Cypermethrin: Sources, pathways and environmental data

October 2019

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Executive summary

Cypermethrin is a synthetic pyrethroid insecticide. It is used in the UK to control a range of pests in both arable and livestock farming, in homes and gardens, and in public and commercial buildings.

The amount of cypermethrin used in arable farming in the UK has halved between 2000 and 2016. Approximately 24,000kg was used in 2016, mainly on wheat and oilseed rape. In 2017, approximately 13,000kg of cypermethrin was sold in the UK for use as a veterinary medicine to control ticks, lice and flies on cattle, sheep and horses.

No information is available on the amount used as a biocide to control a range of insect pests in homes and buildings or in relation to home garden use.

Cypermethrin is not very persistent in the environment nor is it likely to bioaccumulate in aquatic organisms, but it is highly toxic to some species of aquatic life, particularly aquatic invertebrates such as insects and crustaceans.

Cypermethrin has been designated as a Priority Substance under the Environmental Quality Standards Directive (2013/39/EU), a daughter Directive of the Water Framework Directive (WFD) (2000/60/EC) and a new Environmental Quality Standard (EQS) has been applied since December 2018. Prior to this it was identified as a Specific Pollutant in the UK under the WFD.

Our monitoring programme detects cypermethrin in both fresh and saline waters across England, sometimes at concentrations above the Environmental Quality Standard (EQS). The high toxicity of cypermethrin, which is reflected in the very low EQS value for cypermethrin of 0.00008µg/l for freshwaters, means that relatively small inputs can potentially be a cause for concern.

The wide range of uses of cypermethrin means there are a number of routes by which it can enter the water environment. These include surface run-off following application to arable crops and loss from hard standings on farms following treatment of sheep and cattle or washing of pesticide equipment. Environmental inputs can also arise from industrial processes such as wool processing or from domestic sources as a result of home and garden use.

Many initiatives are currently in place which aim to promote best practice and safe use of plant protection products, veterinary medicines and biocides such as cypermethrin. These all help to reduce the entry of cypermethrin to the water environment. However, for many sites where we are finding concentrations of cypermethrin above the EQS we need to understand which sources are contributing. By doing this we can identify relevant and appropriate measures to help reduce input to the water environment and reduce risk.

Where the presence of cypermethrin can be linked to known local sources, steps are taken to control inputs. For example, work to reduce emissions of cypermethrin from wool processing sites.

A number of activities are either underway or planned to investigate sources of cypermethrin. We are carrying out a targeted monitoring programme for cypermethrin between 2018 and 2020 to better understand the relative contributions and potential pathways for release from different uses of cypermethrin at a national scale. Monitoring sites have been identified based on knowledge of the use of cypermethrin alongside land use data to help identify sites likely to be associated with high cypermethrin use such as oilseed rape. In addition conceptual modelling has been used to identify sources and pathways that could be a significant source of cypermethrin to the water environment on a

national scale. This has identified surface run-off from hard standings on arable and livestock farms which will be considered in future monitoring programmes.

Cypermethrin has been detected in the effluents of all the wastewater treatment works sampled to date in the Chemical Investigation Programme (CIP). It can arise from a number of sources including industrial discharges and from homes due to use of home and garden pest control products. Further work to investigate sources of cypermethrin in sewer networks is planned for the next phase of CIP.

In addition to the steps identified above, further work will be required to help understand the relative inputs of cypermethrin to the water environment and ensure EQS compliance. For example, we have specific knowledge gaps on its use as a biocide. A wide range of stakeholders, who have an interest in the use of cypermethrin, can also contribute suggestions on viable management options that could further reduce environmental emissions.

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1. Introduction

Cypermethrin is a synthetic pyrethroid insecticide. It has a wide range of uses in the UK. These include the control of pests on a range of crops and in public and commercial buildings and homes, as well as use as a wood preservative. It is also used as a veterinary medicine to control lice and ticks on cattle and sheep.

It is highly toxic to aquatic life, particularly to some invertebrates such as insects and crustaceans. Adverse effects on aquatic organisms have been observed at concentrations as low as 0.0013µg/l (EFSA, 2008).

Cypermethrin has a very low solubility in water, less than 9µg/l (EU 2013, ECHA, 2019). It binds strongly to soil and sediment. It is not expected to be very mobile in soil and in water will rapidly bind to suspended particles and sediment.

Cypermethrin is not very persistent in the environment and is degraded by bacteria and sunlight. Measured degradation rates in water have been reported in the range of a few days (0.88 and 4 days) (EU 2013 and ECHA, 2019). In sediment, degradation rates have been reported in the range of 12 and 67 days (ECHA, 2019).

Cypermethrin does not bioaccumulate significantly in aquatic organisms (EFSA, 2008, EU 2013, ECHA, 2019). It has a low potential to volatilise and will not be present in significant quantities in air (EFSA 2008).

Cypermethrin has been designated by the EU as a Priority Substance under the Environmental Quality Standards Directive (2013/39/EU), a daughter Directive of the Water Framework Directive (WFD) (2000/60/EC). As a result an Environmental Quality Standard (EQS) for the protection of aquatic life has been derived by the EU. The EQS for cypermethrin applies to all forms of cypermethrin, including alpha and zeta cypermethrin (2013/39/EU). This narrative refers to all forms of cypermethrin

This document reviews information on the uses of cypermethrin (Section 2), sources and pathways (Section 3), monitoring data (Section 4) and existing controls (Section 5).

The focus of this narrative is on contributing effects to and assessment of the condition of surface waters in relation to cypermethrin. However, the contribution that groundwater makes to the surface water status failures is also considered as part of the WFD and the Groundwater Directive (2006/118/EC as amended by 2014/80/EU). If groundwater contributes more than 50% of the cypermethrin load in any surface water status failure then the groundwater body will also go to poor chemical status. We will be assessing this further as we develop water body classifications for the draft river basin plans.

2. Uses of Cypermethrin

Cypermethrin is used in the UK as a plant protection product, biocide and veterinary medicine. These types of products have to be authorised for use in the UK before they can be marketed, sold and used. Authorisation is granted if the proposed uses can be shown to be safe for human health and the environment. Details of how the product can be used, including how it should be applied and whether it is for professional use only or amateur use in homes and gardens are specified in the authorisation and provided on the product label.

2.1. Use as a plant protection product

Plant protection products are used to protect crops and ornamental plants against a range of pests and diseases. Cypermethrin is currently used in the UK to control a number of insect pests including aphids, beetles and caterpillars in the following situations:-

– on crops including cereals such as wheat and barley, fodder beet, oilseed rape and sugar beet
– on vegetables such as broccoli, beans, peas, carrots, cabbage
– as a post-harvest treatment to treat grain stores, to protect stored grain such as wheat and barley from pests, and as a seed treatment prior to sowing
– on ornamental plants such as roses including in domestic gardens
– in forestry on young trees both pre- and post- planting to control large pine weevil and on felled logs for bark beetle (HSEa, The Pesticides Register Database)

At the time of writing, approximately 60 plant protection products containing cypermethrin are authorised for use in the UK. Approximately half are approved for amateur use to control pests in gardens (HSEa, The Pesticides Register Database).

Information on the amount of cypermethrin used on different crops is collected through pesticide usage surveys undertaken on behalf of the HSE (Health and Safety Executive). Various crop types including arable, orchard, soft fruit, outdoor vegetable, amenity and edible protected crops are surveyed on a regular basis.

Cypermethrin is a key insecticide used on arable crops, especially for wheat and oilseed rape (Fera Science , 2018a) as shown in Figure 1 (See Appendix 1 for further information). Most use occurs in the autumn (September to December) as shown in Figure 2, with peak use in November (Fera Science Ltd, personal communication, 2017). Cypermethrin is also used in spring (March to May).

Figure 1. Amount of cypermethrin applied to different arable crops in UK in 2016 (Fera Science, 2018a)

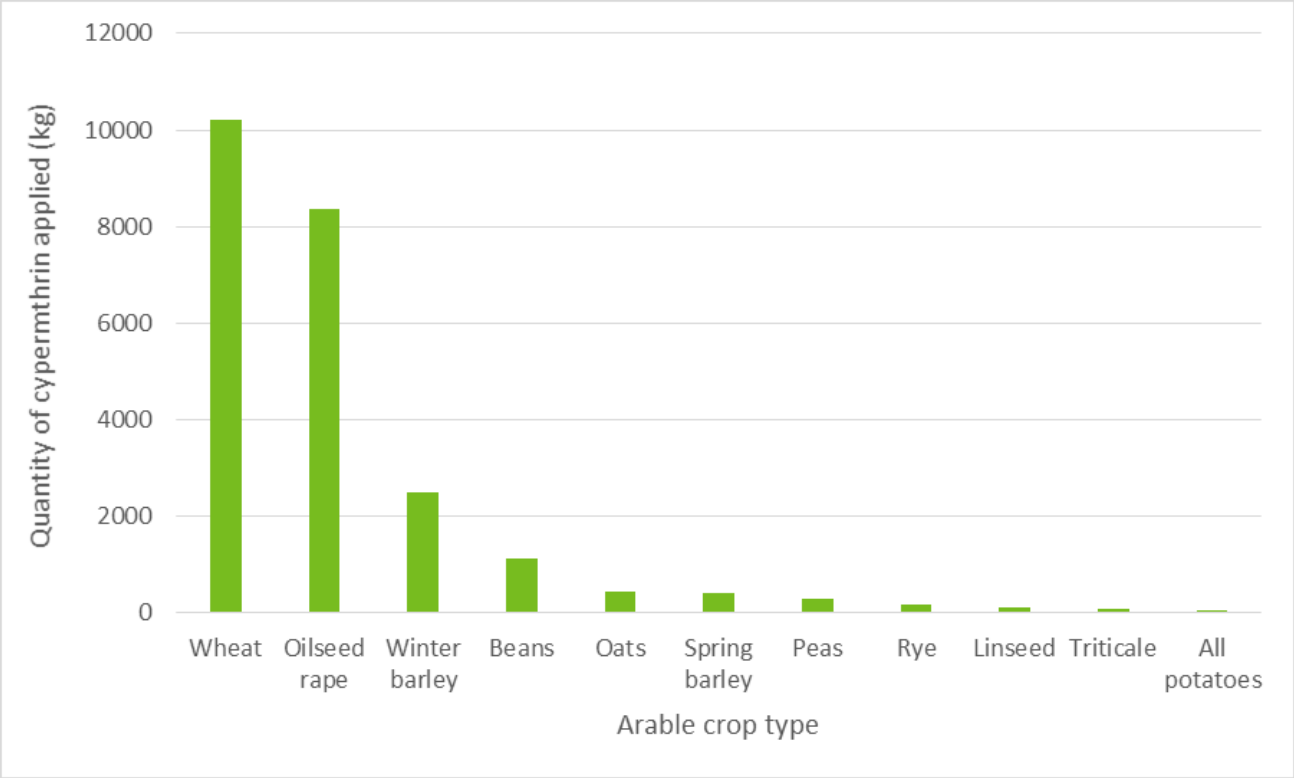
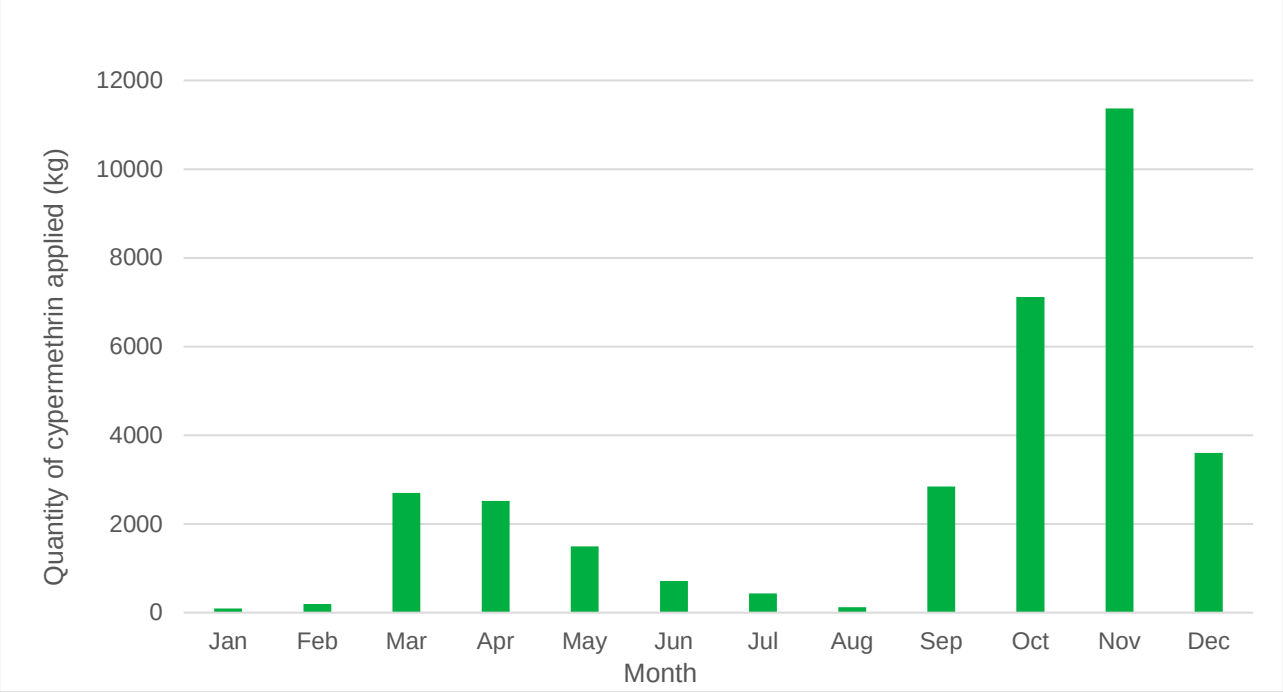
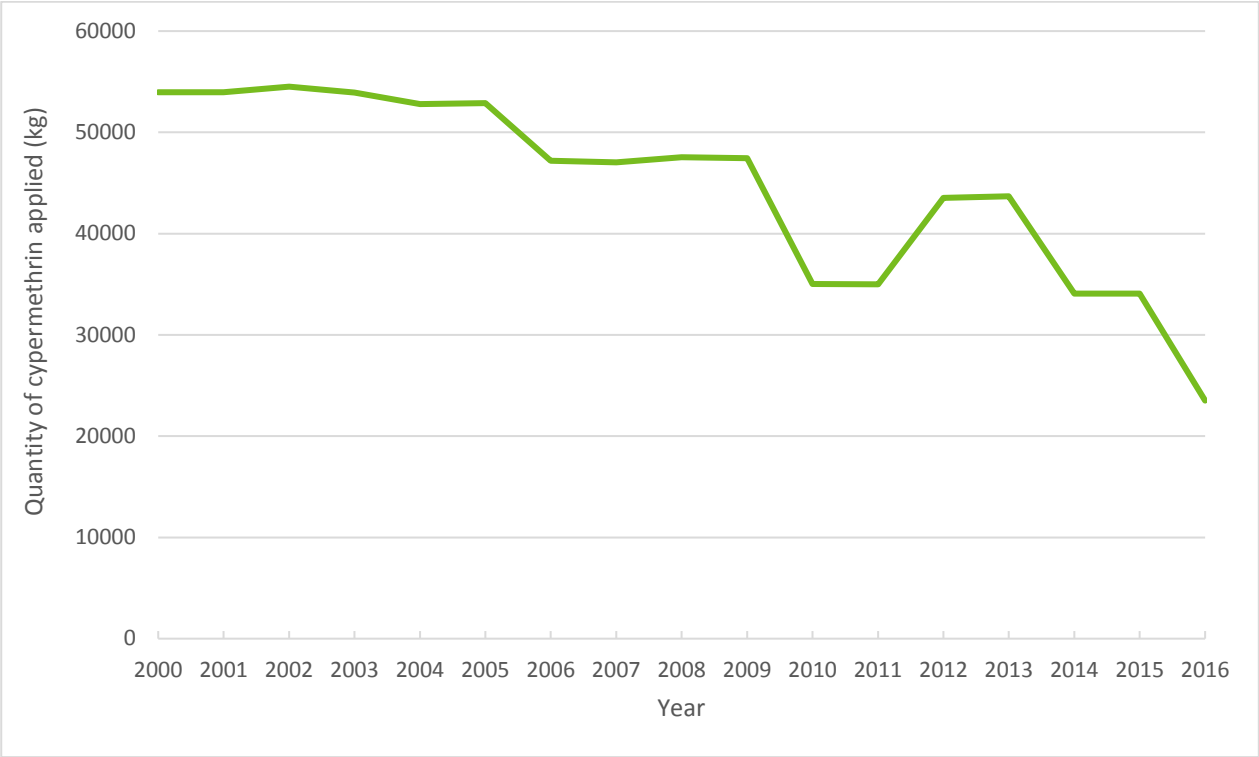


Figure 2. Quantity of cypermethrin applied to arable crops per month in England (2014) (Fera Science Ltd, personal communication, 2017)



The amount of cypermethrin applied to crops in the UK has declined in recent years. From over 50,000kg in 2000 to around 24,000kg in 2016 (Fera Science, 2019) (see Figure 3).

Figure 3. Quantity of cypermethrin applied to crops in the UK between 2000 and 2016 (Fera Science, 2019)



We do not have information on the quantity of cypermethrin used in forestry and domestic gardens as this is not collected as part of the Pesticide Usage Surveys.

Cypermethrin is used in forestry as a post planting treatment on saplings to control the large pine weevil. This typically occurs in April to June and August to October - the peak times for damage from this pest (Forest Research, 2017). In the future there may be a decline in the use of cypermethrin in forestry as it has been identified as a hazardous pesticide in a forest certification scheme (See Section 5.3 for further information).

2.2. Use as a biocide

Biocides are used to control a wide range of pests and organisms ranging from bacteria to rodents. Cypermethrin is currently approved under the EU Biocidal Products Regulation (528/2012) for use as a wood preservative (EU 2013b) and insecticide (EU, 2015; EU, 2018).

At the time of writing, approximately 170 biocidal products containing cypermethrin are authorised for use in the UK as insecticides (HSEb, UK Authorised Biocidal Products database; HSEc, Control of Pesticide Regulation database). They are used to control a range of insects including flies, ants, earwigs, fleas, bedbugs and moths. The products are used in homes, public buildings such as hospitals and schools, commercial buildings such as offices and industrial buildings such as food manufacturers and animal housing.

The method of application varies between products. Spray applications are the most common but smoke generators, bait and powders are also used (HSEc Control of Pesticide Regulations database). The products are approved for use by those using them for their job – professional use - or by members of the public in homes and gardens – amateur use.

At the time of writing 13 products containing cypermethrin are authorised for use in the UK as wood preservatives (HSEb UK Authorised Biocidal Products Database). They are used

to control wood destroying insects such as furniture beetle and house longhorn beetle (EU, 2013a). The products are approved for use by both professionals and amateurs (HSEb UK Authorised Biocidal Products Database) and application methods include surface application by brush.

The quantity of cypermethrin used in biocides is unknown because information on the amount of biocide used in the UK is not collected (HSE, personal communication, 2017).

A pesticide usage survey on amenity use in 2012 (Fera Science, 2015) reported 1,300kg of cypermethrin was used by pest control officers working for local authorities. The most recent amenity survey carried out in 2016, did not collate usage data for pest control (Fera Science, 2018b).

2.3. Use as veterinary medicine

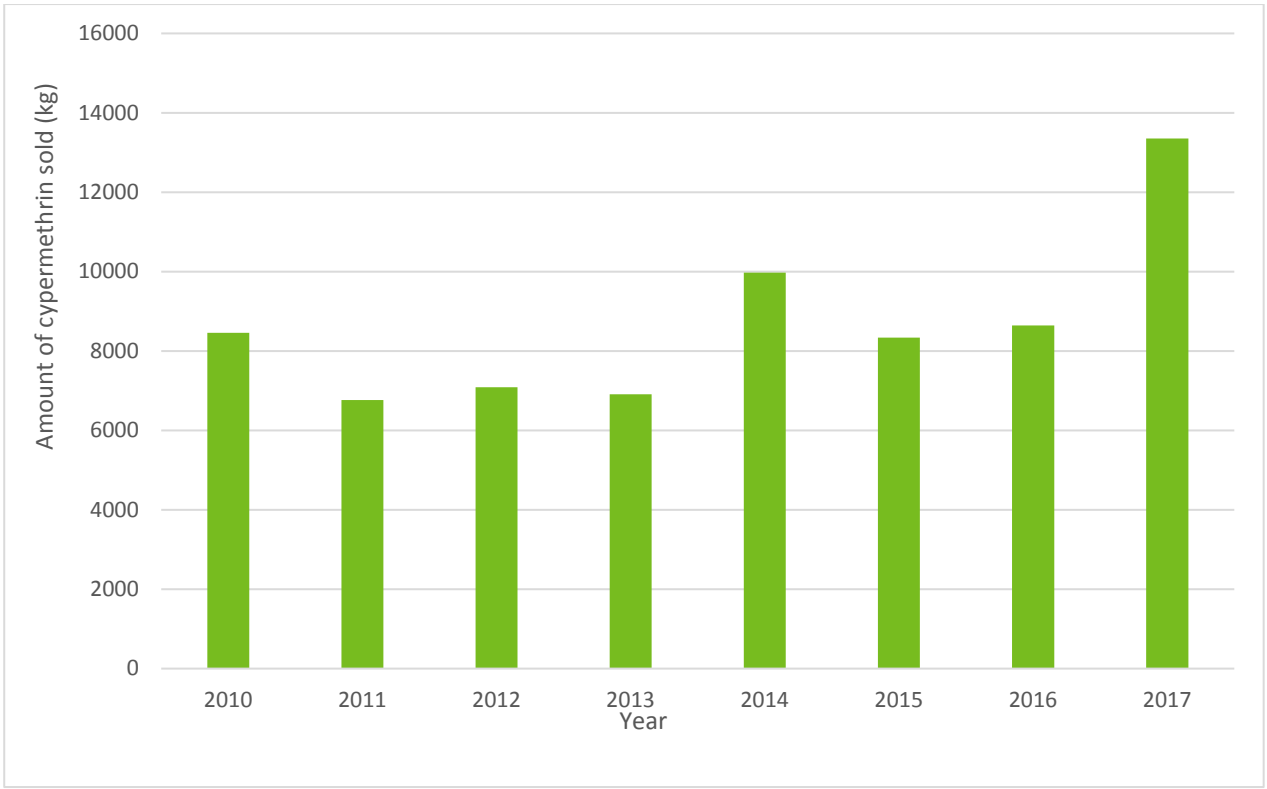
Veterinary medicines are used for the prevention and treatment of disease in animals.

At the time of writing 11 cypermethrin based veterinary medicines are authorised for use in the UK to control lice, ticks and flies on sheep, cattle and horses (VMD Product Information database).

The majority of products are used on cattle and sheep and applied topically as 'pour-on' products. This means they are poured along the back of the animal being treated. The only product authorised for horses is applied by spray to the animal's coat.

Between 2010 and 2016 the amount of cypermethrin sold for use as a veterinary medicine in the UK fluctuated within the range of around 7,000 to 10,000kg as shown in Figure 1 (VMD, personal communication 2018). In 2017 however there was a notable rise in 2017 to over 13,000kg. The data are based on the sale of authorised products. The latter varies between years as new products are authorised and authorisation for others expires.

Figure 4. Amount of cypermethrin sold in veterinary products in the UK between 2010 and 2017 (VMD, personal communication 2018)



Cypermethrin is applied at different times of the year depending on the pest being controlled. Lice are more numerous in the winter with lower levels in the summer (SCOPS, undated). Treatment for flies, blowflies and ticks occurs over the spring and summer months. The treatments are generally effective for a number of weeks (SCOPS, undated, VMD Product Information Database) and therefore more than one application over the year may be required. Changing weather patterns may have an influence on the period of risk in the future. For example the period of risk from blowfly strike has been extended from March to December in recent years which has been linked to changing weather patterns (SCOPS, undated).

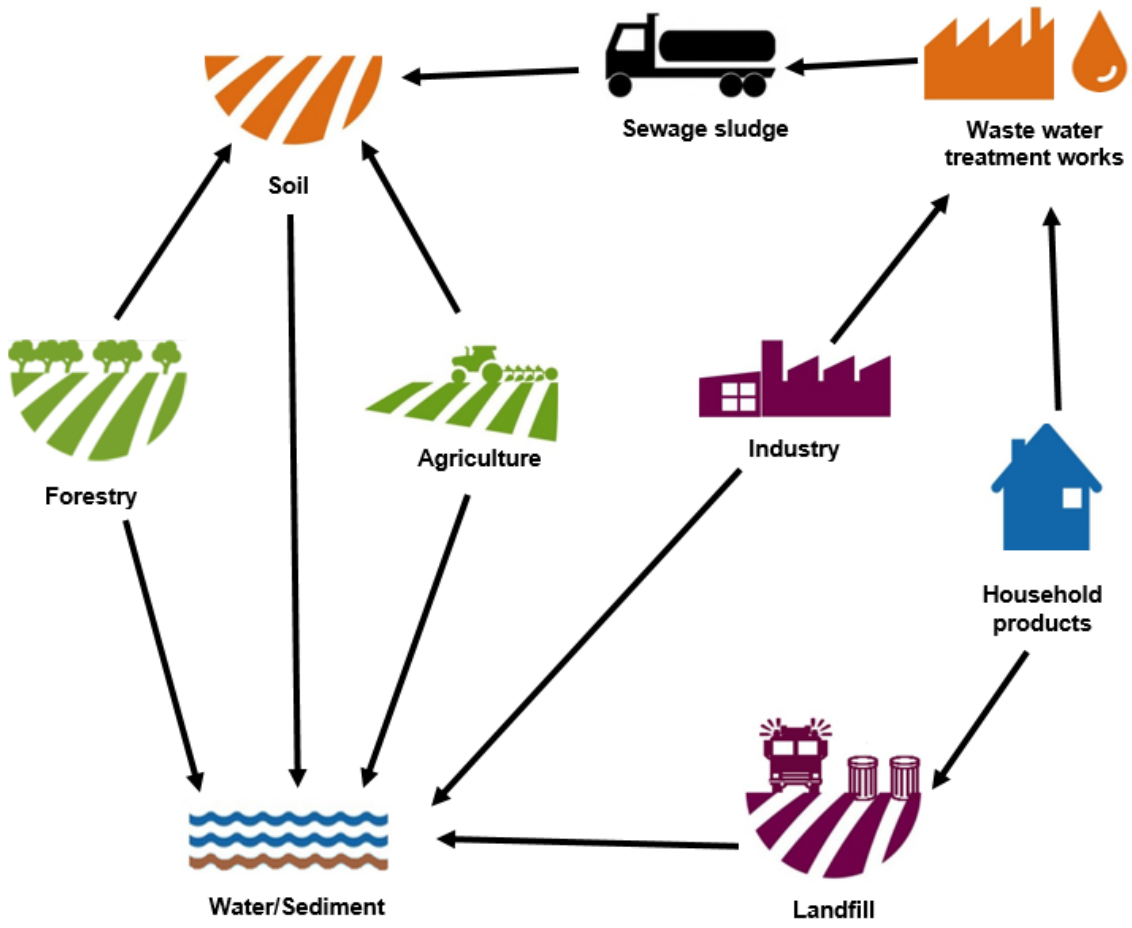
Cypermethrin has previously been used to treat sheep by dipping. However, manufacturers voluntarily withdrew these products in 2010 (VMD, 2011). Prior to this, in 2006, the marketing authorisations for these products had been temporarily suspended by the UK government following reports of serious pollution incidents in the water environment (VMD, 2011) (See Section 5.4).

Cypermethrin was used for the treatment of lice on farmed salmon however authorisation for the product expired in 2014 and no other products containing cypermethrin are currently authorised for this purpose in the UK (VMD Product Information Database).

3. Sources, emissions and pathways

Cypermethrin does not occur naturally. Its presence in the environment is a result of human activity. Cypermethrin can enter the water environment via a number of routes during its use and disposal as illustrated in Figure 5 and discussed in more detail below.

Figure 5. Sources and pathways of cypermethrin into the environment



3.1. Plant protection products

Plant protection products containing cypermethrin can reach the water environment via a number of routes. These include spray drift during application to crops and surface runoff following rainfall (Defra, 2009).

The risk of exposure through spray drift is mitigated through the use of buffer zones, no spray zones adjacent to watercourses. Low spray drift technology can also be used to reduce during application.

Many of the cypermethrin products currently authorised, have an 18 metre aquatic buffer zones in order to reduce the risk of exposure to the water environment from spray drift during application. This means that the product cannot be applied to the cropped within 18m of a watercourse.

Surface water runoff can occur during periods of high rainfall. Concentrations of pesticides in run off have been noted to be highest when there is a short time between

application and rainfall (Defra, 2009). Cypermethrin was detected at a concentration of 1.6µg/l at one of the sites included in a study on surface run-off which indicates the potential for exposure via this route (Defra, 2009).

Cypermethrin may reach watercourses following rainfall and subsequent surface run-off from hard standing areas in farms where spray tanker filling and emptying, and washing down of spray equipment occurs (ADAS, 2004).

Many cypermethrin products are authorised for use in gardens across the UK. The risk of environmental exposure through inappropriate use or disposal may be higher in this sector as home users are unlikely to be professionally trained in pesticide use and application. They may be unaware of the correct disposal routes for waste product and containers and may not understand the risks associated with their actions. For example, disposal of unused product via the sink or drain, disposal of water from the washing of empty containers and disposal of containers containing unused product in household waste by the public was reported by a Pesticides User Habit Survey (HSE, 2016).

3.2. Biocides

Cypermethrin is used as an insecticide in homes and public buildings, as well as industrial buildings and animal housing. It is applied to hard surfaces, such as floors and walls, and to other materials such as textiles, for example in the control of bed bugs.

As a result of this use cypermethrin may enter surface waters through drains or waste water from wet cleaning of treated surfaces or from rainfall on treated external surfaces. The EU recognised wet cleaning as a potential pathway for cypermethrin to reach the environment and it is considered as an exposure route as part of the risk assessment carried out when approving these type of products (EU, 2015).

Cypermethrin may reach the water environment from use as a wood preservative, either during application or from wash-off and/or leaching from a product following treatment.

To mitigate risks and minimise exposure to the aquatic environment, timber treated with cypermethrin must not be used in constructions in or near water. In addition, existing constructions in such locations must not be treated with products containing cypermethrin (Regulation 945/2013).

Many biocidal products containing cypermethrin are approved for use by amateurs around the home. As highlighted by the Pesticide User Habit Survey (HSE, 2016) (see Section 3.1) incorrect use and disposal of such products could be a potential source of cypermethrin to the environment, along with accidental spillages. As many wood preservatives are applied by brush, the washing of brushes could also be a potential source of cypermethrin.

3.3. Veterinary medicines

The use of cypermethrin to treat sheep, cattle and horses can potentially result in environmental releases during its use and disposal and also from treated animals.

Sheep and cattle are treated with cypermethrin by pouring the product along their backs. Spillages may occur during treatment, which often takes place on hard standing areas on farms. Runoff from hard standings has been identified as a potential source of pesticides to the water environment (ADAS, 2004).

Treated animals can be a source of cypermethrin in the water environment if they come into contact with water following treatment, for example, when crossing streams (Ramwell et al (2007), during rainfall, or through washing the treated animal, for example, horses following exercise. Some of the products authorised for use on sheep note that as a

precautionary measure animals should be kept away from watercourses for a defined period following treatment (VMD Product Information Database).

As noted for plant protection products (Section 3.1) and biocides (Section 3.2) incorrect disposal of excess and unused product, along with rinsing's from empty containers may be a source of cypermethrin used in veterinary medicines to the environment.

Livestock markets are sites that deal with large numbers of sheep and cattle. They have potential to act as a source and pathway for cypermethrin. For example, wash off from animals that have been treated prior to being brought to market. No information on levels of cypermethrin arising from this source has been located.

Sheep fleeces contain residual amounts of treatment medicines such as cypermethrin (EC, 2003). Wool scouring, undertaken during the processing of fleeces, has been reported to remove more than 90% of these chemicals from the fleeces (EC, 2003).

In 1998 a study at seven scouring mills reported the mass load of cypermethrin in greasy wool prior to processing ranged from 3.45 to 7.06grammes per tonne (EC, 2003). Between 86-100% of the cypermethrin was reported to be removed during the scouring process with the mass load of cypermethrin reported in the effluent from the scouring mills studied ranging from 0.02 to 0.52grammes per tonne (EC, 2003).

Discharges from wool scouring are therefore a potential source of cypermethrin to the water environment. As a result of increased awareness of fleeces being a source of cypermethrin to the environment, changes made since the study (See Section 5) may have reduced the amount present in fleeces and therefore released during processing. However, wool scouring remains a potential source and pathway for cypermethrin (see below).

The majority of cypermethrin present in fleeces is removed during scouring but some remains associated with the fibre produced. For example, cypermethrin has been reported to be present at levels in the range of 0.002 – 0.014grammes per tonne of textile product (EC, 2003). This may be removed during later stages of wool processing such as dyeing (EC, 2003).

A number of textile industry sites reported releases of cypermethrin on the Environment Agency's Pollution Inventory in 2017. The Pollution Inventory collates information on mass releases of specified substances to air, controlled waters and land as well as quantities of waste transferred off site from large industrial sites regulated by the Agency (Environment Agency, Pollution Inventory Data).

Two wool scouring companies and 8 companies involved in yarn production and/or wool dyeing activities reported releases of cypermethrin to the Pollution Inventory in 2017. Reported releases from the wool scouring sites were 0.232 to 3.269kg and were much higher than those from the sites involved in yarn production and wool dyeing which ranged from less than 0.005 to 0.075kg. All the emissions were to waste water apart from one which was to a watercourse.

The wool processed at these sites often originates from a number of countries including the UK, Australia, New Zealand, as well as Scandinavian and South American countries. The amount of cypermethrin present on the wool processed at these sites is therefore dependent on the extent of use of cypermethrin both here and outside the UK.

3.4. Forestry

Saplings treated with cypermethrin prior to planting can be a source of cypermethrin to the water environment if put in contact with drains or watercourses while awaiting planting, or as a result of planting in wet ground (Forest Research, 2019). Disposal of the bags used

to transport the treated plants has also been identified as a potential source (Forest Research, 2019).

Treating saplings with cypermethrin after planting can also result in cypermethrin reaching the watercourses. Accidental release during preparation of the pesticide for spraying, during application and through accidental spillage or incorrect disposal, are all potential exposure pathways, particularly when application takes place on wet ground or near to drains or watercourses (Forest Research, 2019).

Environment Agency Wales, Forestry Commission and UPM (2010) have studied the release of cypermethrin to the water environment following application to saplings after planting. Chemical and biological samples were taken at 51 sites across Wales where cypermethrin had recently been applied. In addition, more intensive sampling was undertaken at 8 newly planted forest plots identified as being of higher risk of causing pollution.

At two of the intensively sampled plots cypermethrin was detected at levels of concern in some of the small drainage channels, but there was sufficient dilution to prevent any impact on water quality in the main streams near these locations. Cypermethrin was not detected at levels of concern in receiving waters at any of the sampling locations from the other 51 sites, although it was noted that a delay between application and sampling increased the chance of short term impacts being missed (Environment Agency Wales, 2010).

3.5. Landfill

Leachate from landfill is a potential source of cypermethrin to the environment due to the disposal of materials such as timber that have been treated with cypermethrin. Cypermethrin may also be present as a result of disposal of pesticide containers, sometimes containing unused product, in the household waste (HSE, 2016). Disposal to waste rather than recycling has been the recommended route for disposal of pesticide containers (Defra, 2013a) although containers for ready to use products can now be recycled.

Eight landfill sites reported emissions of cypermethrin to the Pollution Inventory in 2017(Environment Agency, Pollution Inventory Data). In all cases however emissions were noted as below the reporting threshold of 0.005kg.

We have no other information on concentrations of cypermethrin in landfill leachate. As cypermethrin adsorbs to organic matter the potential for it to leach from landfills may be reduced.

3.6. Waste water treatment works (WwTW)

Cypermethrin has been detected in the effluent of WwTWs sampled as part of the water industry's Chemical Investigation Programme (CIP). The latter involves the analysis of a wide range of chemicals in WwTW effluent at works across the UK.

The current phase of the CIP programme known as CIP2 will monitor effluent from over 600 WwTWs over the period 2015 to 2020. The CIP2 has focused on sites with low dilution in the receiving waters and so at greatest risk of causing noncompliance with EQSs downstream. WwTWs sampled have ranged in size from 250-1.6 million population equivalents, although most are between 5,000-50,000 population equivalents (pe).

Results reported to date show cypermethrin was detected in the effluent of all WwTWs monitored. The average concentration of cypermethrin in the effluents in the first group of WwTW was reported to be 0.00034µg/l (UKWIR, 2018) and 0.00094µg/l for a subsequent group (UKWIR, 2019).

Three WwTWs reported releases of cypermethrin to the water environment to the Pollution Inventory in 2017 (Table 2) (Environment Agency, Pollution Inventory Data). The amount released from these three sites ranged from 0.06 to 8.92kg.

Cypermethrin may enter the sewage network via a wide range of routes. These include effluent from industrial activities, such as the wool scouring and paper and pulp industries, as well as input from domestic sources. The latter include the disposal of excess or unused pesticide or biocide product down the drain or sink as well as washings from the cleaning of empty containers (HSE, 2016), and also as a result of washing surfaces that have been treated with cypermethrin, for example, for the control of bed bugs.

Cypermethrin adsorbs to organic matter and therefore has the potential to be present in sewage sludge, and consequently in sludge spread to land. We do not currently have any information on levels of cypermethrin in sewage sludge. Some sludge analysis was undertaken as part of CIP2, however cypermethrin was not one of the parameters studied. Further work to investigate the presence of chemicals in sludge is planned for the next phase of the CIP programme, CIP3. Cypermethrin has been proposed as one of the chemicals that may be considered in this work and therefore further information may be available in the future in relation to presence in sewage sludge.

3.7. Paper and pulp industry

Eleven pulp and paper industry sites reported releases of cypermethrin to the Pollution Inventory in 2017 (Environment Agency, Pollution Inventory Data). Four of the sites reported releases to controlled waters with the remainder discharging to wastewater. Reported releases to controlled waters from these four sites ranged from 0.01 to 0.58kg.

The source of the cypermethrin released from these sites is currently being investigated. Cypermethrin may have been used to treat the wood from which the wood pulp is made. However, cypermethrin may also be present in the water abstracted for use in the process and as a result of water loss during the manufacturing process it may be concentrated up to a level where it is then detectable in the discharge. Following discussions between the Environment Agency and industry, cypermethrin is being monitored in the incoming water as well as the discharge from these sites to investigate further.

3.8 Chemical industry

A report in 2011 for the EU for the purposes of the Water Framework Directive did not identify any manufacturing or formulating sites for cypermethrin in the UK (ENTEC 2011). More recent investigations identify two chemical sites that have reported releases of cypermethrin to the Pollution Inventory in the last 5 years. In both cases releases were noted to be below the reporting threshold of 0.005kg.

Further investigation indicated that one site has not reported any releases of cypermethrin since 2014. At the other site, emissions are thought to be associated with pesticide formulation.

Formulation is not covered by the Environmental Permitting Regulations (EPR) 2010 and therefore there is no requirement to report emissions from this activity to the Pollution Inventory. Emissions have only been reported as the sites' principal activity is regulated by EPR. The Environment Agency does not regulate formulation plants so we currently do not have more information on the extent of this activity and the potential for this to be a source of cypermethrin to the environment in England.

4. Environmental monitoring data and risk assessment

We monitor for cypermethrin in surface waters across England. In addition, as noted in Section 3, cypermethrin is being monitored as part of the CIP2 programme. As a result data is available on concentrations present in surface waters upstream and downstream of many WwTWs included in CIP2.

Cypermethrin has been designated by the EU as a Priority Substance under the Environmental Quality Standards Directive (2013/39/EU), a daughter Directive of the Water Framework Directive (WFD) (2000/60/EC). Prior to this cypermethrin was identified as a Specific Pollutant in the UK under the WFD.

An Annual Average (AA) EQS for cypermethrin of 0.00008µg/l for freshwaters and 0.000008µg/l for saline waters is specified in the Directive (2013/39/EU). Annual averages are derived in relation to the effects of long term exposure to a chemical.

In addition EQSs expressed as Maximum Allowable Concentrations (MACs) of 0.0006µg/l and 0.00006µg/l have been set for freshwaters and saline waters, respectively. MACs are derived in relation to the effects of short term exposure to a substance.

Both the AA and MAC EQSs for cypermethrin came into effect in December 2018 and replaced the UK specific EQSs for cypermethrin which were derived previously when it was a Specific Pollutant in the UK (Defra, 2015).

The available surface water data is summarised below and compared with the EQSs.

4.1. Environment Agency surface water monitoring data

We have only considered monitoring data obtained since May 2016 in this narrative. Prior to this date, we did not have a sufficiently sensitive analytical method to enable cypermethrin to be measured at the very low concentrations required to allow assessment against the freshwater EQS.

Analytical constraints remain for saline waters as our method is not sufficiently sensitive to accurately measure at or below the saltwater EQS.

We monitored for cypermethrin at 280 freshwater sites over the period 2016 to 2018. The majority were downstream of many of the WwTWs included in the CIP2 programme. Approximately 40 saline water sites were monitored during this period. The number of samples taken at each site ranged from just one or two up to 30.

The average concentration at the freshwater sites ranged from 0.000005µg/l up to 0.001296µg/l with the highest average concentration being more than 16 times the freshwater AA EQS value of 0.00008µg/l.

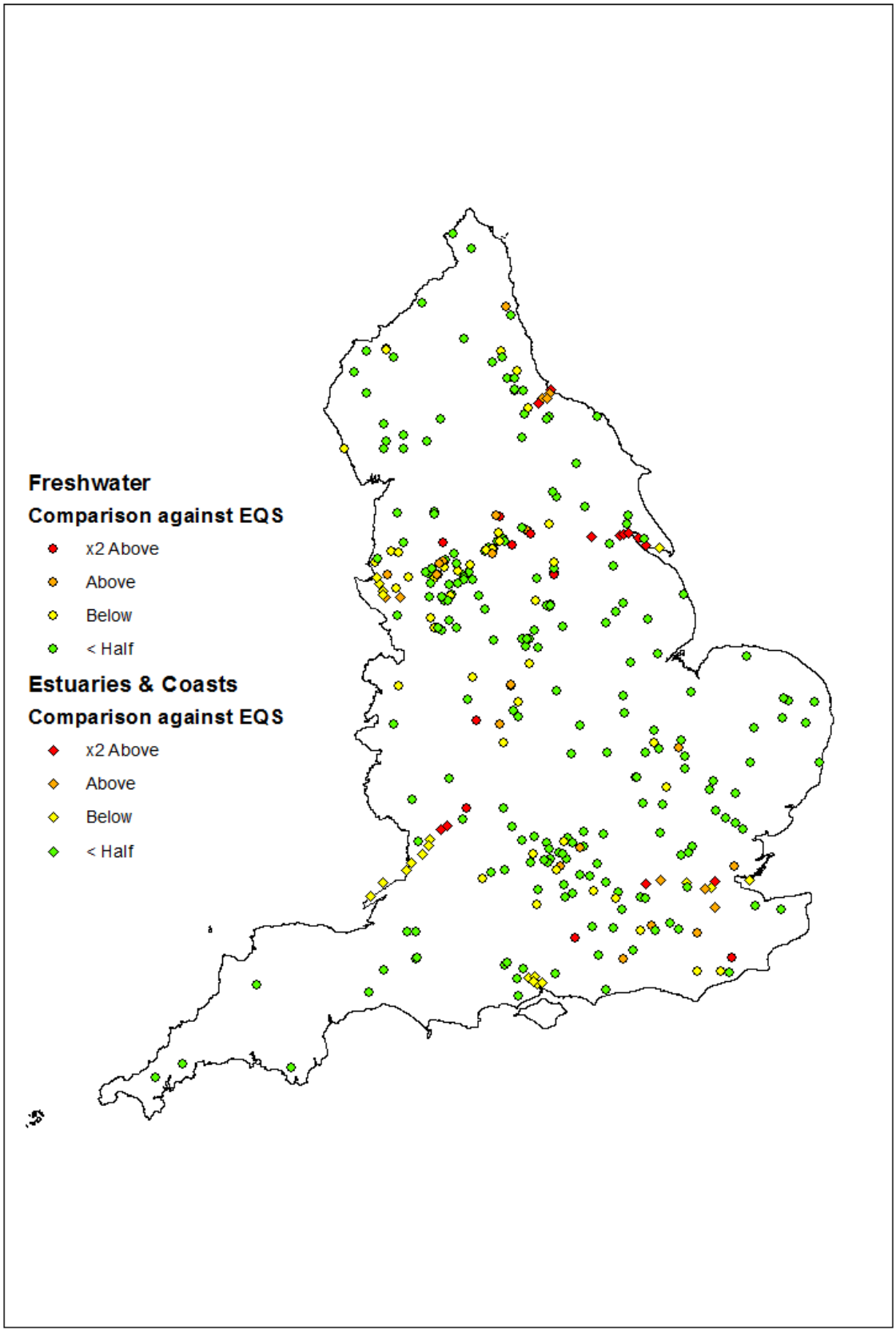
The lowest average concentration of 0.000005µg/l occurred at those sites where no positive detections were reported. All the results at these sites were therefore below the Minimum Reporting Value (MRV) for cypermethrin of 0.00001µg/l. In these circumstances the concentration used to calculate the average is half the MRV, resulting in an average of 0.000005µg/l at those sites where no positive detections were reported.

The average concentration was above the EQS at 26 of the 280 freshwater sites monitored (Figure 6). These sites were located across the country including the north east, north west and south east. At 9 of these sites the average concentration was more than double the EQS.

At the saline sites, average concentrations ranged from 0.000005µg/l up to 0.000096µg/l. The highest average concentration (0.000096µg/l) is 12 times the AA saline EQS value of 0.000008µg/l. As for the freshwater sites an average concentration of 0.000005µg/l was calculated for those sites at which no positive detections were made and where all the results were below the MRV for cypermethrin of 0.00001µg/l.

The average concentration was above the EQS at 20 of the 40 saline sites monitored (Figure 6). These sites were in estuaries across the country including the Tees, Humber Thames, Severn and Mersey. At 12 of these sites, the average concentration was more than double the AA saline EQS.

Figure 6. Comparison of average concentrations of cypermethrin measured at freshwater and saline water sites across England, 2016 to 2018, with the Annual Average EQS



Cypermethrin is highly toxic to aquatic life and can have adverse effects on aquatic life following short exposures. Individual concentrations detected over the period 2016 to 2018 have therefore been compared with the MAC EQS values to assess whether any individual concentrations could be of concern for aquatic organisms.

In freshwaters, the concentration detected was above the MAC in only 31 of the 3,400 (0.9 %) samples. These occurred across 9 sites with several of these sites only having one concentration above the EQS. In saline waters 16 of the 340 samples (4.7%) reported concentrations above the MAC. These occurred across 3 sites of which two were on the Humber.

4.2. Surface water monitoring data from the Chemical Investigation Programme (CIP)

In addition to monitoring WwTW effluent, upstream and downstream environmental samples are taken for most sites monitored as part of the CIP2.

The average concentration at the upstream sites of the latest tranche of WwTWs to be considered was 0.00012µg/l (UKWIR, 2019). Across the three tranches of work undertaken to date, between approximately 30 and 40% of the upstream sites monitored in each tranche had a mean concentration above the freshwater AA EQS based on a face value assessment (UKWIR, 2019).

At the downstream sites in the latest tranche of monitoring the average concentration was 0.00025µg/l (UKWIR, 2019). The mean concentrations were above the freshwater AA EQS at approximately 40 to 50% of the downstream sites monitored in each of the three tranches to date based on a face value comparison (UKWIR, 2019).

The results to date indicate that at many of the WwTWs studied in the CIP2 programme, the upstream concentrations contribute to the cypermethrin load measured downstream of the WwTWs. This indicates that WwTW effluent is not always the most significant contribution to the downstream load.

The results highlight the need to consider upstream sources of cypermethrin when assessing potential inputs and sources of cypermethrin at a catchment scale. Given the range of uses of cypermethrin and potential sources, these are likely to vary according to land use within the catchment.

5. Control measures

Many initiatives are currently in place which aim to promote best practice and safe use of plant protection products, veterinary medicines and biocides such as cypermethrin. These include EU and national legislation, national codes of best practice and guidance drawn up by a range of organisations, such as the Forestry Commission.

5.1. Biocides

Cypermethrin has been approved for use in the EU as an insecticide (EU 2015, EU 2018) and wood preservative (EU, 2013a) under the Biocidal Products Regulation (528/2012). The approval process assesses the potential impact on both human health and the environment from the use of cypermethrin.

Following EU approval each Member State can authorise products containing that active ingredient.

The Chemicals Regulation Division of the Health and Safety Executive (HSE) is responsible for product authorisation in the UK. Product authorisation takes into consideration any specific conditions set by the EU in relation to the approval of a substance for a particular use. For example, the EU approval for use of cypermethrin as a wood preservative states that it should not be used to treat outdoor constructions near or above water, unless there is evidence that the risk is acceptable (EU, 2013b). The EU approval for its use as an insecticide, notes that Member States should assess risks to the aquatic environment from wet cleaning of treated surfaces when approving products containing cypermethrin (EU, 2015).

Prior to the introduction of the Biocidal Products Regulation insecticidal biocide products were regulated in the UK under the Control of Pesticides Regulations (COPR) 1986 (amended 1997). At the time of writing, approximately 150 cypermethrin based insecticidal products are still regulated by this legislation which is enforced by HSE (HSE, Control of Pesticide Regulations database). This legislation is likely to become redundant as products controlled under COPR gradually move under the scope of the Biocidal Products Regulation (528/2012).

Authorised products are labelled with a range of information including how to apply the product, how much can be applied, and methods of application and disposal. The label will also state whether the product is approved for use by those using it as part of their work and/or by members of the public in home and garden situations too.

General guidance on the use of biocides, provided by HSE (Using biocides), highlights that such products should be used responsibly and correctly and that where possible alternatives to biocides should be considered. The guidance states that professional users of such products should receive appropriate training which is available from a number of organisations.

5.2. Plant protection products

Cypermethrin has been approved in the EU for use as a plant protection product under Regulation 1107/2009 (EU, 2011, EU 2018b, EU, 2019). The potential impact of the substance on both human health and the environment is assessed as part of the approval process. Once approved by the EU, companies can apply to Member States for authorisation to market plant protection products containing cypermethrin.

The Chemical Regulation Division of HSE is responsible for authorising plant protection products for use in the UK. Each authorised product has conditions for its use including

the crops on which it can be applied, the amount which can be applied and timing of application. The product label will also specify any additional measures necessary to protect workers, residents and the environment. These include the use of buffer zones, when spraying near water, and the use of equipment that reduces the potential for spray drift, known as drift reduction technology. Buffer zones, for the protection of aquatic life, are effectively no spray strips to prevent spray drifting out of the treated area.

The use of cypermethrin, along with other pesticides, will also be influenced by a range of measures that have been put into place to promote the best use of pesticides. The EU Directive 2009/128/EC, for example, aims to achieve sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide use on human health and the environment, and promoting the use of Integrated Pest Management and alternative approaches to pesticides. The need for training for users, advisors and distributors of pesticides, the inspection of pesticide application equipment, prohibition of aerial spraying, limitation of pesticide use in sensitive areas, and information and awareness raising about pesticide risk are all outlined in the Directive. It also requires Member States to develop National Action Plans to set out measures and timetables to meet the requirements of the Directive.

The Plant Protection Products (Sustainable Use) Regulations 2012 incorporates the above Directive into UK legislation. A UK National Action Plan for the sustainable use of pesticides (plant protection products) (Defra, 2013b) includes a range of requirements. These include the need for all professionals using such products to undergo training and hold an agreed certificate, for all spraying equipment to be tested under the National Sprayer Testing Scheme, as well as initiatives to reduce the risk of pesticides reaching the environment. These include two industry led schemes the Amenity Forum and the Voluntary Initiative which help promote best practice and responsible use of pesticides.

In addition, the Code of Practice (HSE, 2006) for using plant protection products provides advice and guidance in relation to best practice on the use of pesticides. An accompanying guidance note has been produced to take into account the requirements of the 2012 Regulations (HSE, 2014). It includes guidance on the use and storage of pesticides to help minimise the risk to the environment and human health.

5.3. Forestry

Cypermethrin based products approved for use in forestry are types of plant protection products and are therefore subject to the legislation and guidance outlined in Section 5.2.

In addition a number of forestry specific guidance documents and forest certification schemes consider the use of pesticides, including cypermethrin. These are outlined below.

The UK Forestry Standard (UKFS) (Forestry Commission, 2017) sets out the government's requirements for sustainable forest management including guidance on the use of pesticides in forestry. A key principle of the UKFS is that pesticides should be used as a last resort when practicing sustainable forest management and that necessary use should be minimised. The UKFS provides guidance on minimising the potential impact of pesticides on the environment, including:

– pesticides should be applied by appropriately trained personnel, used according to the label, and be stored and disposed of appropriately
– weather conditions should be taken into account when applying pesticides and application delayed if heavy rain or wind is forecast or the ground is waterlogged
– drainage channels in the area to be treated should not discharge directly to a watercourse and buffer areas should be extended to incorporate individual drains

– preparation of pesticides for spraying and filling, and cleaning or maintenance of sprayers should be undertaken in conditions that ensure any spillage, run-off or washings are prevented from entering any surface water or wetland and should not be undertaken within 10 metres of any surface water or wetland
– treated planting stock should not be soaked in surface water or wetland prior to planting

The UKFS highlights the particular concerns associated with the impact of cypermethrin on the aquatic environment. It notes that when using cypermethrin rigorous attention should be paid to good practice and spraying precautions in order to minimise risk of water contamination. In addition it states that buffer zones should be extended when using cypermethrin to incorporate boggy ground and drains that form the source area of streams, even if these appear dry at the time of application (Forestry Commission, 2017).

The Forest Research report (2019) on managing forests to protect water quality provides further guidance on the safe use of pesticides.

Cypermethrin is primarily used in forests to control pine weevil. Forest Research (2017) developed interim guidance on the control of this pest. It recommends use of an integrated approach which can involve a range of different techniques, potentially in combination with each other, including physical controls, biological controls, chemical controls as well as wider management techniques such as species planted and clear felling approaches. The use of an integrated approach means there is not sole reliance on chemicals. However the report notes that the use of insecticides will still be needed.

Forest certification schemes have been developed with the aim of giving independent assurance that timber bearing the certification label, and the forest from which it is derived, have been responsibly managed. The Forest Stewardship Council (FSC), for example, runs a global forest certification scheme. This is a voluntary scheme which enables consumers to identify, purchase and use wood, paper and other forest products produced from well-managed forests.

The FSC pesticides policy (FSC, 2019a) identifies 'highly hazardous' pesticides which are prohibited from use in FSC certified forests unless a derogation is in place (FSC, 2019b). Cypermethrin is on this list.

No derogations are currently in place in the UK for the use of cypermethrin (FSC, 2019c). Prior to this there were 31 derogations in the UK for the period June 2014 to October 2017 (FSC, 2016). The use of cypermethrin to treat planted saplings is therefore likely to reduce in the UK due to the fact there are no derogations in place for FSC certified forests in the UK.

The UK Woodland Assurance Standard (UKWAS, 2018) is a voluntary, independent certification standard. It includes the requirements of the UKFS as well as those of the two main global forest certification schemes, the FSC and the Programme for the Endorsement of Forest Certification (PEFC). Meeting the requirements of the UK Woodland Assurance Standard therefore means the requirements for both the FSC and the PEFC certification are met along with those for the UK Forestry Standard.

5.4. Veterinary Medicines

The EU Veterinary Medicinal Products Directive 2001/82/EC sets out the controls on the manufacture, authorisation, marketing, distribution and post-authorisation surveillance of veterinary medicines. This Directive provides the basis for the UK controls on veterinary medicines which are set out in the Veterinary Medicines Regulations 2013.

Veterinary medicine products require a marketing authorisation before they can be sold and used in the UK. Authorisations can be made at a UK level by the Veterinary

Medicines Directorate (VMD) or at an EU level by the European Medicines Agency (EMA), if the product is to be marketed across the EU. Authorisation includes details on how the product may be used, for example, to treat what condition, at what dose and how it should be stored and disposed of. Some of the products used to treat sheep include statements that the treated sheep should not come into contact with a watercourse for a defined period, including one hour and twelve hours (VMD Product Information Database).

Cypermethrin based sheep dip products were previously authorised for use in the UK. However, following Environment Agency reports of serious pollution incidents arising from the use of cypermethrin as a sheep dip, the UK government temporarily suspended the marketing authorisations of these products in 2006. A pollution reduction programme was drawn up in 2007 (Environment Agency, 2007). However at the beginning of 2010, manufacturers of the cypermethrin sheep dips voluntarily withdrew their marketing authorisations (VMD, 2011). No cypermethrin based sheep dips are currently authorised for use in the UK.

Wool processing has been identified as a potential route for the release of cypermethrin to the water environment (Section 3). The textile industry, which includes wool processing activities such as wool scouring, is regulated under the Industrial Emissions Directive 2010/75/EU. The latter regulates emissions from industrial installations through the use of Best Available Technology (BAT). BAT for different industries are outlined in BAT Reference Documents (BREFs). The BREF for the textile industry (EC, 2003) acknowledges that ectoparasitides such as cypermethrin are removed during processing and considers options to reduce levels. One approach is to minimise the amount of residue on the fleece before it enters the textile processing chain through, for example, product substitution, different methods of application and withholding treated sheep for certain time periods before shearing. It is noted in the BREF that many of the trade associations across the world have recognised the importance of minimising residues by good flock management, controlled application and use of recommended withholding periods (EC, 2003). The BREF is currently being updated by the EU.

The EU Ecolabel for textiles is a voluntary ecolabelling scheme which aims to encourage the use of sustainable practices in textile manufacturing. The ecolabel includes a number of ecological criteria including restrictions on ectoparasitide concentrations in wool (EU 2014/350/EU, as amended by 2017/1392/EU). A limit of 0.5 parts per million (ppm) is set for the sum total of the synthetic pyrethroids (cypermethrin, deltamethrin, cyhalothrin and flumethrin) in raw wool prior to scouring. Wool scourers that operate closed loop water systems that do not discharge wastewater effluent and which breakdown the ectoparasitides are derogated from the requirement to test wool for these substances (2014/350/EU). The International Wool Textile Organisation (IWTO) has adopted the EU Ecolabel standards as its definition of ‘eco-wool’. IWTO is the international body representing the interests of the world’s wool textile trade and industry. The Australian sheep industry is noted to be actively advocating low or zero residues in fleeces sheep and takes into consideration the requirements of the EU Ecolabel as do organisations involved with wool production in New Zealand (Wools of New Zealand).

6. Discussion

Cypermethrin is used in the UK as a plant protection product, biocide and veterinary medicine. As a result it is used in both arable and livestock farming, in homes and gardens and in public and commercial buildings.

Approximately 24,000kg was used for UK arable farming in 2016, mainly on wheat and oilseed rape. In 2017, approximately 13,000kg of cypermethrin was sold for use in the UK as a veterinary medicine. No information is available on the amount used as a biocide or for forestry or home garden use.

Although the amount of cypermethrin used in arable farming in the UK approximately halved between 2000 and 2016, it is still widely used, with cypermethrin accounting for 23% of the total area of arable farm crops treated with insecticide in 2016 (Fera Science, 2018a). The amount of cypermethrin sold for veterinary medicine in 2017 showed a notable rise compared to the previous years (2010 to 2016).

Due to the wide range of uses, the sources and potential pathways of cypermethrin to the environment are varied. They include diffuse sources arising from use in arable and livestock farming and point sources including industrial discharges and inputs from WwTWs.

Surface water monitoring data for both fresh and saline waters across England show the average concentration of cypermethrin detected at a number of the sites monitored over the period 2016 to 2018 were above the respective AA EQS. These sites were located across the country including the north east, north west and south east. In addition data from the CIP2 programme showed that the average concentration at many of the sites upstream of the WwTWs had average concentrations which were above the EQS.

Due to the high toxicity of cypermethrin to aquatic life small concentrations have been identified to be of concern. This is reflected in the very low EQS values for cypermethrin, for example the freshwater AA EQS is 0.00008µg/l. Relatively small inputs can therefore potentially be a cause for concern.

Many initiatives are currently in place which aim to promote best practice and safe use of plant protection products, veterinary medicines and biocides such as cypermethrin. These include both legislative measures, such as EU Directives and national legislation through to national codes of best practice and guidance. These help to promote best practice and use of cypermethrin which can help to reduce the entry of cypermethrin into the water environment. The EU Ecolabel for textiles, for example, raises awareness of the need to control levels of cypermethrin in sheep fleece before processing. In addition the FSC certification scheme is likely to lead to reduced use of cypermethrin on planted saplings due to restrictions on the use of cypermethrin in forests seeking certification.

Where the presence of cypermethrin can be linked to known inputs at a local level, steps have been taken to control inputs. Work, for example, is being undertaken through permitting and liaison with the industry to reduce inputs of cypermethrin from wool processing sites. In addition, we are working with the pulp and paper industry to identify the source of cypermethrin present in the discharges to the water environment by monitoring for cypermethrin in the water entering the site as well as the discharge.

Further evidence is required however to understand the sources of the cypermethrin detected in surface waters across the country, and their relative contributions, so that relevant measures can be identified to help reduce input to the water environment. Data from the CIP2 programme show that upstream concentrations of cypermethrin contribute to the cypermethrin detected downstream of WwTWs along with that present in the

effluent. At a number of sites the upstream concentration was found to be the predominant contributor of the cypermethrin detected downstream of the WwTW. This highlights the contribution of sources other than WwTWs (UKWIR (2019). The fact WwTWs are not always the dominant source of cypermethrin in a catchment was also reported in the findings from catchment investigations undertaken for CIP2. The relative contributions from these different sources was noted to vary between catchments depending on the nature of the catchment including land use (UKWIR, 2018). These findings are expected, based on the wide range of uses of cypermethrin, but reflect the need to understand the key inputs on a national basis to identify suitable measures.

A number of steps are planned and underway to develop this understanding. Targeted monitoring programmes in 2018/19 and 2019/20 have been developed to try and identify inputs from different sources of cypermethrin at a national level. Land use information has been used to identify sites in locations likely to be associated with high cypermethrin use including those where wheat and oilseed rape are grown, and where sheep and cattle farming occurs. Sites have also been identified to confirm the influence of emissions of cypermethrin that have been reported from industries such as wool processing and pulp and paper. In addition some of the upstream sites identified in the CIP2 programme have been included to try and gain additional information to help identify potential sources.

Conceptual modelling has been used to identify sources and pathways that could be a significant source of cypermethrin to the water environment on a national scale and to evaluate potential source control measures for cypermethrin (Environment Agency, 2019). Surface run-off from hard standings on both arable and livestock farms have been identified as potential key sources along with surface run-off from arable application. These will be considered in the development of the 2020/21 monitoring programme.

Initial analysis of the available monitoring data indicates that at many sites cypermethrin can be present at intermittently high levels. This brings challenges for the monitoring programmes as peaks may be missed by the sampling programme. Additionally a few high concentrations can have a significant influence on the average concentrations calculated for a site for comparison with the EQS. Plans are in place to increase the frequency of monitoring during the 2019/20 monitoring programme at arable sites during times where the highest use of cypermethrin has been identified based on usage data.

The monitoring data has been considered to assess whether there is a consistent time period when highest occurrence of cypermethrin is detected in surface waters to see if this indicates potential use patterns and sources. Initial analysis does not show a consistent time period of occurrence of the high concentrations of cypermethrin detected but further analysis will be undertaken as additional data becomes available.

Cypermethrin has been detected in all the WwTW effluents monitored to date for the CIP2 programme. Inputs to the sewer network include industrial emissions, for example from wool scouring activities, inappropriate disposal of unused home and garden products or disposal of container washings to the sink (HSE, 2016) and wash off from treated surfaces in the case of biocidal use. As part of the next phase of the CIP programme (CIP3) a number of sewer catchment investigations will be undertaken which will involve monitoring within the sewer network as well as influent and effluent to try and identify the sources of the cypermethrin present.

In addition to the steps identified above, further work will be required to help understand the relative inputs of cypermethrin to the water environment and ensure EQS compliance. We do not yet, for example, have a full picture of the scale of use of cypermethrin and data on the extent of the use of cypermethrin as a biocide is not available. The need for further information on the use of cypermethrin as a biocide was identified in a recent report (Environment Agency, 2019). This identified a number of biocide uses as potentially key

sources of cypermethrin but noted further information on the extent of use is needed to clarify the potential significance of these sources.

A wide range of stakeholders who have an interest in the use of cypermethrin can contribute to developing an understanding of potential control options and identifying appropriate and targeted measures to take forward.

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Appendix 1

Table 1. Amount of cypermethrin applied to different crop types in the UK (FERA Pesticide Usage Surveys 2016[1] and 2017[2])

Crop type	Total weight (kg)	Comments on use of cypermethrin
Soft fruit[1]	N/A	Limited use with no quantities provided
Orchard[2]	74	Used primarily on apples.
Arable[3]	23,743	43%(10,221kg) on wheat, 35% (8,358kg) on oilseed rape
Edible protected crops[4]	Less than 1	Very low amounts below the recording threshold used (includes tomatoes, peppers and lettuce).
Outdoor vegetable crops[5]	161	24% used on brassicas, 43% on 'other vegetables' including peas, beans and carrots.
Potato storage[6]	None	No use reported
Grassland and fodder[7]	40	Fodder beet/mangolds (16kg), stock feeding crops (13kg) and stubble turnips/catch crops (11kg)

1 The soft fruit survey considers pesticide use on strawberry, blackcurrant, redcurrant, gooseberry, blueberry, raspberry, blackberry, vine, hybrid berries. The latest survey for this crop type was undertaken in 2016 (Fera, 2017a). No specific information was given for cypermethrin indicating relatively low usage. It was noted to be included in the results for 'other insecticides' which indicates some but small use.

2 The survey considers pesticide use on apples, pears, plums and cherries. The latest survey for this crop type was undertaken in 2016 (Fera, 2017b)

3 The arable survey considers pesticide use on wheat, barley, oats, rye, triticale, oilseed rape, linseed, peas, beans, sugar beet and potatoes. The latest survey of arable crops was in 2016 (Fera, 2018a)

4 The edible protected crops survey considers pesticide use on for example, tomatoes, cucumbers, peppers, lettuce, other vegetables, strawberries and other fruit as well as edible plants in propagation. The latest survey of this crop type was in 2017 (Fera, 2018b). Very low amounts of cypermethrin were reported to be used.

5 The outdoor vegetable crops survey considers pesticide use on a range of crops. The latest survey was in 2017 (Fera, 2018c). Cypermethrin use was noted for peas and beans, brassicas, carrots and parsnips, lettuce, other root vegetables and other vegetables.

6 The latest potato storage survey was undertaken in 2016 (Fera, 2018d). No use of cypermethrin was reported.

7 The grassland and fodder survey considers pesticide use on grassland including permanent pasture and rough grazing as well as a range of fodder crops including maize, turnip, swede, fodder beet, kale, cabbage, rape, stubble turnips and catch crops and other crops used for stock feeding. The latest survey was undertaken in 2017 (Fera, 2018e).

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List of abbreviations

AA
Annual Average

BAT
Best Available Technology

BREF
BAT reference document

CIP
Chemical Investigation Programme

CIP 2
Chemicals Investigation Programme, phase 2

CIP3
Chemicals Investigation Programme, phase 3

COPR
Control of Pesticide Regulations

EC
European Commission

EMA
European Medicines Agency

EPR
Environmental Permitting Regulations 2010

EQS
Environmental Quality Standard

EU
European Union

FSC
Forestry Stewardship Council

HSE
Health and Safety Executive

IWTO
International Wool Textile Organisation

LOQ
Limit of quantification

MAC
Maximum Allowable Concentration

MRV
Minimum Reporting Value

PEFC

Programme for the Endorsement of Forest Certification

UK
United Kingdom

UKFS
UK Forestry Standard

UKWAS
UK Woodland Assurance Standard

UKWIR
UK Water Industry Research

VMD
Veterinary Medicines Directorate

WFD
Water Framework Directive

WwTW
Wastewater Treatment Works

Glossary

Adsorb
A sorption process in which one substance becomes attached to another via adhesion to the surface.

Bioaccumulate
The accumulation of a substance, such as a toxic chemical, in various tissues of a living organism.

Derogation
A temporary agreed exemption from a restriction on the use of a substance.

Environmental Quality Standard
A threshold for a substance in the water environment below which an adverse effect on the aquatic environment is not expected.

Pollution Inventory
The inventory collates data from large regulated industrial sites on emissions of specified substances to air and controlled waters and sewers, as well as quantities of waste transferred off site.

Priority substance
A substance identified as presenting a significant risk to or via the aquatic environment at an EU level under the Water Framework Directive.

Specific Pollutant
A substance identified by an EU Member State as being of Regional or local importance under the Water Framework Directive.

Synthetic pyrethroid
An organic compound, widely used as an insecticide, which is similar to natural pyrethrins produced by the chrysanthemum flower family.

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