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Department
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Fire and Rescue Authorities Operational Guidance

GRAs
generic risk assessments

GRA 2.1.1
Rescue from sewers

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Generic Risk Assessment 2.1.1

Rescue from sewers

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SECTION 1

Generic Risk Assessment 2.1.1 Rescues from sewers

Scope

This generic risk assessment examines the hazards, risks and controls to fire and rescue personnel, personnel of other agencies and members of the public when undertaking rescue activities in sewers.

Generic Risk Assessment 2.1 *Rescues from confined spaces* consists of four intrinsic assessments that deal with specific activities involving rescues from confined spaces:

- 2.1.1 sewers
- 2.1.2 silos
- 2.1.3 trenches/pits
- 2.1.4 collapsed structures.

This assessment examines only those hazards, risks and controls that are specific to incidents involving rescues from sewers and similar underground water systems. Although this generic risk assessment focuses on rescues from sewers its contents are applicable to rescues from any underground pipe work eg dry docks, fresh water trunk mains, underground reservoirs, sewage pumping stations (known in the industry as wet wells) and sewers under construction. It should be read in the context of Generic Risk Assessment 2.1 *Rescues from confined spaces* that provides information relating to Fire and Rescue Authorities work in confined spaces.

Fire and Rescue Authorities must conduct their own assessments and produce their own safe systems of work (which include standard operating procedures, training programmes, provision of equipment, levels of response etc) within the context of integrated risk management plans, local conditions, knowledge and existing organisational arrangements.

Significant hazards and risks

‘Sewer’ is a generic term for pipework, usually sub-surface, that carries foul water ie domestic, industrial and other waste. The size of sewers can range from a small 150mm pipe from households, to a tunnel large enough for a person to stand erect in. Many

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sewers also carry surface water from roads but in the last 20 years a twin pipe system has been used to ensure that sewerage works are not overloaded during periods of heavy rain.

To carry out a rescue from a sewer it may be necessary to effect an entry. In addition to those hazards identified in Generic Risk Assessment 2.1 *Rescues from confined spaces*, personnel entering sewers may be at risk of serious injury from the following hazards that are specific to rescues from sewers:

Types of rescue incidents associated with sewers include:

- falls from internal ladders – on to platforms or projections
- falls from external surface – to the base of the sewer or an intermediate level
- entrapment in the product – the casualty may be partially or fully submerged
- entrapment in sewer from collapse or entrapped in machinery or pumping equipment
- casualty overcome by fumes/hazardous material
- casualty unable to make unaided egress.

Falls from height

There is a risk of personnel or equipment falling from:

- the vertical shaft of the sewer access
- between different sewers separated by a vertical shaft
- one sewer to another at a 'T' junction.

In addition to the injuries that may be sustained by the individual or damage to equipment that results, there is the danger of equipment striking the casualty or other service personnel. The integrity of fixed access ladders must be carefully examined before use.

Internal conditions

Due to the nature of construction of sewers, access in many cases is extremely limited and natural lighting is virtually non-existent. Both of these factors increase the risk of injury to personnel, when gaining access to and moving around inside the sewer. Once inside the sewer, complex layout, hazardous conditions and difficult egress increases the risk of disorientation and the psychological stress on personnel.

The presence of water/sewage/oils increases the risk to personnel from slipping, tripping and falling. The hazards and control measures relating to personnel moving around in surface water are discussed in Generic Risk Assessment 2.4 *Flooding and water safety*. In older sewer systems there is a risk that the lining of the sewer itself will collapse onto personnel.

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Sluice gates/wet wells

Sluice gates are physical barriers that are usually operated automatically by fluid pressure or controlled remotely for flood control to prevent back-wash. They are intended to direct or divert flow usually at tunnel intersections.

They may become a hazard due to:

- being inoperative or jammed allowing water to enter the area or compartment of the casualty
- being damaged or unstable and striking any casualty or fire and rescue personnel
- being opened/closed inadvertently.

Sewage wet wells or lift stations are locations on the sewerage system where sewage is pumped from a lower level to a higher one, usually using a submersible pump. Sewage flows under gravity and the sewage has to be pumped to a higher level to continue the flow. The risk occurs when the wet well chamber is entered.

Atmospheric conditions

The waste carried in sewers may result in the atmosphere being:

- toxic (eg presence of hydrogen sulphide H₂S)
- explosive/flammable (eg presence of methane CH₄)
- oxygen deficient (caused by certain micro-organisms).

If there has been a pumping failure there may also be a considerable amount of organic material that will have been there for some time that may lead to the production of significant amounts of hydrogen sulphide if it is disturbed.

Oxygen deficient atmosphere

A reduced through flow of 'fresh' air due to a lack of natural ventilation or insufficient air currents from sewerage movement (blockage or pump failure) can lead to higher concentrations of other gases (asphyxiants) resulting in an oxygen deficient atmosphere. The operation of equipment, such as internal combustion engines, in or near the opening may not only use up oxygen from the air but also produce exhaust gases, such as carbon monoxide, which can accumulate in the opening.

Biological and chemical hazards

The presence of human waste increases the risk of infection eg gastroenteritis, Weil's disease, hepatitis A and B etc. This risk is further increased in areas where hypodermic needles and other 'sharps' have been discarded in the sewer system.

The presence of rodents and other vermin presents the risk of personnel suffering animal bites and contracting zoonosis, such as leptospirosis (Weil's diseases).

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There are additional risks from chemicals in the effluent which have been introduced illegally/accidentally; this may include substances such as:

- corrosive materials
- fuels oils
- solvents
- paints
- other flammables.

There is an immediate risk of personnel suffering the harmful effects of direct contact with contaminated effluent. In addition the presence of such substances in any quantity is liable to alter the atmosphere within the sewer (eg some volatile substances will readily deplete oxygen levels).

Manual handling

At sewer rescues there is a heightened risk of musculoskeletal injuries to personnel resulting from:

- restricted access
- poor lighting
- bulk and weight of casualty/equipment
- difficult/restricted access, egress and movement within the sewer
- internal conditions ie dark, slippery, wet
- general lack of space to operate/set-up equipment.

Fatigue

Personnel involved in sewer rescues may have to climb a number of vertical ladders and travel through restrictive tunnel systems in extreme temperatures before reaching the scene of operations. This may lead to cases of exhaustion, collapse or impaired judgement.

Weather conditions

The hazards and risks within sewers will be exacerbated by the depth and flow of water that can be subject to rapid change causing potential fatal 'flash' flooding. Conditions that will precipitate flash flooding include:

- an increase in temperature producing melt water
- storm events
- remote rainfall within a wide catchment area
- localised flooding of surface water systems.

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Communications

Due to the complexity of design, depth and size of the sewer network, radio black-spots may be encountered which will result in poor communication between personnel inside and outside the sewer.

Moral pressure

At all incidents, on arrival of fire and rescue personnel, there will be a societal expectation from those directly affected by the incident for prompt action to resolve the situation and mitigate any damage or loss. Under such expectations fire and rescue personnel may attempt to carry out tasks before they have sufficient resources to safely do so. Any deviation from procedure must be justifiable in terms of risk versus benefit and based upon the Incident Commander knowing the actions which are normally required as part of operational procedure.

Key control measures

Planning

Planning is key to enhancing the safety of firefighters and others likely to be affected by Fire and Rescue Authority operations. Each Fire and Rescue Authority's strategic plans will set standards and identify the resources required to ensure safe systems of work are maintained.

Duty holders must make adequate arrangements for recovery/recovery of employees in difficulty. The duty holders risk assessment must take account of foreseeable events based on known hazards, risks and experiences of their sector.

Each Fire and Rescue Authority must assess the hazards and risks in their area relating to this generic risk assessment. The assessment must include other Fire and Rescue Authority's areas where 'cross border' arrangements make this appropriate.

Site-specific plans must be considered for locations where the hazards and risks are significant and plans must take into account and specify any variation from the normal operational capability of personnel, appliances and equipment. In particular, recognition must be given to the physical and psychological pressures that an operational incident may apply to fire and rescue personnel.

Site-specific plans must include:

- levels of response
- relevant standard operating procedures
- tactical considerations, including rendezvous points, appliance marshalling areas and access points
- identification and where necessary, the formal notification to person(s) responsible for the site of any Fire and Rescue Authority operational limitations

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- location of main access points
- any specialist advice or equipment available on site and remotely.

Other useful information:

- diameter of entry points/depth of shaft/anchorage points etc
- the direction or variation of flow in tunnels
- any known radio dead space
- effects of local weather ie storm events, tidal activity
- location and type of air pressure vents if any
- arrangements for monitoring and warning of severe weather conditions.

Good liaison between Fire and Rescue Authorities and the relevant water and drainage authority is important. Authorities must ensure, by regular contact, that they have full and up to date details of any sewage tunnel large enough for workers to enter. Arrangements must be made for the attendance of water company representative in any emergency situation involving sewer rescues.

Fire and Rescue Authorities must use appropriate standard systems of work, training, supervision, equipment and specialist personal protective equipment to ensure the safe operational conclusion of these types of incidents. Authorities must undertake debriefs as appropriate feeding any significant learning points back into the development of the standard system of work, training programmes and equipment procurement.

Fire and Rescue Authorities must identify equipment suitable for use during sewer rescues eg safety and rescue harness, hoists, explosive meters, gas analysers, air monitoring equipment, intrinsically safe and waterproof lighting/communications equipment and decontamination showers. The full implementation of fire and rescue procedures requires breathing apparatus to be worn when entering sewer workings.

Planning is underpinned by information gathering, much of which will be gained through inspections or visits by fire and rescue personnel – for example, those covered by section 7(2)d and 9(3)d of the *Fire and Rescue Services Act 2004*.

Information must also be gathered and used to review safe systems of work from sources both within and outside the Fire and Rescue Authority, including:

- incident de-briefs
- health and safety events
- local authorities
- local resilience forum.

Involving others in planning is an effective way to build good working relations with partner agencies and other interested parties, such as site owners.

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Fire and Rescue Authorities must ensure systems are in place to record and regularly review risk information and to ensure that new risks are identified and recorded as soon as practicable. The *Fire and Rescue Service Operational Guidance – Operational Risk Information*¹ provides further information on this subject.

Fire and Rescue Authorities must ensure that the information gathered is treated as confidential, unless disclosure is made in the course of duty or is required for legal reasons.

Fire and Rescue Authorities must consider the benefits of using consistent systems and formats to record information from all sources. Consideration must also be given to how timely access will be provided to inform and support operational decision-making.

Information needs will vary in proportion to the size and nature of the incident. The capacity of fire and rescue personnel to assimilate information will vary in relation to the complexity of the incident. Therefore, arrangements may need to be flexible and be based on more than one system.

Further guidance on planning can also be found in the Operational Risk Information manual referenced above.

Pre-determined response/attendance

Fire and Rescue Authorities must ensure that the operational response to an incident would be sufficient to allow the relevant standard system of work to be implemented. A task analysis of the various scenarios at this type of incident will enable a Fire and Rescue Authority to plan an effective response. This together with any known site-specific information will provide a risk based assessment of the pre-determined response/attendance. As part of the planning process the pre-determined response/attendance may also include the need for: specialist vehicles, equipment, teams (urban search and rescue), techniques and assistance from other agencies.

Competence and training

When formulating a competence and training strategy a Fire and Rescue Authorities must ensure:

- specific risk assessments for this incident type are suitable and sufficient
- those tasked with carrying out the assessment and developing procedures are competent to do so
- that their personnel are adequately trained to deal with hazards and risks associated with the generic risk assessment
- that the level and nature of training undertaken be shaped by an informed training needs analysis that takes account of Fire and Rescue Authority guidance on the competency framework, national occupational standards and any individual training needs.

¹ www.gov.uk/government/uploads/system/uploads/attachment_data/file/5914/2124406.pdf

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Training and development programmes must:

- Follow the principles set out in national guidance documents
- Generally be structured so that they move from simple to more complex tasks and from lower to higher levels of risk typically cover standard operational procedures. As well as ensuring knowledge and understanding of equipment and the associated skills that will be required to use it
- Consider the need for appropriate levels of assessment and provide for continuous professional development, to ensure maintenance of skills and to update personnel whenever there are changes to procedure, equipment, etc
- Involve personnel involved in other processes that support the emergency response, such as planners devising procedures and people procuring equipment.

Training outcomes must be evaluated to ensure that the training provided is effective, current and meets defined operational needs as determined by the Fire and Rescue Authority's integrated risk management plan.

Specific training requirements for rescues from sewers will include the standard operating procedure and the equipment to be used.

Site-specific tactical exercises must be undertaken with other agencies or staff likely to assist at an actual incident.

Specific training for sewer incidents must be undertaken to familiarise and train operational personnel for conditions which may be encountered at such sites. The level of training provided must be appropriate to the role expected of personnel responding in accordance with the pre-determined response/attendance.

Fire and Rescue Authorities must have arrangements in place to ensure the continued competence of those personnel who are liable to attend such incidents. This must take account of input from local water companies where possible.

In some locations the Ambulance Service provides the Hazardous Area Response Team. This team is capable of supporting Fire and Rescue Authorities with casualty assessment and care in the hazard zone of an incident. Where appropriate, Fire and Rescue Authorities must make arrangements to train with these teams.

Fire and rescue personnel must take part in a regular programme of practical training which includes:

- breathing apparatus technical bulletins
- working in confined spaces
- working in darkness
- sewer simulator work
- crawling galleries
- command and control exercises

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- the use of breathing apparatus
- the use of forward control points and bridgeheads.

The provision and use of equipment

Consideration must be given to the provision, use and maintenance of equipment that minimises personnel injury whilst gaining access to sewers through maintenance/inspection covers or manholes and via vertical shafts. Specialist equipment may include:

- quad/tri/bi pod
- personal harnesses
- fall arrest/restraint systems
- high level anchorage points
- winches
- atmospheric monitoring equipment.

Fire and Rescue Authority 'tested' equipment must be used as a priority, however, on-site 'specialist' equipment could be used after liaison/assessment by the Incident Commander. The integrity of fixed access ladders must be carefully examined before use.

Approach/cordon

Consideration must be given to vehicle marshalling and a holding area/rendezvous point at the earliest opportunity. Enhanced precautions and illumination will be a necessity at night, an inner cordon must be established (high-risk area). Where there is a fall potential exclusion zones must be implemented, personnel required to work within 3m of an unprotected drop must use a restraint system to control the risk of falls.

Non-essential emergency service personnel must be moved outside the inner cordon. The Incident Commander must liaise with the police to ensure that police control or divert traffic away from the incident.

Access/egress

Access and egress must be controlled via an identified route. Consideration must also be given to the use of a system to log personnel in and out of the risk area. All crews must be briefed prior to entering the inner cordon; personnel entering the sewer must be fully briefed on their task, evacuation procedures, hazards and controls. The number of personnel entering the sewer must be kept to the minimum required to safely conduct the rescue or render first aid.

Command and control

The Incident Commander must follow the principles of the current national incident command system. Prior to committing personnel into any hazard area, the Incident Commander must take account of the actual information available regarding the incident at the time. This will assist them to make effective operational decisions in what are recognised as sometimes dangerous, fast moving and emotionally charged environments.

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On arrival at the incident, the Incident Commander must liaise with any on-site teams, assess the situation and act accordingly. If there is no likelihood of saving life then the level of urgency will be reduced. A thorough safety brief prior to deployment of personnel within the hazard zone must be carried out.

Usually the Incident Commander will be able to seek advice from a member of the drainage/on-site team at the incident, who can give advice and information on what/who is involved, rate of flow of effluent, the best access point/s for rescue teams, available site plans etc.

The maintenance/manholes or access covers immediately beyond and behind the point of an incident must be opened up at an early stage to provide ventilation and give alternative egress from the sewer.

The area at the top of a sewer must be well lit before personnel are allowed to enter this may be augmented with portable lighting or hand lamps. Intrinsically safe lighting must be used where possible with generators well away from the access/ventilation points.

Communications

For all practical purposes there is no penetration of the surface by any of the frequencies used in normal above surface communications. These frequencies will only propagate through air and thin walls. The energy is absorbed very quickly by other media such as rock, brick or water, this may also cause problems for breathing apparatus telemetry systems.

A means of intrinsically safe communication must be established between: personnel working in the sewer, those at the surface, and with the Incident Commander. The entry point to the sewer system must be attended at all times. A breathing apparatus wearer must also remain at the foot of the entry shaft to aid communications between the breathing apparatus team and the surface and where possible, efforts must be made to ensure a line of sight is maintained with personnel working in the sewer.

Operational considerations

Work by breathing apparatus teams is likely to be protracted and difficult and the use of air is likely to be excessive, with the possible risk of wearers misjudging their exit times. Crews must be reminded of the importance of frequently checking the breathing apparatus cylinder contents gauge.

The weight of the equipment and any casualties may be such that they constitute an excessive load for personnel to lift. Consideration must be given to the use of a mechanised hoist or pulleys during lifting operations.

The water and drainage authority will be able to provide the Incident Commander with information as to the likelihood of increased flow rates due to inclement weather, melt water and peak usage times. Constant monitoring of the flow rate by rescue personnel will enable the Incident Commander to make a decision to either continue with operations or

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evacuate the sewer, the use of the 'Firemet'² weather system may also be of assistance. Consider asking the sewer operator if it possible to close sluice gates to reduce/stop/divert the flow from the sewer during rescue operations.

Safety Officer(s)

The early appointment of one or more 'Safety Officer' will help ensure that risks are either eliminated or reduced to an acceptable level.

A safety decision-making model must be used to brief Safety Officers regarding the nature of the incident, the allocated task and prevailing hazards and risks. The Incident Commander must confirm that the Safety Officer understands:

- their role and area of responsibility
- allocated tasks
- lines of communication.

Those undertaking the Safety Officer role must:

- be competent to perform the role
- ensure personnel are wearing appropriate personal protective equipment
- monitor the physical condition of personnel and/or general or specific safety conditions at the incident, in accordance with their brief
- take any urgent corrective action required to ensure safety of personnel
- update the Incident Commander or senior safety officer regarding any change in circumstances
- not be engaged in any other aspect of operations, unless this is required to deal with a risk critical situation.

The role of a Safety Officer can be carried out by any of the fire service roles, however, the complexity of the task, the size of the incident and the scope of responsibility must be considered by the Incident Commander when determining the supervisory level required.

Safety Officers must wear nationally recognised identification to indicate they are undertaking the Safety Officer role.

Safety Officers will raise the alarm with the agreed evacuation signals; this signal must be recognisable from other ambient sounds. All personnel present, including works personnel and other emergency service personnel, must understand the evacuation signal and the actions to be taken when it is sounded.

Fire and Rescue Authorities must ensure that training and other measures (such as aide-memoires) are in place and available to support those staff liable to undertake this role.

² FireMet is a weather system designed to provide fire and rescue responders with the latest weather information to help them identify a safe approach when dealing with a major incident.

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Personal protective equipment

Fire and Rescue Authorities must ensure that any personal protective equipment provided is fit for purpose and meets all required safety standards. When choosing suitable protective garments, the standard of clothing worn beneath the specialist personal protective equipment must also be taken into account. Consideration must also be given to the selection of suitable sizes and gender specific requirements of personal protective equipment.

Personal protective equipment must also take account of the need for rescuers to be visible against the operational background including night working and for the Incident Commander and other managerial and functional roles (defined in the national incident command system) to be distinguishable.

Sewage can be made up of both known substances (legitimate waste from households and permitted waste from industries) and unknown substances (chemicals, oils etc from households and industries introduced illegally).

Precautions to prevent contamination:

- standard firefighting uniform including breathing apparatus and gloves will 'normally' provide adequate protection, specific risk assessments may dictate an increased level of protection
- prior to working in possibly contaminated environments, cover any cuts and abrasions with waterproof adhesive dressings
- avoid hand contact with eyes or mouth prior to washing hands and forearms
- ensure contaminated clothing and the affected areas are cleaned in accordance with the relevant Fire and Rescue Authority procedures.

Crew welfare

Working conditions for this type of rescue may be difficult and the nature of the tasks may be arduous, therefore the Incident Commander must make suitable arrangements for rotation or resting of crews and the early provision of relief crews.

Personal hygiene arrangements must be established (eg for washing hands) before undertaking the provision of refreshments. In cold/inclement weather and at protracted incidents it may be necessary for additional welfare and food to be provided.

Firefighters must also pay close attention to personal hygiene. It is, therefore, imperative that all personnel are prohibited from eating, drinking and smoking at sewer incidents unless a clearly defined clear area for washing and welfare is set-aside solely for that purpose. When washing at the incident or on return to the station personnel must pay particular attention to nails, between fingers etc.

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Decontamination

Arrangements must be made on-site to allow the cleaning/decontamination of boots, gloves and fire-kit. If items cannot be sufficiently cleaned at the incident additional/specialist cleaning must be established in accordance with existing Fire and Rescue Authority decontamination procedures.

Post incident

The following measures must be considered to help eliminate or remove risks after an incident, as appropriate to its nature and scale:

- Record any safety events; personal injuries, exposure to hazardous substances or near-misses. These must be investigated and reported in line with current Fire and Rescue Authority procedures.
- Put in place arrangements to either remove all contamination from personal protective equipment or to ensure it's safe and appropriate disposal and to check that personal protective equipment maintains the agreed levels of integrity and protection for the wearer throughout its lifecycle.
- As appropriate, ensure occupational health support and surveillance follow up.
- Conduct a de-brief to identify and record any 'lessons learned' from the incident. De-briefs will range in complexity and formality, proportionate to the scale of the incident and in line with individual Fire and Rescue Authority's procedures.
- Consider any changes required to safe systems of work, appliances or equipment in the light of any lessons learned from debriefs or from safety events. Where these are likely to impact on other Fire and Rescue Authorities procedures then information must be relayed through the appropriate channels to ensure learning from incidents is shared with the wider fire and rescue community.
- Consider the need to review existing information held on a premises or location, or the need to add a new premises or location into future preplanning eg by adding to visit or inspection programme.
- Support and monitor staff to identify whether they are experiencing any adverse affects and to check whether they would benefit from accessing counselling and support services.
- Consideration must be given to arranging for staff to make a contemporaneous written record of their actions. This information may be used to assist in any internal or external investigations or enquiries that follow any incident eg Coroner's Court, public enquiry, etc.

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Technical references	
1	Home Office Guide to Operational Risk Assessment
2	The Confined Spaces Regulations 1997
3	HSE Operational Circular 334/5 Confined Spaces and the Fire Service
4	Generic Risk Assessment 2.1 Rescues from confined spaces
5	Home Office Technical Bulletin 1/97 Breathing Apparatus
6	Manual Volume 2, Fire Service Operations, Safe Work at Height, 2006
7	Fire Service Manual Incident Command
8	DCO/L 1/1998 Safe work in confined spaces
9	2/2005 Physiological assessment of firefighting, search and rescue in the built environment
10	1/2005 Operational physiological capabilities of firefighters: literature review and research recommendations
11	Health and Safety Executive Guidance Safe Work in Confined Spaces 09/11
12	Approved Code of Practice, Regulations and guidance L101
13	Health and Safety Executive Guidance Working with Sewage 02/96
14	Manual Handling Operations Regulations 1992

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SECTION 2
Summary of Generic Risk Assessment 2.1.1

Rescues from sewers

Task – Pre-incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
1.0	Training for sewer incidents	Training in realistic conditions	Entrapment Muscular skeletal injuries Heat stress/syncope Asphyxiation	Fire and rescue personnel	All Fire and Rescue Authority training to be carried out in accordance with current Fire and Rescue Authority guidance Consider mechanical lifting systems for casualty rescue Drill mannequins to be as casualties Monitor sewer atmosphere before training and during training period.
1.1	Planning	Inadequate preparedness for operational incident	Major injury if not carried out	Fire and rescue personnel Public Personnel from other agencies	Fire and Rescue Authority to gather information; liaise with industry; and record appropriate information, plans etc Fire and Rescue Authority to ensure crews and Incident Commanders are adequately trained and competent and undertake regular training and exercises for sewer risks in their area Fire and Rescue Authority to ensure suitable standard operating procedures are in place; current, and regularly reviewed.

Task - Initial stages of the incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.0	Gaining access/egress to sewer	Working at height, slippery surfaces	Slips, trips and falls on level and from height, collisions, unable to get out – serious injuries/death	Fire and rescue personnel Personnel from other agencies	Maintain controlled access/egress and supervision at all times Liaise with on site agencies/relevant water and drainage authority Request on site plans Ensure crews briefed Consider aerial appliance for access and egress Establish evacuation plan and ensure all personnel are aware Secure personnel with lines/harnesses Illuminate as required Appropriate personal protective equipment.
2.1	Gaining access/egress to sewer	Working at height	Falls into opening – physical injury, death	Fire and rescue personnel Personnel from other agencies	Establish and identify cordons Strictly monitor personnel entering cordon Clearly identify sewer entry points Brief crews Adequately lit with appropriate lighting Commit minimum personnel only (avoid if possible) Provision and use of suitable working at height equipment.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.2	Attending sewer incidents	Vehicular traffic	Collision/trauma injuries	Fire and rescue personnel Personnel from other agencies	Establish cordons Use of police for traffic control, road closure etc.
2.3	Casualty rescues	Protracted working in difficult conditions	Fatigue/stress	Fire and rescue personnel Casualties Personnel from other agencies	Crew selection Appropriately trained and supervised teams of firefighters Identify relief crews early into incident Appoint Safety Officer(s) Supervise and monitor Correct selection of personal protective equipment allowing for ambient conditions Provide welfare facilities.
2.4	Casualty rescues	Fatalities, stressful occurrences	Post traumatic stress Anxiety	Fire and rescue personnel Casualties Personnel from other agencies	Critical incident debrief Welfare, support and counselling, health surveillance.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.5	Casualty rescues	Manual handling/ manual labour	Musculoskeletal injury	Fire and rescue personnel Personnel from other agencies non-service personnel	Use mechanical aids where possible (hoists, harnesses, stretchers) Crew selection Supervision Crew rotation Use approved manual handling techniques Provide people moving manual handling training.
2.6	Working in the sewer	Poor illumination	Slip trip and falls, collisions, injury and death	Fire and rescue personnel Personnel from other agencies non-service personnel Casualty	Supplement with appropriate portable lighting or hand held lamps Consider the need for intrinsically safe lighting early into incident Request additional resources.
2.7	Working in the sewer	Hazardous materials (biohazards, sewage, effluent)	Infection by pathogen, poisoning	Fire and rescue personnel Personnel from other agencies non-service personnel Casualty	Carry out atmospheric monitoring Ventilate Appropriate personal protective equipment/ respiratory protective equipment Use breathing apparatus Decontamination and hygiene procedures in place Resuscitation equipment for casualty Establish strict hygiene arrangements ie eating, drinking etc Appoint decontamination officers.

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
2.8	Working in the sewer	Oxygen deficient/ irrespirable, noxious, Toxic, flammable atmospheres	Asphyxiation, fire, explosion, burns, death	Fire and rescue personnel Personnel from other agencies Non-service personnel Casualty	Cordon off, and control area Regular atmospheric monitoring Ventilation Establish and maintain intrinsic safety Appoint safety officer Open up other covers in the area.

Task – As the incident develops

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
3.0	Casualty rescues	Lifting and lowering casualties	Muscular skeletal injuries	Fire and rescue personnel Personnel from other agencies Casualty	Consider mechanical lifting systems for casualty rescue.
3.1	Working in the sewer	Exposure of crews to extreme working environments	Exhaustion; heat stress, heat syncope	Fire and rescue personnel	Reduce crew exposure time, consider relief crews. Make hydration available to crews when withdrawn from the incident Consider requesting specialist technical rescue teams where available (urban search and rescue).
3.2	Working in the sewer	Exposure to hazardous substances	Infection contamination or poisoning	Fire and rescue personnel Casualties	Incident Commander to deploy Safety Officer(s) Record any exposure to hazardous materials.

Task – Post incident

Ref. No.	Activity	Hazard	Risk	Persons at risk	Control measures
4	Post incident de-brief	Exposure to extreme working environments	Post traumatic stress disorder	Fire and rescue personnel Public Other agencies	Fire and Rescue Authority to make counselling services available Critical incident debrief Welfare, support and counselling, health surveillance.