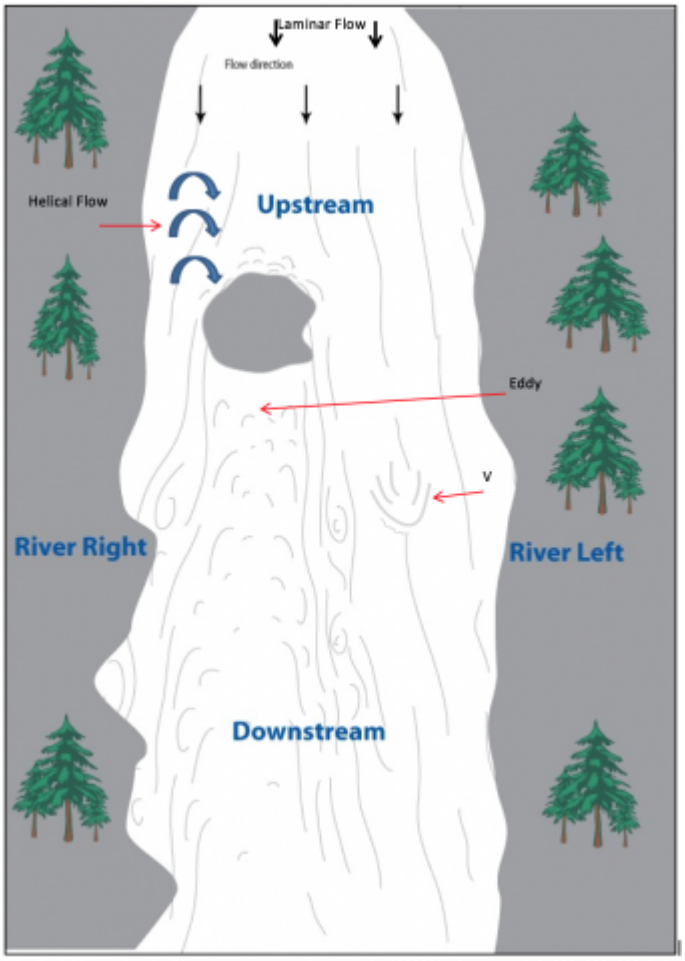

Figure: Diagram demonstrating terminology used for flowing water

Further information on river terminology and hydrology, such as laminar flow and helical flow, can be found on this website.

Communication with personnel committed to the water can be difficult. The noise of moving water and the distance between personnel may make verbal communication between personnel difficult. Although waterproof communication equipment is available, it is often not appropriate for swimmers, due to the effects of the water, personal protective equipment (PPE) and levels of exertion.

Hand and whistle signals

To ensure interoperability and joint understanding between teams regardless of their agency, it is essential that all teams use a standard set of signals for communication prior to entering the hazard area. The Department for Environment, Food & Rural Affairs (Defra) Flood rescue concept of operations (FRCO) (page 39) provides a list of standard hand signals and whistle blasts that will assist with communication for emergency responders when working near, on or in water.

If the standard hand or whistle signals are inappropriate for a specific task or incident, variations should be established and confirmed with all emergency responders.

Radios

A consideration for communicating with other agencies that may be involved in water rescue may assist in improved interoperability. For example, Her Majesty's Coastguard (HMCG), other MCA assets and various rescue organisations use very high frequency (VHF) radios.

Strategic actions

Fire and rescue services should:

- Provide appropriate communication equipment for water rescue incidents

Tactical actions

Incident commanders should:

- Consider using appropriate equipment or other methods of communication for water rescues
- Ensure all emergency responders involved in the water rescue have a joint understanding of

the communication signals and terminology being used

Control measure - Safety officers: Water rescue

Control measure knowledge

Safety officers should be appointed, briefed and positioned as soon as practicable. They should have an understanding of the nature of the incident and the environment that personnel are working in. The hazard area and activities being carried out should influence the number and location of safety officers required at water incidents. Safety officers should not carry out their duties in isolation and should always have an appropriate method of communicating. For more information refer to Effective communications: Water rescue.

The effective use of personnel and equipment, particularly when waiting for additional resources to arrive, will need to be prioritised. It may be necessary to implement either downstream safety teams or upstream spotters according to a risk assessment.

The following safety officer roles are suitable for water incidents:

Upstream spotters

Upstream spotters should be appointed to identify hazards, such as debris that may present a risk to personnel and the casualty in the water. This information should be communicated to personnel, including the incident commander, at the earliest opportunity. Upstream spotters should also communicate any changes in conditions, or sudden releases of water.

Downstream safety officers

Downstream safety officers are positioned to retrieve personnel and provide assistance to casualties.

Situational awareness and a risk assessment should be promptly used to determine if downstream safety teams will be required. This should take into account the urgency of the rescue and the available resources.

Personnel should be positioned at a suitable point downstream to perform rescues. When using safety systems, such as downstream safety lines, the time required to establish and deploy them is a factor to be considered. It may be necessary to adopt alternative downstream safety until

systems have been established.

Safety systems of work, personal protective equipment (PPE) and equipment should be appropriate for the water environment; for example, when working near large static bodies of water, watercraft may be used to recover personnel who accidentally enter the water. A fixed downstream safety line, or teams positioned on the bankside, may be appropriate to perform in water or bank-based rescues.

Downstream safety officers should be positioned with safe entry and egress points in mind. Entry and egress may not necessarily be the same point; water and bank conditions may make a point further downstream more suitable for egress.

Downstream safety teams should be comprised of a suitable number of personnel and appropriate equipment, with the ability to rescue all people committed to the water, including personnel in watercraft and casualties.

If downstream safety officers are not deployed, another means of recovering casualties or personnel should be considered, such as hose inflation kits or a safety boat.

Safety officers for the management of tethers or lines

If watercraft or personnel are tethered, trained personnel should manage any lines or tethers in use. They should be positioned at a point of relative safety, considering the requirements of the rescue.

Appointed safety officers should perform checks of equipment and personal protective equipment (PPE), confirm communication signals, hazards, control measures and any expected tasks. Safety officers should ensure that the clean line principle is maintained throughout the rescue. For more information refer to Clean line principle: Working near, on or in water.

Any member of personnel managing a line should always have a clear line of sight to the tethered member of personnel or personnel in the watercraft and maintain verbal or visual communication with them.

Controlling hazards entering the area of operations

Members of the public, including swimmers, divers and those using vessels, may be unaware of operational activity. They may affect search and rescue activities or endanger personnel, casualties and themselves. Moving vessels can also cause water movement, making searching and rescues more difficult.

To provide a safe working environment, spotters should be positioned a suitable distance from the area of operations so that they can inform personnel of potential hazards entering the area. They

may also need to stop members of the public from entering the area while a water search or rescue is in progress. When positioning spotters, consider the speed of flow and physical restrictions of the location, to allow the best opportunity for early identification and communication of hazards.

Control of cordons

It may be necessary to appoint a safety officer to ensure that the cordons are maintained and that the personnel operating within the cordons are wearing the necessary PPE in line with the identified risks, such as unstable riverbanks and unguarded hazards.

The cordons may need to be extended or reduced, following a risk assessment. The safety officer should monitor the situation and make recommendations for changes to the incident commander. The safety officer should also ensure personnel are kept advised about any changes to the cordons. For more information refer to Cordon controls: Water rescue.

Strategic actions

Fire and rescue services should:

- Provide equipment suitable for establishing safety systems at water incidents

Tactical actions

Incident commanders should:

- Consider appropriately deploying adequate safety officers at water rescue incidents
- Consider using safety systems when carrying out water rescues
- Appropriately restrict members of the public from entering the area of operations while a water search or rescue is in progress

Hazard - On-site machinery: Water management systems

Hazard Knowledge

Water management systems are the various types of on-site machinery used to stabilise channels and manage water levels. The systems are used to:

- Manage flooding
- Maintain water supplies for irrigation
- Impound water for navigation
- Control levels up or downstream of the system for ecological or other purposes

Water management systems include:

- Sluices
- Weirs
- Pumping stations
- Locks

Individual features may appear in isolation, especially static weirs, but usually form part of a system of water management features. Locks or channels that bypass the system are normally found where structures prevent navigation of the main channel.

When these systems are activated or in use, they may create movement of water that can produce a range of hydrological hazards. For more information refer to Hydrological hazards.

Locks are structures that allow vessels to navigate a channel. Although lock gates are operated either manually or automatically by someone on site, it is possible for them to move as water pressure changes. This occurs if the gates have not been secured properly, have been poorly maintained or due to a failure in the system. Guillotine gates are used to reduce pressure to allow lock gates to open; these can release water, which can form strong currents.

The Canal & River Trust website provides more information about lock gates and canals.

Pumping stations manage water levels between two separated bodies of water, for example, a drain or dyke and a river. The size and design of pumping stations vary greatly, but most operate using an impeller system protected by a weed screen, with secure hatches to prevent entry. Impellers may operate with little or no warning and will almost immediately achieve a hazardous velocity. The volume of water moved can be substantial, creating hazards upstream and downstream of the system. An upstream pull towards a filter designed to safeguard operating equipment can generate enough pressure to pin or trap a casualty or rescuer, similar to a strainer in fast-flowing water.

Sluices and weirs may be fixed in position but can often be lowered or raised, changing level depending on local requirements or weather conditions. Weirs are man-made features designed to

regulate the flow of water downstream. The regulation of water can create increases in speed and dangerous currents. Changing levels can cause the formation of undertows, hydraulics or recirculations downstream of a weir.

A person or object in the water may be drawn towards the face of the weir and forced under the surface. Depending on the design and the presence of undercutting, a person caught in a recirculation may be flushed out further downstream or held below the surface. The recirculating water may also hold a person within it.

Sluices operate in a similar manner to weirs but allow water to run underneath rather than over the top of the gate. Changes in position and conditions created are harder to identify and are likely to be submerged. Sluice gates restrict flow by allowing the release of water below the surface, which can create dangerous eddies, unseen recirculation, siphons and undertows.

Activation of water management systems

Water management systems may be fixed, or operated manually, automatically or remotely. Activation of automated systems can be based on water level triggers, timed or seasonal programmes. Any decrease or increase in water levels will affect the flow and hydrology of a body of water. Decreasing or increasing flow rates can be hazardous, as unexpected hydrological features may form. When water levels decrease, submerged objects may come closer to the surface and the risk of entrapment may increase. Any risk assessment of a water management system is time-limited. Changes in water levels and operation of the system will change the hazards associated with the system.

Although systems may have visual or audible warnings when activated, it is common for no activation warning to be given. Changes in conditions may not be evident, for example, a sluice gate raised incrementally may not be obvious, but conditions may change significantly enough to prohibit entry into an area that was previously assessed to be safe.

Control measure - Safe system of work: Water management systems

Control measure knowledge

When attending incidents on canals, all lock gates and paddles should be completely closed before any rescue attempt. Personnel should not attempt to open the lock gates or paddles to empty the lock as releasing the water can result in strong currents and turbulence downstream.

Personnel should not work in the water near a lock gate without first taking control of the gates, unless there is a threat to life. Where possible, an exclusion zone should be established around the lock gates and paddles. Access to the lock should be via the fixed raking ladder. Mud and silt will be present on the canal bottom and lock walls.

Any attempt to drain the lock should consider the potential of trapping the casualty. A 50mm gap will create sufficient pressure to pin a person.

Personnel should not enter the operating areas of the pumping station unless confirmation that isolation has been achieved is received from a responsible person. Any related machinery including weed screen cleaners should be isolated prior to a rescue attempt.

Weirs and sluice gates vary greatly in their potential for harm. Personnel should avoid entering these features unless a well-informed risk assessment identifies that it is safe to do so, with appropriate control measures in place.

Fire and rescue services should identify appropriate means of rescue, control measures and exclusion zones for water management systems in their area. It may be beneficial to participate in joint on-site training and exercises to provide personnel with a better understanding of water management systems.

Isolate water movement and holding systems

Automated water management systems may have on-site isolation switches or control panels. To prevent public access, they are usually in a secure location. Activating these systems may affect hydrology in unexpected ways and the effects will vary with levels and speed of flow. Activation will also affect areas remote from the system, including the potential to cause flooding or damage to vessels located up or downstream. Activation should only ever be considered with the permission and advice of the managing agency.

Personnel should not enter an area where there is a water management system until confirmation has been received of its isolation.

For more information refer to Utilities and fuel: Isolate power supplies for on-site machinery.

Specialist advice

Water management systems are usually operated by either an environmental agency, canal trust or an internal drainage board. Contact details for engineers and responsible persons for water management systems should be displayed nearby. Fire and rescue services should maintain a record of managers of known water management risks and their contact details as appropriate.

GOV.UK provide information about river level and strong stream warnings for certain areas and

rivers. This includes warnings of increased activation of water management systems.

Strategic actions

Fire and rescue services should:

- Identify potential locations for water management systems and establish safe systems of work where required
- Establish methods of identifying and sharing information on water management systems
- Establish protocols with responsible bodies for the isolation and control of water management systems
- Consider participating in joint on-site training and exercises to provide personnel with an understanding of water management systems

Tactical actions

Incident commanders should:

- Consider taking control of lock systems when working near or rescuing casualties from water management systems
- Liaise with the responsible person to isolate or control the water management system
- Establish an exclusion zone to restrict access around lock gates and paddles until control of the gates is confirmed
- Establish an exclusion zone to restrict access to an area with a water management system until isolation has been confirmed
- Consider obtaining strong stream warnings to identify the likelihood of system activation