National Operational Guidance

Ecology and environmental science

This section outlines some basic concepts of environmental science, pollution studies and ecology relevant to fire and rescue service (FRS) personnel; a basic understanding of these subjects and their interrelationships will provide them with some of the tools necessary to prioritise environmental protection activities.

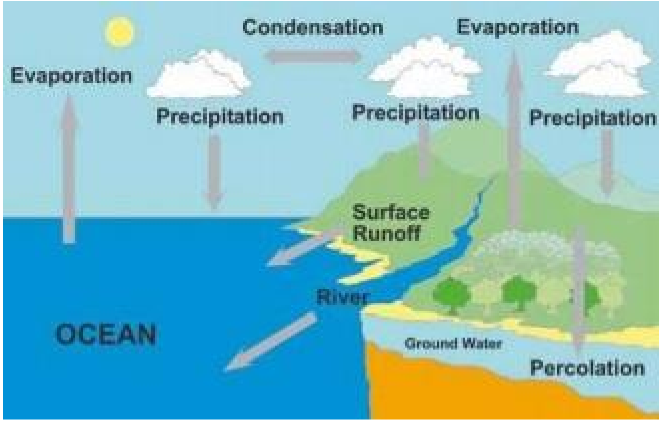
Environmental science

There are three relevant underlying natural laws of physics: the law of the conservation of matter; the first law of thermodynamics; the second law of thermodynamics.

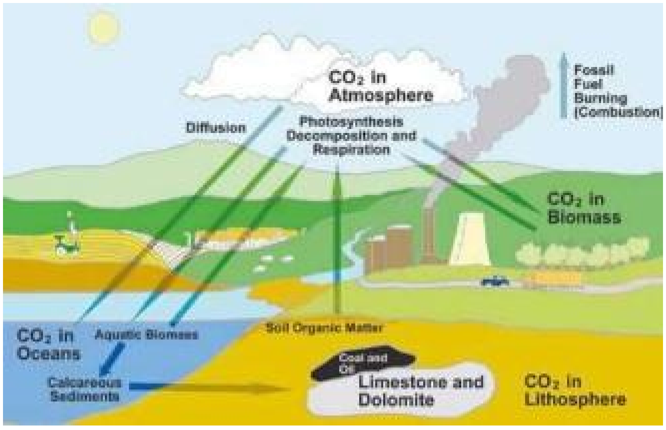
Where is ‘away’?

The law of the conservation of matter states that no atoms are created or destroyed; there is no such thing or place as ‘away’ (Dr Anne Miller 2001). So, when waste is thrown, flushed, washed or otherwise taken ‘away’, it merely ends up at another location.

On a global scale, material continually cycles around the global system; this is known as biogeochemical cycling. The images below show how water and carbon move around the globe. If pollution of the water or air occurs in one part of the world, it can affect others. Examples include acid rain, ozone depletion and concentrations of chemicals such as Perfluorooctanesulfonic acid (PFOS) in the environment. Emissions of greenhouses gases such as Carbon dioxide (CO2) into the atmosphere is another example which is leading to impacts such as climate change and the acidification of the seas.



The water cycle



The carbon cycle

If waste or pollution is created it will always take a lot more energy to clear it up once it becomes dispersed than if it can be contained when it is still in one place; for instance, on the surface of a highway on in highway drains, rather than dispersed in a river or groundwater. In some cases, clean up may not even be possible or practicable once a pollutant has entered the environment. Containment as close to the source as possible is therefore the best approach and is the basic principle behind the hierarchy of pollution control, see, Environmental protection operational strategies and techniques.

Ecology

The relationship between plants, animals and the environment is called ecology.

A simple way to view ecology is as a series of interconnected food chains. Each food chain is a linked series of living things, each of which is the food for the next in line in the chain. Pollution may destroy one or more components causing species higher up the food chain to starve or species lower down the food chain to overpopulate. Ecosystems consist of species within trophic levels or stages in a food chain These trophic levels can be divided into:

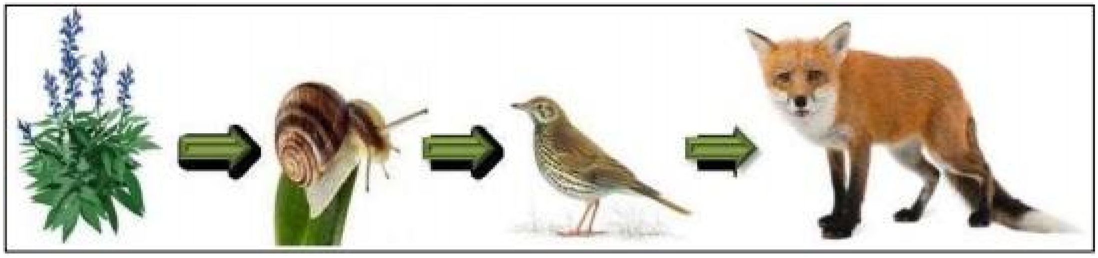
• Producers

• Primary consumers

• Secondary consumers

• Tertiary consumers

• Detritivores



A simple food chain

Producers

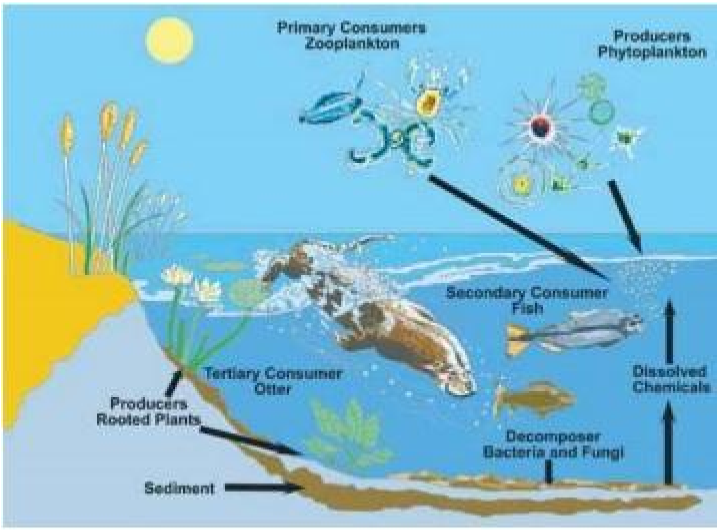
These are mainly plants with some bacteria and protists such as. Protozoa, which produce their own nutrients using sunlight. Should these organisms, which are sensitive to pollutants, be eliminated everything else would starve.

Consumers

Primary consumers or herbivores feed directly on living producers. Secondary consumers, or carnivores, feed on living primary consumers. Tertiary consumers, also carnivores, feed on living secondary consumers. Omnivores eat everything and so may be at any or all of these levels.

Detritivores, sometimes called decomposers, feed only on dead organisms and the waste products of living organisms, but eventually all the producers and consumers will end up in the detritivores area. They take in complex organic materials and break them down into simpler components, some of which they use, and others which they release into the environment. Eventually these simple components will become available to be taken up again by the producers, so completing the loop.

Most ecosystems are much more complicated than those described above since they contain some organisms that feed at different levels in different situations or at different stages of their lifecycle.



A simple aquatic food chain

Why it is important to protect the water environment

All living things need water to live. Rivers and lakes are fragile ecosystems that depend on water to be non-toxic, clear and containing adequate dissolved oxygen. Importantly for humans, we all depend on clean water for drinking water supplies. Clean water is also important for the watering of livestock the irrigation of crops and gardens and industrial and recreational uses such as fishing and bathing. Pollution of surface and groundwaters can impact on all these uses.

Pollutants are defined as anything that harms the environment. Water pollutants include not only chemicals, oils and pathogens but also organic materials, heat and suspended solids. Most of the major categories of pollutants are shown in the table below.

Pollutants released during fires, road traffic collisions and other emergency incidents can pollute air, land and water. FRS can take action to protect all of these in appropriate circumstances, but it’s usually the water environment that the FRS can protect most readily.

Incidents that threaten the water environment

The FRS deals with a variety of emergency incidents that may pollute the water environment. The safety of public and personnel will always remain the highest priority. But, protecting public and private drinking water supplies and the environment should still be prioritised.

In some circumstances it may be the actions of the FRS that cause the pollution or contribute to its severity, for example when foam is used as an extinguishing agent. In these circumstances, UK environmental law requires FRS to take mitigating actions see Environmental law for more information. Where the risk to the environment is high, incident commanders may decide on a course of action to reduce or eliminate environmental impact completely. Guidance on operational tactics designed to protect the water environment is available here.

FRS incident types with the potential to pollute the water environment

Incident type	**Effect**
Fires	Firewater run-off will be contaminated with products of combustion any firefighting agents used such as firefighting foam and any other pollutant that may be present which can dissolve in or washed be off site by the water used. If uncontrolled it may enter the drainage systems and then, surface or groundwater and or sewage treatment works. Smoke may also deposit pollutants contained within it when the plume grounds, from where it can be washed into the water environment when it rains. Or pollutants may be washed out of the plume itself by rainfall.
Road Traffic Collisions (RTCs)	Fuels, lubricants and fluids, such as cooling or brake fluids, may be released by the crash, along with any pollutants being transported

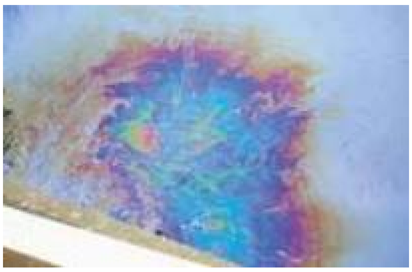
Incident type	**Effect**

Spillage or release	Incidents that involve the spillage or release of a material that harms the environment; these materials may include: • Hazardous materials • Eco-toxic – materials that are not classified as hazardous materials but are toxic to the environment such as inks, dyes or detergents • Organic materials – milk, beer or sewage • Inorganic materials – Silt, cement or sand

Spillages of oils and fuels are one of the most common sources of water pollution in the UK, causing approximately 10% of the total water pollution. Just half a litre of oil can cover an area of water equal to a football pitch. In England in 2017 there were 230 confirmed pollution incidents following an RTC. The figures do not take account of incidents where FRS actions prevented pollution.

The FRS attends around 250,000 fires each year and in England and Wales alone there are around 4,000 hazardous materials incidents and 10,000 incidents classified as spills and leaks (source www.gov.uk), many of which present potential and actual pollution to attending FRS personnel. This risk requires a common approach to environmental protection if we are to meet the aims of the EC Treaty, Article 6, to promote sustainable development (EC 1992).

A firefighter contains all on a roadway using a clay drain mat following a vehicle fire.



Iridescence by the outfall indicates that a small quantity of the oil has entered a nearby stream at the outfall from the road before the drain can be blocked.

Pollutant Categories

There is a very wide range of potential water pollutants which can be group into range of categories. See table below.

Categories of water pollutants

Acids and alkalis
Anions for example sulphide, sulphite, cyanide
Detergents
Domestic and industrial sewage effluent and sludge
Farm effluents, slurries and manures
Food and beverages including processing wastes and animal feeds
Firefighting foams and additives, for example flurochemicals
Gases taken into solution in water such as chlorine, ammonia
Heat

Leachate or digestate, this may be from landfill or anaerobic digestion plants
Metals such as. cadmium, zinc or lead
Nutrients especially phosphates and nitrates
Oil, mineral and vegetable, and oil dispersants
Organic chemicals for example formaldehydes, phenols
Pathogens
Pesticides
Polychlorinated biphenyls (PCBs) and other persistent substances
Radionuclides
Solvents
Suspended solids such as silts and sands

Some of the most common types encountered by FRS and their sources and impacts are described below

Organic pollutants

Organic matter includes:

- Agricultural wastes such as slurry and silage
- Blood
- Food and drink
- Sewage
- Substances containing organic materials including many fire foams

Although many of these pollutants are not in themselves toxic, they can still have serious indirect consequences. This is because rivers, lakes and other waterways are organic matter processing systems. Adding large quantities of organic matter disrupts the balance of the system.

Microbes process any organic matter spilt into a waterbody and their populations grow exponentially due to the extra food source. As the microbes increase, they consume more dissolved oxygen, reducing oxygen levels in the water. If enough organic pollutant is available, all the dissolved oxygen will eventually be used, and anaerobic conditions will arise. In such conditions most species of aquatic animals will die.

If anaerobic conditions persist, for example due to a continuous discharge of sewage, specialised microbes, called 'sewage fungus', will thrive. This appears as a grey filamentous growth in the water. A smell of bad eggs will usually be noticed. Some aquatic organisms are particularly sensitive to any reduction in dissolved oxygen levels, for example, stonefly and mayfly larvae, trout and salmon and will be affected detrimentally by small changes.

Over time, the organic matter is used up and disperses. River water re-oxygenates moving downstream as oxygen dissolves in from the atmosphere and from aquatic plant growth. The temperature and flow rate will influence how quickly this happens. Employing aeration or other pollution mitigation tactics such as the addition of hydrogen peroxide will speed up this process as well as keep aquatic life alive until dissolved oxygen levels in the river recover.

Organic Pollution incidents, such as milk can have serious but usually temporary effects on the local ecosystem. There impacts can be reduced by containing them at source on the roadway, by damming a stream or by aeration or use of hydrogen peroxide

Measuring organic pollution -Biochemical Oxygen Demand (BOD)

The 'oxygen sag' is an indirect measure of the amount of organic matter in a liquid. The biochemical oxygen demand (BOD) test is designed to quantify the amount of change imposed on the river by the entry of the particular organic substance. A measure of oxygen requirement will indicate the likely impact of an organic pollutant on the river.

This test provides a standard by which organic pollutants can be compared and it's used to monitor both river pollution and the effectiveness of treating organic materials before discharge into the water environment.

BOD values for different wastes and effluents

Typical BOD values	**(mg oxygen/l)**
Natural rivers	0.5–5.0
Crude sewage	200–800
Treated sewage	3–50
Poultry waste	24,000–67,000
Silage liquor	60,000
Dairy waste	300–2,000
Skimmed milkand cream	70000-40,0000
Brewery waste	500–1,300
Orange juice	80,000
Paper mill effluent	100–400
Typical firefighting foam concentrate	50,000-600000

Biological water quality testing

methods

An assessment of the number and type of living organisms in surface water can also be used to monitor organic and other forms of pollution such as heat or chemical pollution. These assessments are referred to as biological indicators.

Different organisms have different tolerances to low oxygen levels or pollutants. Using the presence or absence of particular organisms, visible with naked eye, pollution levels can be assessed by specialists. An ecologist moves across a river pushing a net over the riverbed. They can then identify and count the organisms caught in the net. The more sensitive the organisms present, the better the quality of water in the river.

Environment Agency officer sampling a river

Inorganic and organic toxic chemical pollutants include substances like metals and acids, and mamufactured organics such as:

- Pesticides
- Polychlorinated biphenyls (pcbs)
- Polycyclic aromatic hydrocarbons (pahs)
- Fluorochemicals
- Phenols

Many of these are highly toxic and can cause damage or complete destruction of aquatic ecosystems. They can also have serious impact on people too either through direct exposure to them in the environment or indirectly for example by eating contaminated food.

The specific toxic nature and impact of these chemicals varies and is influenced by a variety of properties exhibited by the chemical, for example its persistence in the environment as well as environmental conditions. The table below describes these properties in more detail.

Definition of key terms

Environmental term	**Description of meaning**
Persistence	Persistence of chemicals indicates that they are stable and long-lived in the environment, resisting degradation, for example lead, cadmium, mercury, PCBs, many fluorochemicals and other man- made organics
Xenobiotic	May harm biological organisms they include many manufactured substances, especially pesticides, lead, cadmium and mercury
Biodegradation	Breakdown of a complex chemical into (simpler) components by actions of biological organisms. It's not always broken down into more benign components, for example the pesticide Dieldrin biodegrades into photodieldrin, which is considerably more toxic
Bioconcentration (Biodegrading)	Extraction of chemicals from the environment, and concentration within the organism. For example, seaweed concentrates iodine from the seawater within its tissues, so it's very useful for humans as a source of concentrated iodine. Similarly, plutonium is present at very low levels in seawater. It's concentrated within tiny algae, (phytoplankton) that make up the producers in the open sea ecosystem (up to 3,000 times stronger in one of these algae than in the sea water). Algae also concentrate PCBs to 2,000 times the ambient sea water levels
Bioaccumulation or biomagnification	Concentration of pollutant; gradient that occurs in moving from one trophic level to another, such as when an animal eats a plant or another animal

Perhaps the best-known example of a pollution event that affected humans was in the 1950s in Minemata Bay, Japan. Mercury (mercuric sulphate) was discharged untreated into Minemata Bay over many years where it accumulated in the sediment offshore. Here it was naturally converted into methyl mercury, a more soluble toxic form readily taken up by plants and animals. The level of methyl mercury found in these plants and animals increased the higher up the food chain the species was located due to bioaccumulation. When the local population ate species of carnivorous fish at the top of this food chain they were ingesting 500,000 times the normal seawater concentration of mercury. This led to a number of serious health problems and birth defects.

Other Common Pollutant Types

There are wide range of other pollutant types. These together with their likely impacts on ecosystems are described in the table.

Types of Pollution and their effects

Type of pollution	Effects
Suspended inorganic solids such as silt pumped into a river	• Substrate changed due to the riverbed being covered with silt • Fish gills and filter feeders become blocked • Fish spawning areas and eggs smothered • Light penetration is reduced, reducing photosynthesis and plant growth • Changes in the community of organisms present • Loss of diversity
Thermal Pollution for example. from fire runoff water	• Water body is heated • Oxygen content of the water is reduced • Self-purification processes are accelerated if oxygen levels don't fall too low. Some species, such as trout, salmon and pike are particularly sensitive to elevated water temperatures • Changes in the community of organisms present • A loss of diversity occurs
Inorganic chemicals	• May be toxic • May change acidity or alkalinity (pH) of the water • Change in the community of organisms present • A loss of diversity occurs
Oils and fuels	• Physical coating of animals and plants, particularly water foul • May be toxic • Reduction in oxygen levels • Changes in the community of organisms present • Loss of diversity
Organic matter such as a milk spillage	• Reduction of oxygen levels • Changes in the community of organisms present • Loss of diversity

Nitrogen and phosphates such as a fertiliser spillage	• Eutrophication, producing algal blooms, which can lead to deoxygenation of water bodies and changes in the community of organisms present • Loss of diversity • Many fertilisers are also acutely toxic, particularly those based on ammonia compounds

Type of pollution	**Effects**
Toxic and persistent organic chemicals	• Poisonous • Changes in the community of organisms present • A loss of diversity occurs • Bioaccumulation and persistence possible
Pathogens	• Spread disease

Environmental conditions

Environmental conditions in any particular geographical area of the UK can directly influence the toxicity and fate of pollutants in a body of water. Environmental specialists within the FRS should consider these when pollutants are released into the water environment.

Hardness: in hard water, high concentrations of dissolved calcium and magnesium reduce the toxicity of metals such as cadmium, lead or copper. Such waters will also be better able to cope with an acid spill due to better buffering capacity. However, the toxicity of other substances such as ammonia is increased.

Acidity: the solubility of many metals is increased as water becomes more acidic. This can lead to negative impacts on aquatic ecosystems.

Temperature: high water temperatures naturally reduce dissolved oxygen levels. These conditions also encourage greater microbial growth, so the effect of an organic spill during the summer period may be more severe, but self-purification is accelerated.

Mixtures: pollutants can change their toxicity in the presence of other toxins. They may produce three possible outcomes:

- Additive toxicity
- Increased toxicity
- Decreased toxicity

For example, the presence of chromium can increase the toxicity of nickel ten-fold whereas the presence of strontium can decrease it three-fold.

Surface water, groundwater and foul and surface drainage systems

Pollutants contained in firewater and washwaters, or released following a spill will, usually enter the water environment via surface or foul water drainage systems unless action is taken to prevent this. Drainage systems will discharge into surface water, groundwater or sewage treatment works. In other cases, the pollutant will flow directly from the incident scene into a nearby watercourse or soak into unmade ground before entering groundwater.

Surface water

Surface water is the term used to describe water contained in rivers, streams, ditches, lakes, lochs reservoirs and coastal waters. As well as drinking water supplies, surface waters provide an important recreational and economic resource for example recreational and commercial fishing and fisheries and bathing waters.

Groundwater

Groundwater is the term used to describe the water underground in areas of permeable rocks, known as aquifers. Aquifers hold at least 20 times more water than all the UK's surface reservoirs and provide a third of the UK drinking water so are a major national resource. The proportion of the supply can vary by location and time of year. Some towns and areas will take 100% of their water supply from groundwaters.

Livestock watering is one of many uses of water that can be affected by pollution Photo courtesy of the Environment Agency

Groundwater abstractions are also an important source of water for agriculture and industry and provide for people or businesses that cannot, or would rather not, use water from the public mains. The quality of private wells used for drinking is overseen by the Drinking Water Inspectorate and local authorities.

Removal of groundwater can cause low river flows or for rivers to dry up. Reducing the quality or the quantity of groundwater can in turn impair river quality and levels.

Over abstraction of groundwater can cause rivers and lake levels to fall

Groundwater is often not considered, because it is not visible, but it can be particularly vulnerable to pollution from emergency incidents. Unlike most river pollution incidents, once an underground water resource is polluted it may remain contaminated for many decades and could be costly or impossible to clean-up. Alternative sources of water would then need to be found which can be a very costly complex and time consuming process as well as potentially environmentally damaging.

Groundwater protection zones

Groundwater is everywhere beneath our feet – the most important groundwater areas have been categorised into Source Protection Zones (SPZ) depending on their importance and vulnerability to environmental damage. The shape and size of SPZ depend on the hydrogeological conditions of the ground, how the groundwater is removed, and other environmental factors.

Each SPZ can be divided into 3 distinct zones:

• Source Protection Zone 1 (SPZ1) – Inner protection zone

• Source Protection Zone 2 (SPZ2) – Outer protection zone

• Source Protection Zone 3 (SPZ3) – Total catchment protection zone

The Environment Agency uses the zones in conjunction with their Groundwater Protection Principles & Practice guidance (commonly known as GP3) to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

Information about areas can be obtained from the local environment agency office or contacts; when operating in groundwater SPZs, the FRS should consider the environmental impact of its operations on groundwaters through liaison with the relevant environment agency.

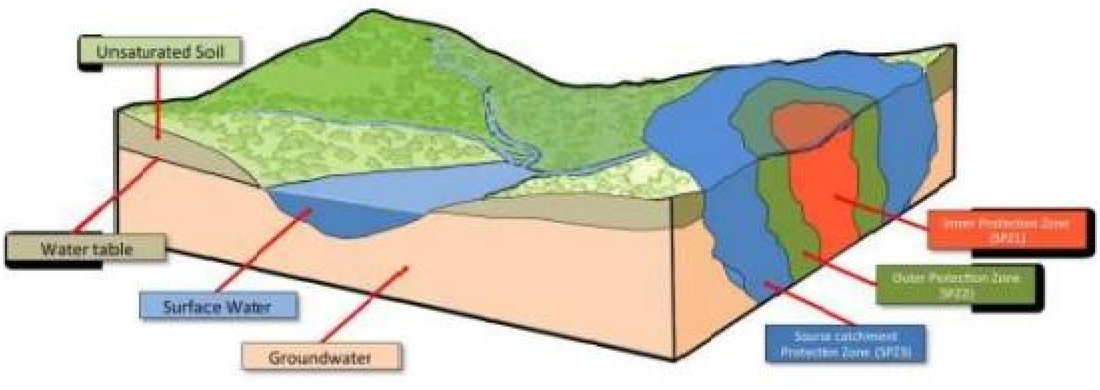


Diagram courtesy of Kent Fire and Rescue Service

Groundwater comes from rain, snow, sleet, and hail that soak into the ground. The water moves down into the ground because of gravity, passing between particles of soil, sand, gravel, or rock until it reaches a depth where the ground is filled, or saturated, with water. The area that is filled with water is called the saturated zone and the top of this zone is called the water table.

Drainage system

An example of a pollutant that has travelled through a drainage system to discharge into a nearby river

Sewage and Sewerage

Sewage is the wastewater carried in sewers, sewerage is the network of pipes and sewers which carries the sewage to a sewage treatment works (STW). The FRS may be able to use sewerage systems at incidents either to contain polluting material, including firewater run-off and washwater or divert the material to a holding facility such as a storm tank or balancing pond until it can be safely removed. Caution should be exercised when doing this though as foul sewers may have storm water overflows built in and blocking the foul system could cause a direct discharge via these overflows to a watercourse. The advice of sewerage undertakers should therefore be sought wherever practicable when this option is being considered.

Types of Sewer

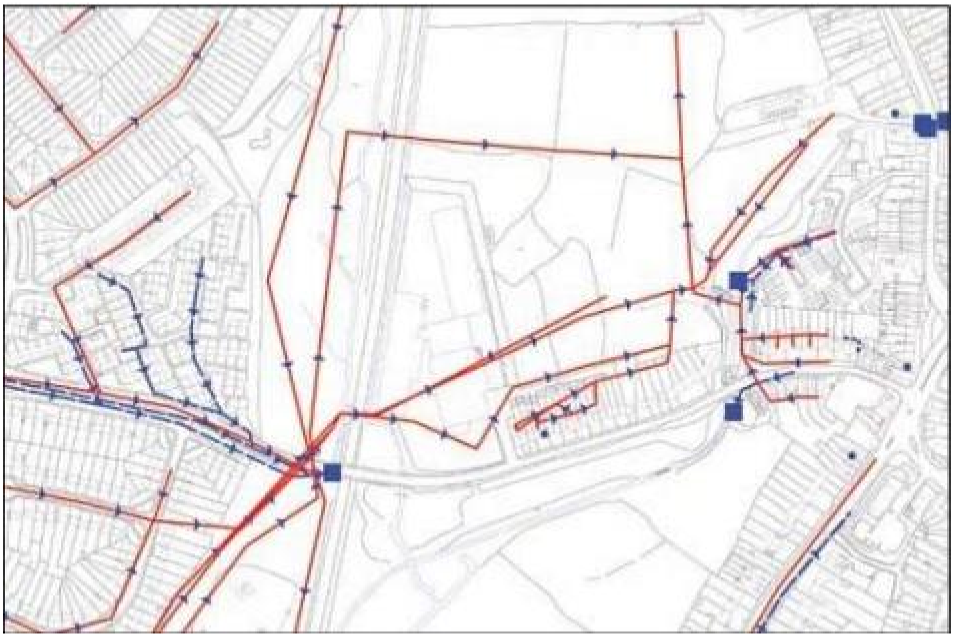
There are three main types of sewer as detailed in the table below.

Types and functions of sewers

Sewer Type	**Function**
Surface Water	Transports rainwater direct to the nearest river, lake or coastal waters. Alternatively, they may drain to a soakaway
Foul Sewers	Transport sewage to a sewage treatment works

Combined sewers	Transport both sewage and rainwater to the sewage treatment works. During storms they may overflow into inland or coastal waters or the sea. They are usually only found in older urban areas

Drainage plans will help identify the type and destination of the system. In addition, the local knowledge of personnel, GIS map layers and information from sewerage undertakers, environment agencies, site occupiers or highway authorities may help. Drainage plans should be made available to personnel at the scene of a pollution event to help decisions on appropriate intervention points and tactics.



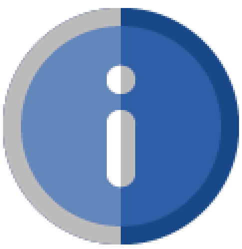
A typical drainage plan showing the location and direction of surface and foul water sewerage systems. Surface sewers are marked in blue and foul sewers in red Picture courtesy of Severn Trent Water

Emergency responders may be able to use pollution control devises incorporated into the drainage system to contain pollutants until arrangements can be made for collection and disposal. For example, storage lagoons or balancing ponds which are open water ponds fitted with an outlet than can be 'closed off' using shut of valves or drain blockers. Sluice valves may also be fitted which can be used to control the flow of water within drainage systems.

Sluice valve Photo courtesy of Carillion-URS

Balancing pond Photo courtesy of Carillion-URS

Drain covers and grills at industrial or commercial premises may be marked with colours, for example red for foul and blue for surface. Other sites may have other types of pipe work such as radioactive water or oily water.



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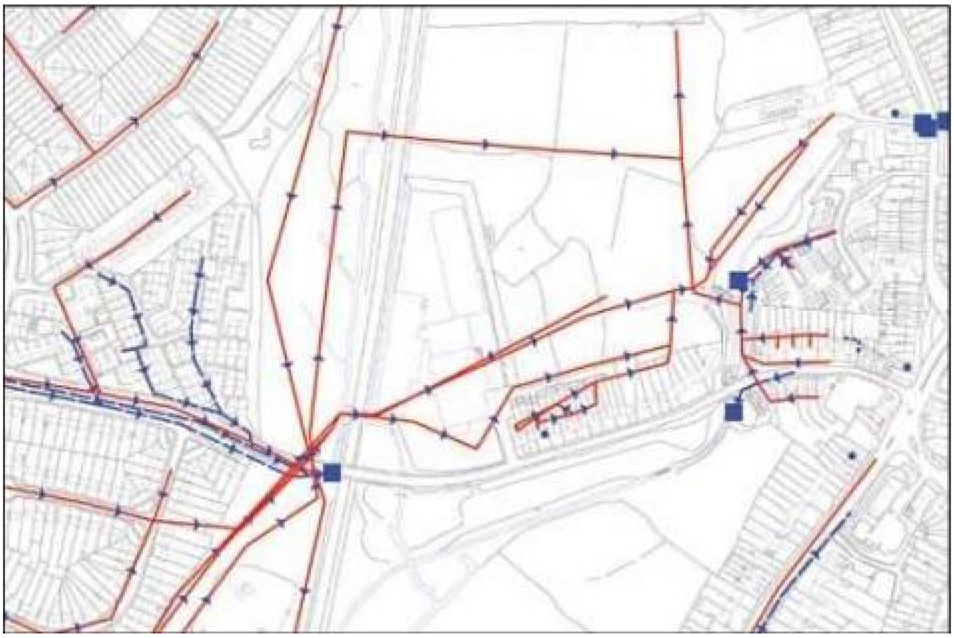

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Sewage Treatment

Most industrial or commercial sites will discharge their sewage to a STW operated by their local sewerage undertaker. All STW works discharge their treated effluent into the water environment. Some sites may not be connected to a public foul sewer or they may have additional treatment on site. In such cases the operator may use one of the methods of liquid waste treatment listed in the table below.

Sewerage Systems

System	Works by

Cesspool	Sealed tank, no discharge; must be pumped out regularly by tanker
Septic tank	Solids settle out in tank, liquids discharge to ground; should be emptied
Private sewage treatment works	Small treatment works with discharge to ground or surface water. Treat
Industrial treatment works	Treatment on site of trade effluent and sewage. Effluent usually dischar

Further details of these systems are available from NetRegs in their guidance GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer

The sewage treatment process

Sewage from industrial and domestic premises is normally discharged via foul or combined sewer systems to a sewage treatment works (STW). Once at the facility, the sewage is passed through physical, biological and sometimes chemical treatment processes which remove contaminants. The treated sewage or effluent is then discharged either directly or indirectly into the water environment.

Although they are designed to remove pollutants, if the concentration of a pollutant entering a STW is too high, it can impair or destroy the biological treatment process. Some pollutants can also cause physical damage to the sewer network and STW. This can result in the pollutant and untreated sewage entering the water environment. If the biological process has been destroyed or there is physical damage to the STW, the discharge of untreated sewage may continue for some time.

The protection of foul or combined sewer systems by FRS personnel is just as important as the protection of surface water sewers and watercourses. Sewage treatment works are often not staffed or staffed for only part of the day. If they are not fitted with warning alarms, it may be some time before anyone notices that a pollutant has affected the operation.

An understanding of sewerage systems and how STW operate is useful for personnel and hazardous materials advisers and environmental protection advisers.

There are four main stages in the treatment of sewage:

- Preliminary treatment
- Primary sedimentation or settlement
- Secondary or biological treatment
- Tertiary treatment

Preliminary treatment removes large solids such as rags, which could cause blockages, and sand and grit, which could cause damage to the STW infrastructure due to abrasion. The main processes are screening and grit channels, which slow the flow to allow grit and sand to settle out. Maceration may also be employed to breakdown larger solids.

Primary sedimentation removes suspended solids by allowing the sewage to remain in the tanks for typically six to eight hours under non-turbulent conditions. The solids, which are denser than the liquid, will settle as sludge towards the bottom of the tank.

Secondary or biological treatment processes oxidise the organic matter in the sewage to reduce the biochemical oxygen demand (BOD). This stage relies on the activities of micro-organisms, mainly bacteria, to break the sewage down into carbon dioxide, nutrients such as Nitrate and water using oxygen.

A sedimentation tank

The two main types of biological process are activated sludge, in which the micro-organisms (biomass) grow in a freely suspended form, and percolating filtration, in which the micro-organisms grow attached to a solid support such as activated carbon ‘trickle beds’. Whichever biological process is used, there must be a method for separating the biomass from the treated effluent. This involves circular secondary sedimentation tanks to allow the biomass to settle out.

A biological treatment 'trickle bed'

Tertiary treatment may be necessary at some STW if the quality of effluent required is high. An example is nutrient stripping of an effluent that discharges into a sensitive habitat where the nutrients would otherwise cause excessive plant growth.

There are a range of tertiary treatment methods one or more of which may be used at a treatment works. The main types are:

- Prolonged settlement, for example in lagoons
- Irrigation over grassland or reed beds
- Micro-straining
- Filtration through media such as sand and gravel
- UV treatment, for example to meet bathing water quality standards
- Chemical Treatment, such as using salts of iron to remove phosphorus

Many STW have storm tanks, which are designed to store excess water and sewage during high rainfall. When the flows drop back to normal after the storm, the stored sewage re-enters the treatment process at a controlled rate. Storm tanks may also be used to store polluting material produced during an emergency.

Permission to intentionally discharge polluting material such as firewater and foam into foul sewers must be obtained from sewerage undertakes before a discharge takes place, as this will allow them to assess the impact on the STW. Environment agencies should also be consulted. FRS should plan for such activities and have established systems and procedures to request permission to discharge to foul sewers. Sufficient time for polluting materials to be diverted to storm tanks must be provided if the pollutant needs to be contained before it enters the STW. Once contained at the STW, pollutants can be removed and taken to a waste treatment facility or 'bled' slowly into the sewage treatment works for treatment.

Photo courtesy of Severn Trent Water

Discharge permits

Discharges from STW into surface or groundwaters are controlled by discharge permits or licences issued by the environment agencies. It is an offence to allow any poisonous, noxious or polluting matter or any solid waste matter to enter any surface or groundwater unless the discharge is made in accordance with the conditions of the permit or licence issued by an environment agency.

The environment agencies have a duty to determine an application for a permit or licence, either unconditionally or subject to conditions such as the nature, origin, composition, temperature, volume and rate of discharge. Once a permit or licence is granted, they monitor the discharge to ensure compliance. Any failure to comply with the permit or licence conditions is an offence and may result in legal action.

Oil seperators

Oil separators, sometimes referred to as ‘interceptors’, are installed within drainage systems to protect receiving waters, surface or ground, from pollution by oil or fuel. Pollutants may be present due to minor leaks from vehicles and machinery, from accidental spillages or due to deliberate and illegal tipping into drains.

Oil separators are found on fuel station forecourts, at oil storage facilities, vehicle workshops, or fire stations with fuel dispensing facilities. These units can be identified at ground level by the presence of three inspection covers in line close to each other, although single chamber models are now the preferred design. They are designed to hold back floating materials such as oils and fuels but to let clean water pass through.

Oil separators will only be effective if they're regularly maintained and emptied. Some installations have an oil level alarm to indicate when emptying is required. Figure below shows a modern singlechamber separator.

A common misconception associated with oil separators particularly when described as interceptors is that they will collect all types of pollutants. This isn't the case; they only collect materials that float on water such as oil or fuel. Materials that mix with water or are heavier than water can pass through the separators and enter the foul or surface water system, this includes some components of fuel, such as biofuels like ethanol and some solvents. A separator won't work for dissolved oils or detergents, including detergent based firefighting foam, if degreasers are present. This is common in vehicle washwater. Such discharges should be drained to foul sewer, or a sealed tank.

Standard size oil separators contain fuels and oils in 'daily' spillage conditions, but will be unable to separate out these products from large quantities of water, for example from firewater run-off. In these circumstances, the system may be overcome by the 'shock load' and let the pollution pass through into drainage systems and surface and ground waters.

Oil separators at fuel filling stations must be able to retain the contents of one road tanker compartment, around 7,600 litres. For areas where contamination is likely to be light or where the risk of a large spillage is considered small, a bypass separator may be used. These units are much smaller than conventional full retention separators as they're designed to only treat rainfall up to 5 mm/hr.

Waste oil contained in separators is classified as hazardous waste and should only be disposed of using registered waste carriers and taken to licensed permitted waste sites.

GPP3 applies to oil separators and can be found at NetRegs

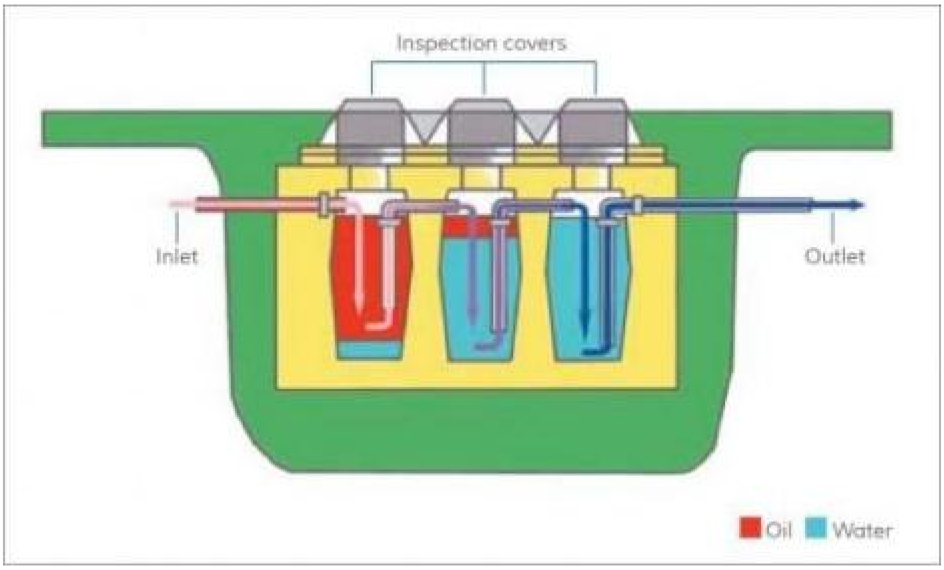
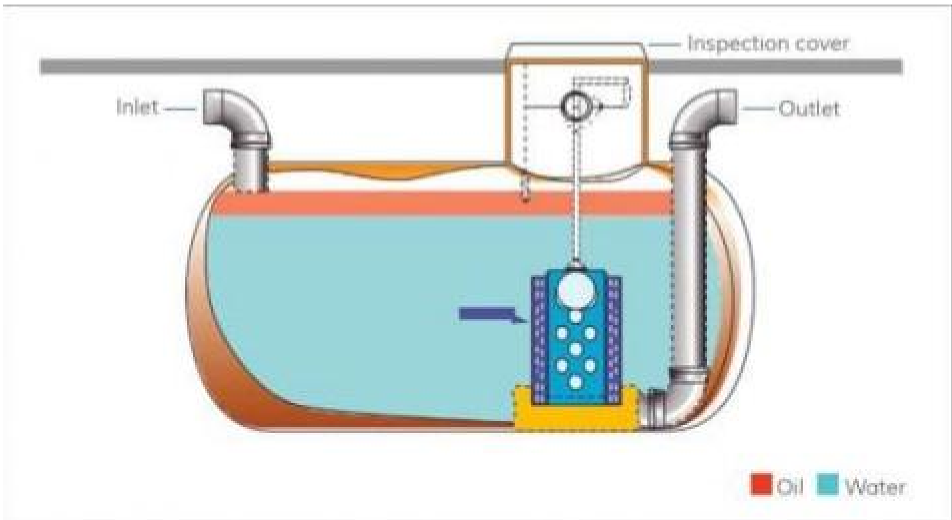


Diagram courtesy of the Fire Service College

The diagram above details an older style three-chamber oil separator and the flow of water and floating material such as oil or fuel. Commonly these devices discharge to surface or groundwater.



A single-Single chamber oil separator showing oil or fuel floating on top of water

The older style of oil separator can often be identified by three in-line inspection covers. Where these discharge to surface water, they should be colour-coded blue

Containment and management of washwater

The principles of containment apply to all washwater where this is reasonably practicable. The nature and amount of contaminants need to be identified so that the washwater can be correctly treated before disposal.

In most cases, the ratio of dilution of any chemicals in decontamination washwater will guarantee minimal impact on the sewage treatment process and the environment. The FRS and ambulance service's system of removing a casualty's clothing before washing will also reduce potential impact. There are a few contaminants which may cause problems even with the recommended rates of dilution.

Discharges of contaminated water to sewer must be at a controlled rate to ensure the capacity of the foul sewer is not exceeded. Advice should be sought from the sewerage undertaker and environment agency. Failure to do so could lead to the discharge of contaminated water directly into the environment following the operation of Combined Sewer Overflows (CSOs) or from surcharging sewers.

Drains should be identified, and surface water drains blocked off to contain washwater. The sewerage undertaker and environment agency must be consulted as soon as is practical. If agreed, the washwater should be directed towards the foul sewer or collected for disposal. The sewerage undertaker can advise emergency service personnel on identifying foul and surface water drainage systems.

Irrespective of the urgency of improvised and interim decontamination, the hierarchy of containment should be applied as soon as operational priorities and resources allow. Environmental protection equipment carried on FRS vehicles and specialist appliances, such as clay drain seals, pipe blockers and portable tanks, is likely to be suitable for this.

In the absence of any advice, and where the waste can no longer be contained safely, the waste should be directed to a foul sewer rather than surface water drains. The sewerage undertaker must be informed as soon as possible to protect their staff as well as the sewerage network and STW.

For more information about CBRN(e) incidents and the decontamination of personnel and mass decontamination of members of the public see Hazardous materials.

Trade effluent

The Water Industry Act, Water Industry (Scotland) Act and The Water and Sewerage Services (Northern Ireland) Order defines any wastewater produced in the course of a trade or industry carried out at a trade premises as “trade effluent”; this includes any wastewater derived from a production process and can vary in size from small launderettes to large chemical manufacturing facilities. The effluent produced by the cleaning of FRS vehicles and equipment would be considered a trade effluent.

The discharge of trade effluent without a consent is an offence. Water companies employ Trade Effluent Officers to protect all assets from trade effluent discharges and maximise trade effluent income. They investigate unsatisfactory or illegal discharges to sewer and impose trade effluent discharge consents. They follow up any breaches of consent conditions which may result in legal proceedings in cases of persistent gross non-compliance. This is to ensure that the receiving wastewater treatment works meets its own permit conditions set by environment agency.