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MAKE RAIN HAPPY

MAKE RAIN HAPPY

PROTECTING YOUR ENVIRONMENT USING SUSTAINABLE DRAINAGE

INTRODUCTION

As towns and cities grow and the population increases, more of our region has been covered by 'hard surfaces'. This means that there is less opportunity for rainwater to soak away naturally, creating greater risks of our drainage systems being overwhelmed and causing localised flooding.

THE BIG QUESTIONS:

- What has this got to do with me?
- What impact does overuse of the drainage system have on the environment, agriculture and our way of life?
- What changes do we all need to make to our traditional drainage system?

These are important questions that affect us all. News headlines show the changing weather patterns, the impacts of climate change and the devastation caused to communities by flooding.

You might think – 'well that's a shame and unlucky for that community, but it's nothing to do with me. It must be someone else's problem' – but is it?

ACTION

Ask your students to collect some stories from the internet, newspapers and magazines. Which countries are affected? Has your local area been affected by flooding?

THE AIMS OF THIS PACK ARE:

- To raise your awareness of the need to think differently about water in our environment, especially about long-term drainage in our region and why this is important.
- To introduce you and your students to an alternative method known as Sustainable Drainage Systems (SuDS), which copies natural drainage as closely as possible by allowing water to return to the water cycle and/or environment.
- To show that SuDS features can be installed as an alternative solution to help with localised flooding.
- To highlight links with the National Curriculum.

We need to ensure that through sustainable development, the needs of the present can be met without compromising the ability of future generations meet their own needs.

CURRICULUM LINKS: GEOGRAPHY

Geography	Geographical skills and fieldwork	Human and physical geography
KS1	Use simple fieldwork and observational skills **to study the geography of their school and its grounds** and the key human and physical features of its surrounding environment.	
KS2	Use fieldwork to **observe, measure, record and present the human and physical features in the local area** using a range of methods, including sketch maps, plans, graphs and digital technologies.	Human geography, including types of settlement and land use, economic activity including trade links **and the distribution of natural resources including** energy, food, **minerals and water**.
KS3	Use fieldwork in contrasting locations to **collect, analyse and draw conclusions from geographical data**, using multiple sources of increasingly-complex information.	Physical geography relating to: geological timescales and plate tectonics; rocks, weathering and soils; **weather and climate, including the change in climate from the Ice Age to the present;** and glaciation, hydrology and coasts. Human geography relating to: **population and urbanisation**; international development; economic activity in the primary, secondary, tertiary and quaternary sectors; **and the use of natural resources.** **Understand how human and physical processes interact to influence and change landscapes, environments and the climate; and how human activity relies on the effective functioning of natural systems.**
KS4	**Physical geography: processes and change**	**Changing weather and climate: The causes, consequences of, and responses to extreme weather conditions and natural weather hazards, recognising their** changing distribution in time and space and drawing on an understanding of the global circulation of the atmosphere. **The spatial and temporal characteristics of climatic change and evidence for different causes, including human activity**, from the beginning of the Quaternary period (2.6 million years ago) to the present day.
KS4	**People and environment: processes and interactions**	Resources and their management: **An overview of how humans use, modify and change ecosystems and environments in order to obtain** food, energy **and water resources**. Detailed study of one of either food, energy or **water, recognising the changing characteristics and distribution of demand and supply, past and present impacts of human intervention and issues related to their sustainable use and management at a variety of scales.**

CURRICULUM LINKS: SCIENCE

Science	Working scientifically	
KS1	Asking simple questions; observing closely; using simple equipment; performing simple tests; using their observations and ideas to suggest answers to questions; gathering and recording data to help in answering questions.	
KS2 Lower	Asking relevant questions and using different types of scientific enquiries to answer them; setting up simple practical enquiries; comparative and fair tests; making systematic and careful observations and recording findings; using simple scientific language, drawings and data charts; reporting on findings from enquiries; using results to draw simple conclusions; identifying differences, similarities or changes; using straightforward scientific evidence to answer questions or to support their findings.	
KS2 Upper	Planning different types of scientific enquiries; controlling variables where necessary; taking measurements; recording data using increasing complexity; using test results to make predictions to set up further comparative and fair tests; reporting and presenting findings from enquiries; identifying scientific evidence that has been used to support or refute ideas or arguments.	
KS3	1. Scientific attitudes; 2. Experimental skills and investigations; 3. Analysis and evaluation; 4. Measurement.	**Chemistry – Earth and atmosphere** Earth as a source of limited resources and the efficacy of recycling.
KS4	1. The development of scientific thinking; 2. Experimental skills and strategies; 3. Analysis and evaluation; 4. Vocabulary, units, symbols and nomenclature.	**Biology – Ecosystems** Positive and negative human interactions with ecosystems. **Chemistry – Earth and atmospheric science** The Earth's water resources and obtaining potable water. **Physics – Energy** Renewable and non-renewable energy sources used on Earth, changes in how these are used.

THE BIGGER PICTURE – FUTURE THREATS

Anglian Water Region – our region has its own specific issues making it vulnerable to climate change.

BIGGER PICTURE CLIMATE CHANGE – GLOBAL

Over the last few years we have seen more and more extreme weather events, both in the UK and around the world.

CLIMATE CHANGE

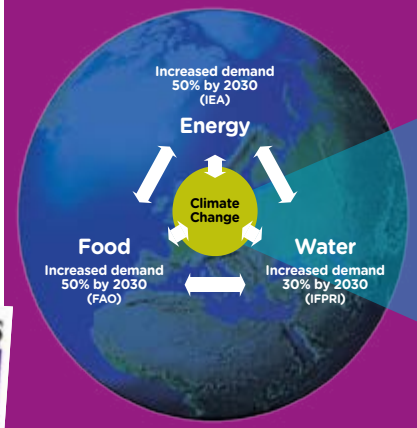
CLIMATE CHANGE IS ANY SIGNIFICANT TREND IN THE WEATHER OF A REGION OVER A PERIOD OF AT LEAST SEVERAL DECADES, E.G. INCREASING AVERAGE TEMPERATURE OR CHANGES IN SEASONAL RAINFALL.

RISING SEA LEVELS – 28% OF THE REGION BELOW SEA LEVEL

LESS WATER TO USE

FLOODING – EXTREMES OF WEATHER LEADING TO FLOODING

The global picture



The local context

...our region is on the front line.

Demand for water will rise but available water won't.

28% of the region is below sea level.

1 million homes will be built over 25 years to cope with our growing population.

We're a low-lying region so it takes lots of energy to pump water around.

We're the driest region in the whole of the UK.

DEMAND FOR WATER – 1 MILLION NEW HOMES WILL BE BUILT

DROUGHTS

For further information about the impact of climate change on the region see our pack.

We know that our region is vulnerable to climate change, but in this pack we are going to focus on flooding and why flooding is a real threat to our region. So let's start by thinking about traditional drainage in our region and the impact of traditional drainage.

WHAT DRAINAGE CURRENTLY EXISTS?

So, let's start at the beginning and think about the current traditional drainage system that is in place in most parts of our region.

TRADITIONAL DRAINAGE

Traditional drains are:

- Underground pipes that are used to take rainwater to either the nearest watercourse or sewage to a recycling centre works, where Anglian Water treats sewage.
- The pipes are either made of plastic, clay or concrete and are difficult to clean and maintain.
- Pipes have a capacity limit, which means they can become overwhelmed and flood.

THERE ARE THREE DIFFERENT TYPES OF SEWERS: FOUL, SURFACE WATER AND COMBINED.

FOUL WATER

Dirty water from toilets, sinks and washing machines etc. should go to the foul water sewer and on to the Water Recycling works.

SURFACE WATER

Clean water or rainwater should go to the Surface Water Sewer which runs into rivers or the sea. This helps the environment.

COMBINED

Foul and surface water all join together in one sewer and go on to the Water Recycling Centre.

OUR REGION – NOT QUITE SO SIMPLE...

Our region is unique. In addition to traditional sewer drainage systems, the Fens has a complex and efficient network of drains, dykes and ditches.

WHAT IS THE ISSUE?

Despite having different types of sewers and drainage systems in our region, our towns and cities are generally composed of impermeable surfaces such as roof areas, road surfaces, concrete surfacing and paving slabs. As the water is not able to soak through these impermeable surfaces it pours into the drains and sewers, which become overwhelmed by the volume of water.

ENVIRONMENTAL AND SOCIAL IMPACT OF TRADITIONAL DRAINAGE

We know that over time large amounts of our green areas have been built on so there is limited natural drainage; this can cause our drainage system to become overwhelmed, leading to flooding.

IMPACT

FLOODING

So why is flooding a real threat to our region?

- **Our climate is changing.** The UK is expected to have drier summers and wetter winters, along with more frequent intensive rainstorms which can cause flash flooding.
- **There is an increase in population and urbanisation**. This means extra housing demand and associated infrastructure needs to be built to cope, such as shops, roads, supermarkets, schools, etc. This has caused a loss of green space, preventing rainwater from soaking into the ground. Before urbanisation the rainwater would filter into the ground where it fell.
- Not only have we **lost green space,** we are also **reducing the habitats available for wildlife** – leading to a **loss in biodiversity**.
- The region has a long, low-lying, soft coastline, making it particularly vulnerable to **the effects of coastal flooding, erosion and rising sea levels.**

SO WHAT DOES THIS MEAN?

Our traditional current drainage system is unable to cope with the extra demand caused by changes in weather patterns and growing urbanisation.

WHY IS THIS IMPORTANT TO ME?

If our drainage system becomes overwhelmed it can lead to flooding. This has devastating consequences on homes, schools, businesses and the environment. Can you imagine what it must be like to go home and find your house ruined and full of dirty water?

SO WHAT CAN WE DO?

IMPACT

We know that flooding is a real threat to our region, but why?

ONE SOLUTION WOULD BE:

To replace current pipes with larger ones, but:

- It's expensive, so bills would have to be raised.
- The environment would suffer; rainwater needlessly enters the sewage network, meaning it needs to be cleaned, adding to expensive pumping and carbon emissions.
- It is not a sustainable or long-term solution as we cannot keep building larger sewers, which may also run out of capacity.
- It would be very disruptive to replace over 76,000km of sewer pipes.

Because of climate change and an increasing population, the problem will only continue to get worse, so we need to work together to implement a long-term, sustainable solution and think about water differently.

WHAT'S THE ALTERNATIVE?

The best plan for us is to work with nature. By creating natural areas, rainwater can soak back into the ground and return naturally to the watercourse. This helps to reduce the need for it to enter the sewer system and reduces the risk of sewers being overwhelmed and causing flooding. We call these solutions 'Sustainable Drainage Systems' (SuDS).

SuDS schemes are effective in reducing the risk of flooding: they work with nature and are a cost-effective option.

Anglian Water starts work on East of England's biggest SuDS scheme

Click here for more

ACTIVITY: TYPES OF FLOODING

Have a look at the characteristics of the different types of flooding. What do you think is the impact of each type of flooding? Can you suggest a possible solution for each one?

Photo of Flooding	Name of Flooding	Characteristics	Impact	Solution
	**Surface water flooding**	This occurs when rainwater, snowmelt or other types of precipitation does not enter a watercourse or drainage system and collects on the surface.		
	**River flooding**	This occurs when rivers or watercourses burst their banks or when the water levels are high enough to overtop the banks. Usually caused by extensive rainfall and can be made worse by blockages, such as fallen trees and rubbish dumped in the river.		
	**Groundwater flooding**	This occurs when the water level in the ground rises higher than normal and approaches the surface. This is usually caused by prolonged periods of heavy rainfall because the ground becomes saturated.		
	**Sewer flooding**	This occurs when the drainage system does not have enough capacity to cope with the amount of water entering the system and overflows. It can also be caused by blockages and failures within the sewer network.		
	**Coastal flooding**	This occurs when intense storms cause high tides which increase sea levels. This in turn forces the water onto land, causing coastal flooding.		

IS THERE A SOLUTION?

WHAT IS SuDS?

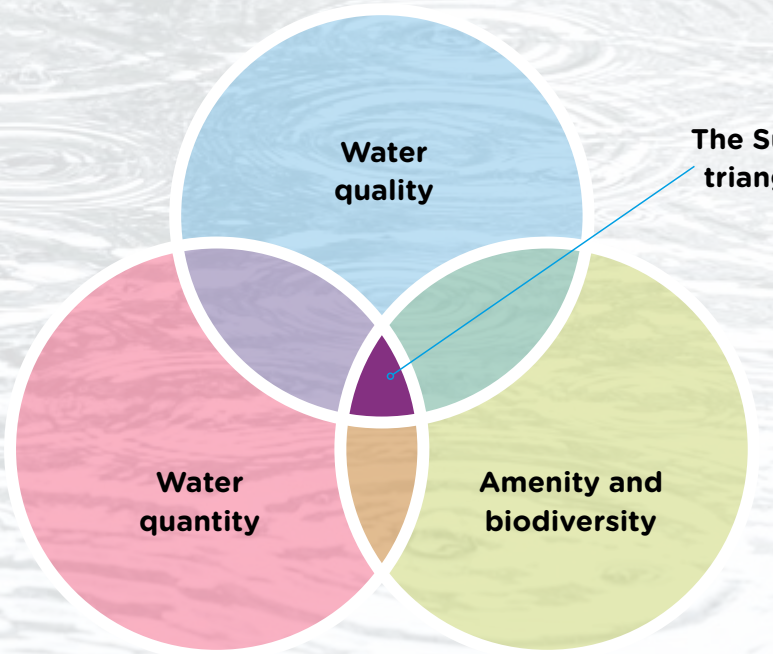
The good news is that to help to combat these problems, Anglian Water is working to implement Sustainable Drainage Systems (SuDS), which can help to mitigate or reduce the likelihood of flooding.

SuDS mimics natural drainage – it tries to copy how rain would fall and soak into the ground naturally before urbanisation. SuDS aims to keep the rain close to where it falls and to get it to soak into the ground instead of flowing down into the sewer and into the water recycling works. This is an environmentally friendly method to traditional drainage, as SuDS collects the rainwater and manages its flow back into the ground and back into the water cycle, without the need to enter the sewer network – saving expensive pumping and resulting in lower carbon emissions.

SuDS can be used to 'convey' (move) or 'attenuate' (store) surface water runoff or help the surface water to 'infiltrate', meaning the water will soak through into the ground.

Not only does SuDS play a critical role in flood mitigation, it also adds environment and biodiversity benefits to the surrounding area.

Prevent and treat polluted surface water runoff to protect the environment



Reduces the risk of flooding and erosion by controlling flow volumes and frequency of surface water runoff

Provides visual and community benefits for people. Creates habitats for wildlife

WHAT IS SuDS?

SuDS CASE STUDIES

PRIMARY SCHOOL NEWMARKET

What was the problem?

A large volume of rainwater from surrounding buildings and concreted areas was going into foul sewers. This caused the sewers to be overwhelmed and led to flooding in an area.

The plan – SuDS flood alleviation scheme

A major scheme of work was planned to help alleviate the flooding. The school was identified as a good place where retro-fitting of SuDS features could be implemented. The school had a large roof area amounting to over 1000m^2 and all the water from these vast roof areas drained into the foul sewer. By installing SuDS features it would divert the rain water from the roof areas into planters and rain gardens. This meant vegetation in the planters and rain gardens could soak up the rainwater and slowly return any excess rainwater back to the natural water course; resulting in a substantial reduction in the volume of rainwater coming from the school and going into the foul sewers.

The impact

By putting SuDS features in the school:

- Flooding – It would substantially reduce the volume of the rain water coming from the school which could otherwise overwhelm the foul sewers and decrease the flood risk in the catchment area downstream.
- Biodiversity – A number of green areas would be added to the school creating natural habitats leading to greater biodiversity.
- Learning outside the classroom – there would be greater opportunities to carry outdoor activities.
- Carbon footprint – The rainwater would be diverted away from the foul sewers so it will not need cleaning in a water recycling centre before it could be returned to the environment. This would help to reduce our carbon footprint and create capacity for development in the area.

ACTIVITY: SuDS INVESTIGATION

SURFACES

Many built-up environments have an **impermeable surface**, which means the rain cannot filter into the ground. By changing the surfaces to **permeable surfaces**, the water is allowed to filter through the ground and return naturally to the watercourse. **This avoids**:

- **the water going into the sewer** – reducing the risk of sewers being overwhelmed

- **costly pumping and cleaning** – so reducing the amount of electricity used and, therefore, reducing carbon emissions.

A CROSS-SECTION OF A CITY STREET PERMEABLE SURFACE

IMPERMEABLE SURFACE

ACTION

The first thing you will need to do is to identify and recognise the types of surfaces which **don't let water through** and are **impermeable**.

PERMEABLE SURFACE

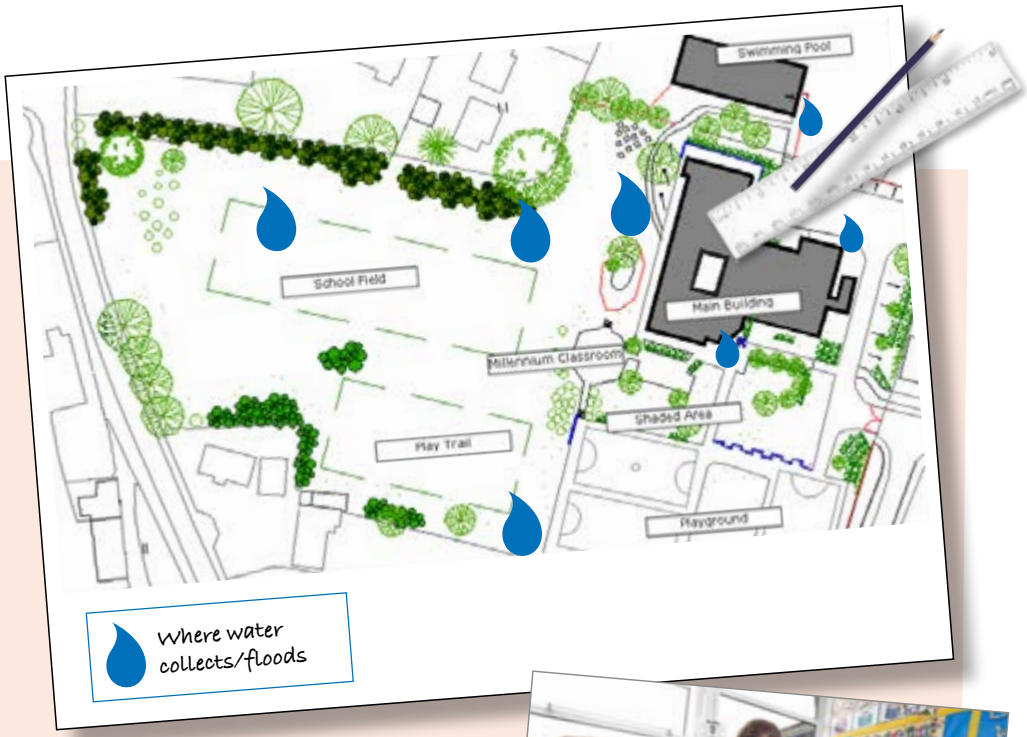
ACTIVITY: INVESTIGATION 1

Flooding audit – your environment: Mapping and identifying permeable and impermeable surfaces.

ACTION

WHAT YOU NEED TO DO:

- If at school – decide who will complete the audit: the school council, a class, a year group, or a small group.
- Start with a plan of your school, home or local area.
- All outside areas need to be inspected. Check the weather forecast – the best time to carry out the audit will be during or shortly after rainfall.
- Go to each area on the map and record the level of water which has collected on the surface. Use a ruler to measure the depth of the water 'pooled' on the surface [or make a rain gauge – (see section 8)].
- Identify the areas which have surface water flooding. For example in your school – the playground, playing fields, teachers' car park or garden area might flood.
- Highlight all the areas where you have seen water collect to create puddles or small areas of flooding. An aerial photograph and a map of your school can help you identify these areas. Try printing an image of your school from Google Maps.



TOP TIP!

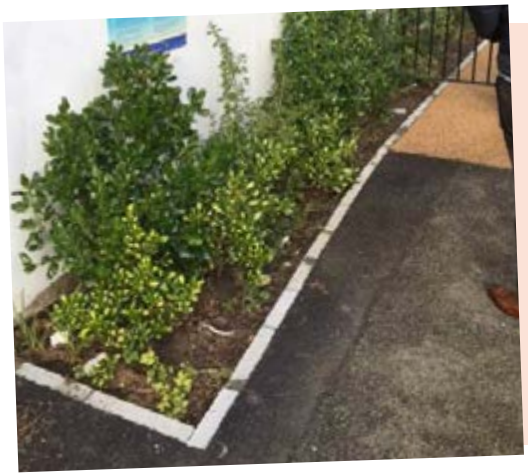
The best time to carry out the audit will be during or shortly after rainfall.

ACTIVITY: MAKING A WATER GAUGE.

You might want to make a rain gauge.

ACTIVITY: INVESTIGATION 1 CONTINUED:

- Complete a table to show the flooded areas and the level of flooding.
- Record the surface where the flooding appears or the water has collected. Is the surface made of Tarmac, concrete, stone? These are **impermeable** surfaces.
- Record any other types of surface which are in your school, home or local environment such as soil, sand, wood chippings, shingle, etc.



The flooded areas identified might be really good areas for putting in a SuDS solution, such as a rain garden to soak up all the excess water – we will look at SuDS solutions later in this pack.

ACTION SURFACE MAPPING TABLE – ADD YOUR WATER GAUGE DATA RESULTS.

Surface	Surface (tick)	Where	Depth of surface water/flooding
Soil			
Sand			
Concrete			
Wood			
Chippings			
Road surface			
Shingle			
Other (describe)			

IMPORTANT: NOW FOR THE HEALTH AND SAFETY BIT!
You will be entering areas which could be wet underfoot, have dips in the path or uneven ground. Walk carefully and wear suitable shoes.

ACTIVITY: INVESTIGATION 1 CONTINUED:

MAKE A RAIN GAUGE

WHAT YOU NEED:

Equipment:

- A plastic 2-litre bottle
- Scissors
- A measuring cylinder or jug

WHAT TO DO:

STEP 1

Cut the top of the bottle and turn the top part upside down to make a funnel. Ask an adult to help you.

STEP 2

Find an open space of ground outside away from trees and buildings. Dig a small hole to stand your rain gauge in.

STEP 3

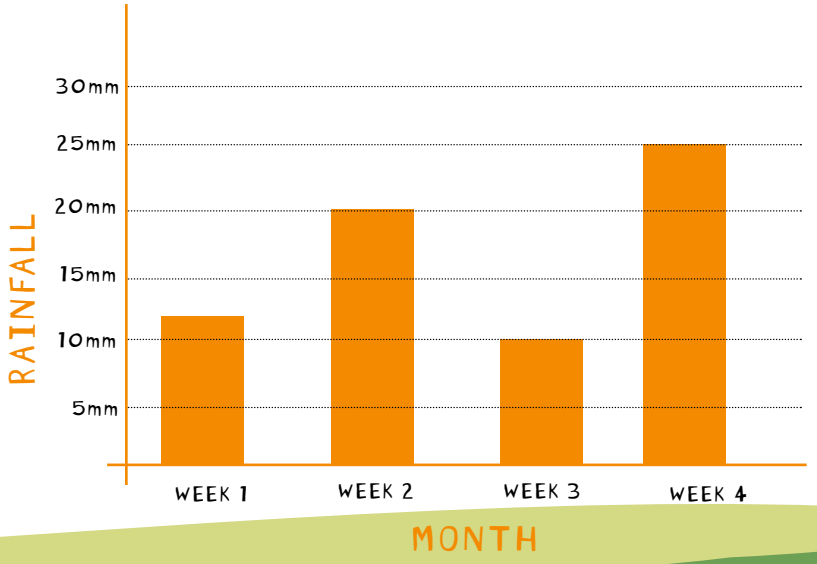
Check the rain gauge each day and pour any water into the measuring cylinder or jug.

STEP 4

Write down how much rain fell each day.

ACTION

ADD YOUR RESULTS TO YOUR SURFACE MAPPING TABLE.



ACTIVITY: INVESTIGATION 1 CONTINUED:

Now that you have identified areas where water collects, try to calculate the rainfall accurately.

WATER QUANTITY CHALLENGE

Calling all mathematicians! Put your maths skills to the test. Can you work out the following problems?

EXAMPLE:

If – 1mm of rainfall = 1 litre of water over $1m^2$

The size of a football pitch is (smallest size pitch) = 90m x 45m = $4,050m^2$

2mm of rainfall = 4,050 x 2 = $8,100m^2 \approx 8,100$ litres of water over just the football pitch

CHALLENGE 1

If 2mm of rain fell over a school of 1,250m x 2,750m, calculate how much water would fall.

CHALLENGE 2

Now calculate if 5mm of rain fell over the size of your own school or home.

How much water does that equate to?

CHALLENGE 3

Using the rain gauge measure for a storm/day and do the calculation.

ACTIVITY: INVESTIGATION 2

Water retention: The impact of permeable and impermeable surfaces

Now you know the different surface areas from your mapping table, let's investigate the impact of the different surfaces.

WHAT YOU NEED:

Equipment:

- Five 2-litre plastic bottles
- A selection of permeable surfaces – soil, sand, bark chippings, stones, shingle
- A selection of impermeable surfaces – Plasticine, playdough or old modelling clay
- Cotton wool balls
- 1-litre measuring jug
- Scissors
- Stopwatch
- 2 litres of water

STEP 1

Cut off the top quarter of each of the plastic bottles **(you need to get an adult to help you with this).**

STEP 2

Plug the drink opening end of each bottle with a cotton wool ball.

STEP 3

Fill 1 plastic bottle with an impermeable surface, such as Plasticine. Press the down plasticine or other material, to fill any holes and create a hard impermeable surface.

STEP 4

Fill each of the other 4 plastic bottles with a selection of permeable surfaces – for example, soil, sand, shingle and wood chippings – to create permeable surfaces.

STEP 5

Pour 200ml of water into a 1-litre measuring jug.

ACTIVITY: INVESTIGATION 2 CONTINUED:

IMPERMEABLE SURFACE

- Slowly pour 200ml of water over the impermeable surface.
- Measure – the time taken for the water to filter through the impermeable surface.
- Measure – the amount of water lying on the top of the impermeable surface. This will show the water which will run into the sewer and will need cleaning before it can be returned back to river and the water cycle.
- Measure – the volume of water which ran through the impermeable surface. Did any water run through the impermeable surface? This is the amount of water which would return naturally to the watercourse.

PERMEABLE SURFACES

- Repeat the investigation pouring 200ml of water over each of the other 4 plastic bottles containing the permeable surfaces.
- Measure – the time taken for the water to flow through each of the permeable surfaces. Is there a difference?
- Measure – the amount of water on the top of each of the permeable surfaces. This will show the surface water which will run into the sewer. Compare the amount of water with the impermeable surface.
- Measure – the volume of water which ran through the permeable surfaces. This is the amount of water which would return naturally to the watercourse. Why are some of the impermeable surfaces slower or faster flowing than other impermeable surfaces?

WHAT DID YOU FIND OUT ?

Compare your data collected and answer these questions.

How quickly did each of the surfaces flood? What problems would this cause?

What would be the impact of these different surfaces on your school, home or local community?

What is the benefit of the water slowly trickling through the permeable surfaces and gradually returning the water to the watercourse?

Which of the permeable surfaces do you think are the best for retaining water or regulating a steady flow of water back to the watercourse?

While all the surfaces are already wet, – repeat the investigation. Record and consider:

What was the same/different this time?

When the surfaces were already wet – did it make a difference or change the impact of water flow or flooding?

In reality – what would be the effect on the ground or our region if there is a 'dry' spell and no rain falls for a long period of time?

In reality – what would be the effect on the ground or our region when there is prolonged period of rain?

We now need to consider how we turn this simple example of SuDS into reality by adding SuDS features to our region. Check out sections 5 and 6.

ACTIVITY: INVESTIGATION 3

EXTREME WEATHER

Climate change predictions are that the UK will experience more extreme weather such as drier summers and wetter winters, along with more frequent intense rainstorms leading to a greater risk of flash flooding. Let's investigate why dry weather followed by lots of rain causes a problem.

WHAT YOU NEED:

Equipment:
Use the equipment from investigation 2 (water retention investigation).

WHAT TO DO:

PART 1

- Press down all the surfaces so that they are compacted.
- Leave all the equipment set up for 3 – 4 weeks to mimic a 'dry' spell when we do not have any rainfall.

PART 2 – AFTER 2-3 WEEKS

1. Fill up a 1-litre measuring jug with 1 litre of water.
2. Slowly pour the water over the top of one of the surfaces until the water floods over the top.
3. Measure – the time taken for the surface to flood.
4. Measure – the amount of water used before the surface flooded
5. Measure – the volume of water which ran through the surface before the water flooded over the top.
6. Record your results

- Refill your jug to measure 1 litre of water
- Repeat steps 1 – 6 for each of the remaining surfaces

Compare your results with the results from your previous investigation (investigation 2 – water retention investigation). What did you discover?

CONSIDER:

Which of the surfaces flooded?

Did any of the permeable surfaces flood after a prolonged 'dry' spell? If so, why?

How quickly did each surface flood after a prolonged 'dry' spell? Why have the properties of the materials changed?

Which surface needed the smallest/ largest amount of water before it flooded?

What do you think is better: slow steady rainfall over a period of time or quick bursts of rain every so often? Explain your reasoning.

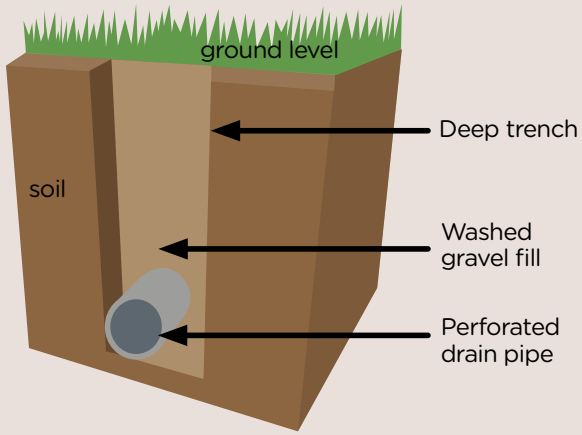
What could be the impact on the environment of heavy rainfall after a prolonged dry spell?

WHAT WE CAN DO

The good news is that to help combat flooding, Anglian Water is working to implement SuDS which can help to reduce the likelihood of flooding.

FILTER STRIP

Uniformly graded and gently sloping strips of grass or dense vegetation where runoff is collected and stored, allow water to filter into the ground.



SWALES

These are shallow ditches which are often grassed, but can be planted.

SILVA CELLS

Silva Cells are underground modular blocks with a large volume of soil on top. The soil allows large trees to be grown on top. The tree roots soak up water while the soil absorbs water.

PONDS AND WETLANDS

Both are features that are constantly wet with the allowance for additional storage after a rain event. Both provide treatment with the aid of vegetation and support biodiversity.

ATTENUATION TANKS

Underground storage tanks which capture the water runoff and allow water to slowly soak into the ground.

DETENTION BASINS

Rainwater is held in shallow depressions called basins to provide temporary 'storage' for surface water runoff. The basins have gentle slopes and can be planted with grasses, native meadow seeds, shrubs and trees. They are normally dry except after heavy rainfall and normally only hold water for a matter of hours.

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GREEN ROOFS – GREEN WALLS

Vegetation is planted on a roof or building, or, alternatively, in the ground and then fixed to walls, which creates a living surface. Water is absorbed within the vegetation or stored within the soil layer and then naturally evaporates back into the atmosphere.

BIORETENTION BASIN – RAIN GARDEN

A shallow landscape dip in the ground allows surface water runoff to form a pond on the surface before it filters through vegetation and underlying soils.

PERMEABLE SURFACES

Surface water runoff is allowed to run into the ground through specially-constructed paving material, which is usually made of material with lots of small holes.

WHAT YOU CAN DO

Putting in SuDS features can have several benefits and can make a big difference. Let's look in a bit more detail at what you can do in your school, home or local environment.

RECYCLE YOUR RAINWATER

Rainwater is collected from building roofs or impermeable surfaces and is stored either over-ground or in underground tanks. The water can then be used for external gardens or, for more advanced systems, the water can be recycled and used within the property.

CHECK OUT...

How to install a rain butt at our Potting Shed Club

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HARVESTING YOUR RAINWATER

We live in the driest region in the UK. On average we get between 450 and 660mm of rain each year, so making the most of that rainfall by harvesting it is vitally important.

WATERBUTTS

Install water butts around your garden. They can be attached to any plastic downpipe. You can even add guttering and downpipes to your shed and place a water butt by it. They can also be lined up in parallel to increase the amount of water stored. For a demonstration of how you can fit your water butt, go to **www.anglianwater.co.uk/install**

A WATER BUTT CAN COLLECT **5,000 LITRES** OF RAINWATER FROM AN AVERAGE SIZE ROOF EACH YEAR.

GREENHOUSE WATER COLLECTION

Greenhouse water collection is an amazing way of collecting your rainwater from the roof of the greenhouse, and it also allows the water to be warmed by the sun. To do this you would need to set up a tank inside the greenhouse and a pipe bringing the water inside from the gutters. This was first done by the Victorians who put tanks underneath greenhouses and then pumped the water up to use it.

WELLS

If you are lucky enough to have an old well in your garden, you could bring this back into operation. These can hold many hundred litres of water and you can 'plumb' them into the downpipes of houses, sheds, etc., to collect rainwater.

FOR THE REST OF US, THE USE OF A WATER BUTT, OR WATER TANKS, WILL HAVE TO DO.

ACTIVITY: MAKING A MINI WATER BUTT.

ACTIVITY: MAKE A MINI WATER BUTT

WHAT YOU NEED:

Essential equipment:

- A large plastic milk bottle and lid
- Scissors
- Strong garden twine or cable ties

Optional equipment

- Outdoor paint
- Paint brushes
- Decorations

WHAT TO DO:

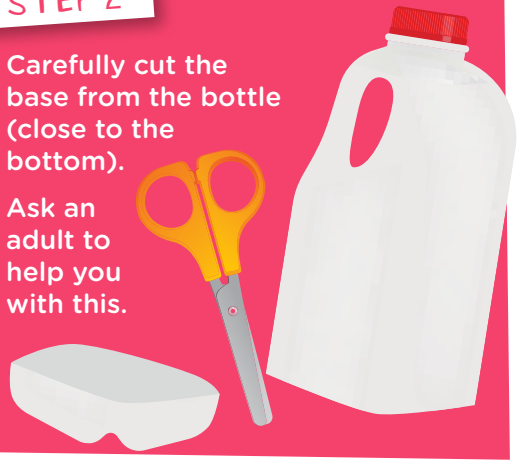
STEP 1

Clean and dry the milk bottle and remove the label.

STEP 2

Carefully cut the base from the bottle (close to the bottom).

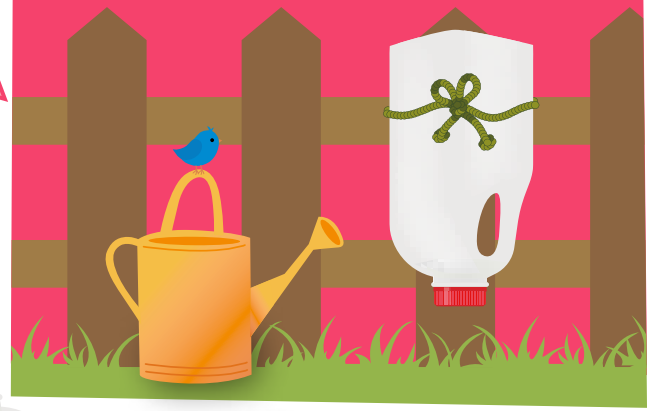
Ask an adult to help you with this.



STEP 3

Use the twine or cable ties to attach your mini water butt to a fence.

When it rains, rainwater will collect in your mini water butt. Remember to unscrew the lid of your mini water butt every so often to let the rainwater flow into a watering can ready for when you need to use it.



OPTIONAL

If you want to decorate your water butt you can decorate with outdoor paint before Step 3.

USING THE RAIN FROM A DOWNPIPE

Have a look at some of the ideas that other schools have tried. These planters all use rainwater that would otherwise have gone from the downpipe straight into a drain.

TREES AND RAISED BEDS

Trees can be planted within most SuDS systems to help improve their performance. Trees can also be used as a stand-alone feature, within tree pits or tree planters. However, they should not be considered for large surface runoff.

Raised beds and planters can also be used where an adjoining downpipe can be connected so that the water which might otherwise have gone straight into the drain will be diverted to water the plants. However, do remember to think about what will happen if the raised bed or planter overflows – where will the water go?

MORE ABOUT...
water harvesting
here

SCHOOL PONDS

School ponds are constantly wet and have extra space to store water after rainfall. Ponds provide vegetation and habitats to support wildlife.

RAIN GARDENS

Rain gardens are planted areas enabling surface water to filter through the vegetation.

RAISED BEDS

Grow more of your own food and make your WATER COUNT

Currently a third of the world's population doesn't have access to clean water. With less than one per cent of our planet's water being available for human consumption, using water wisely (reducing the amount of water we use unnecessarily) needs to become a priority.

Growing some of your own food is one way we can begin to reduce our water usage.

WHAT ARE THE REWARDS OF GROWING YOUR OWN FOOD?

- Fun, anticipation and a sense of achievement from simply planting a seed and watching it grow.
- Eating 'fresh from the garden' means all the nutrients, minerals and vitamins are fresh and intact, bringing increased health benefits.
- You know exactly what you are getting – the freshest seasonal produce available.
- It's better for the environment – no food miles and a lower carbon footprint.
- Growing your own is healthy – you're out in the fresh air, getting exercise.
- You can save money!

GROW YOUR OWN

One of the best ways to grow fruit and vegetables in a garden of any size is using the raised beds system. You can then grow the crops of your choice all year round.

The picture below gives an idea of what can be created. Raised beds are very versatile and you can adapt the size, shape and depth to accommodate your own space.

USEFUL LINKS!

Royal Horticultural Society
www.rhs.org.uk

RHS Campaign for School Gardening
http://apps.rhs.org.uk/schoolgardening/

Garden Organic
www.gardenorganic.org.uk

Food for Life
www.foodforlife.org.uk

Learning through Landscapes
www.ltl.org.uk

BOOKS USED IN THE WRITING OF THIS PACK

Gardening Without Water
Charlotte Green

A Guide to Waterwise Gardening
Michael Littlewood

Grow Your Own Veg
Carol Klein

Sustainable Gardening
Michael Lavelle

BUILDING A RAISED BED

One of the best ways to grow FRUIT AND VEGETABLES in a garden of any size is using the raised beds system. You can then grow the crops of your choice and grow vegetables all year round.

RAISED BEDS ARE EASY TO MAKE AND EASY TO MAINTAIN

- Raised beds define the growing spaces, with access from the paths.
- Raised beds are easy to keep clean and untrampled so they are easy to maintain.
- The use of raised beds improves soil drainage, depth and warmth.
- With improved drainage, raised beds can be worked even on rainy days.
- Raised beds allow the soil to warm up earlier in spring and so crops will be available earlier in the year.
- 'Crop rotation' (the system of how you move the crops that you are growing around your garden to improve the soil and stop disease) is simple to practice and easy to plan using raised beds.
- Crops can be planted close together to give higher yields.
- Looking after the soil is easy as each bed is a separate area, allowing better use of soil improvers such as mulch, manure, compost, etc.
- Easy to protect crops with netting and fleece.

Remember – raised beds dry out rapidly in hot weather, so will need to be monitored carefully to check whether or not your plants need watering.

For more information see Carol Klein's 'Grow Your Own Veg' book.

BUILDING A RAISED BED – STEP-BY-STEP GUIDE

You don't have to have lots of space to create a raised bed.

- Use reconstituted sleepers*, not traditional railway sleepers as they are soaked in creosote and formaldehyde.
- Level or dig the sleepers into the ground and fasten them together with TimberLok™ screws.
- Add the next level on, making sure you overlap the joints and fasten that layer together.

- Line the bottom of your bed with plastic sheeting and puncture with a few holes to allow drainage. The plastic will also retain water for longer, preventing the soil from drying out.
- Fill the middle with peat-free compost or soil to level out the ground. Firm down the top and it's now ready for planting.

*** If you prefer, you could use deck boards or treated wooden planks, cut to size.**

LET'S GET GROWING

Growing vegetables is an uncertain art, subject to the whims of weather and local wildlife, but there are a few things you can do to ensure success when you 'direct sow' seeds in your garden.

HOW TO PLANT YOUR SEEDS

- Seed packets will tell you when to plant and how deep to plant. Follow the instructions carefully to get a bumper crop.
- Some seeds require light to germinate, and prefer to be sown directly on top of the soil. Others need to be buried. Most people wonder 'how deeply do I need to plant them?'. A very good tip for you. In the palm of your hand lay out three seeds next to each other. The length of those three seeds is about the depth that you want to plant your seeds. That is a very general estimation, but it works for most seeds.
- Be careful when you are covering your seeds. You don't want to bury them too deeply so that the sun can't get to them.
- Next, water your seeds. You do need to be a bit careful about how you water, though. A strong blast from the hose will either wash your seeds completely out of the bed or mess up the spacing if you surface-sowed them. Use a 'rose' fitting on a watering can to get a gentle flow of water for your seeds.
- Mark out where you planted your seeds by planting other quicker growing seeds in with them. It prevents you from mistakenly pulling what you thought were weeds but were your seedlings, and it lets you keep close tabs on how things are coming along.
- Know what your seedlings will look like. After they've germinated, it's often hard to tell a weed from say, a tomato. There are websites you can refer to, in order to see what certain seedlings look like, and some seed packets have photos or drawings on them as well. Knowing what your seedlings look like will not only prevent you from pulling them up by mistake, but will also allow you to get rid of weed seedlings that will compete with your seedlings for water and nutrients.

CHECK OUT...

Royal Horticultural 'green space' campaign

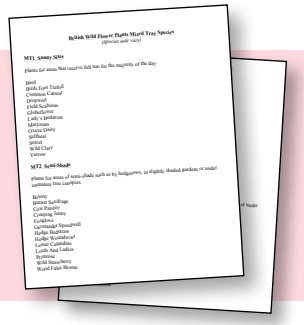
SO ALL YOU HAVE TO DO NOW IS TO CHOOSE WHAT YOU WANT TO GROW AND...

GET GROWING!

SO WHAT PLANTS DO YOU NEED?

Do you know which plants are water-loving and will help in flooded parts of your school or community? No? Well, have a look at the table below. This might help you decide which plants to use in your rain garden to help soak up the water in the parts of your school or community that get flooded or where water forms pools.

DOS AND DON'TS OF A RAIN GARDEN

Dos	Don'ts
• Make sure that you select indigenous plant species (plants that 'belong' in this country). • Pick a range of different species. That way, if one doesn't do particularly well, you'll still have a rain garden which works and which looks attractive.	• Select species that might be invasive – they'll take over the area, preventing other plants from flourishing, and be difficult to control. • Use fertilisers or herbicides.
• Choose species which when planted together maximise flowering and fruiting periods to benefit invertebrates and birds.	• Use mulches – they can reduce permeability!
You might want to consider these species: • Flowering rush (Butomus umbellatus) • Amphibious bistort (Persicaria amphibia) • Gipsywort (Lycopus europaeus) • Brookweed (Samolus valerandi) • Brooklime (Veronica beccabunga) • Globeflower (Trollius europaeus) • Great waterdock (Rumex hydrolapathum) • Fleabane (Pulicaria dysenterica) • Hemp agrimony (Eupatorium cannabinum) • Floating sweet-grasses (Glyceria spp.) • Lesser reedmace/lesser bulrush (Typha angustifolia) • Marsh foxtail (Alopecurus geniculatus) • Marsh woundwort (Stachys palustris) • Marsh marigold (Caltha palustris) • Pendulous sedge (Carex pendula) • Meadowsweet (Filipendula vulgaris) • Purple loosestrife (Lythrum salicaria) • Water forget-me-not (Myosotis scorpioides) • Rush (Juncus spp.) • Water mint (Mentha aquatica) • Yellow iris (Iris pseudacorus) • Watercress (Nasturtium officinale)	DOWNLOAD... the British Wild Flower Plants Mixed Tray Species here  CHECK OUT... Rain Garden info here 

LET'S CONCLUDE

SO DO YOU REMEMBER AT THE START WE NEEDED TO THINK ABOUT...

- What has this got to do with me?
- If the drainage system is overused will this have an impact on the environment, agriculture and our way of life?
- Does anything different need to be done?

CAN YOU NOW ANSWER THE ABOVE QUESTIONS?

ACTIVITY: CREATE A MODEL OF YOUR FUTURE VILLAGE.

Include SuDS and sustainable materials.

Annotate your plan and present it to your class.

OTHER QUESTIONS TO ASK YOURSELF:

What impacts do you think SuDS will have on our future cities and developments?

How will SuDS shape our future environments?

What do you think your responsibilities will be as an individual and responsible citizen?

What influence do you think SuDS will have on our future responsibilities as developers, government, employers and industry?

ACTIVITY: CREATE A SuDS TOWN

BACKGROUND

The idea behind the activity is to help understand the additional benefits that SuDS provide to the surrounding area and how the feature may help to mitigate the risk of flooding in a built-up environment.

LET'S GO

First have a look at the SuDS matrix and the 'looking to the future' page. Have a look at all the different features and the benefits of each feature. Decide what features you would like to include in your development.

- the village/city will have residential areas, schools, supermarkets, etc.
- design your city to include your chosen features. Decide what might be suitable, such as a rain garden, a bioretention basin or swale.
- for each SuDS feature:
  - annotate your design to identify the feature;
  - explain the impact of the feature;
  - note why you think it will be the most appropriate feature to include.

You could design your development on graph paper, as a model or use a computer design. You choose.

ADDED CHALLENGES

1. Limit the SuDS features that you include for example – you can only include a maximum of four features, but try to achieve the greatest impact.
2. Design your development to scale. Calculate the amount of land needed to incorporate your SuDS features. How will this impact on your development?
3. Investigate the cost of including your SuDS. How would the cost be funded?

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FUTURE HOUSING

In the future every new housing development may have:

- Green roofs which reduce peak flow and the volume of water discharged from roofs and improve water quality.
- Rainwater harvesting: (collecting and storing rainwater for reuse) for example, watering gardens, and in some cases substituting mains water with stored rainwater for flushing the toilet.
- Permeable pavements of concrete blocks or crushed stone – these materials allow water to infiltrate into subsoil to be stored in reservoirs with outlets.
- Swales and basins: grassy depressions which save construction and maintenance costs. These basins provide temporary storage in heavy or prolonged storms. This reduced the amount of flooding and allows for natural treatment (filtration).
- Infiltration trenches and filter drains are excavated trenches filled with stones and drained with perforated pipes. They allow collection and storage of water during rainfall and treatment.
- Ponds and wetlands are a visual amenity – they encourage biodiversity and are flexible in their water levels and storage capacity.

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SuDS BENEFIT MATRIX

Let's go SuDS spotting...
What SuDS features have you seen in your school or community?
Have a look at the table to work out the benefits of the SuDS features you have seen.

	Rainwater harvesting	Soakaway	Swale	Pervious paving	Bioretention systems	Ponds/ wetlands	Detention basins	Attenuation storage tanks	Tree pits	Infiltration systems	Green roofs
Flood risk	★	★	★	★	★	★	★	★	★	★	★
Attenuation	★	★	★	★	★	★	★	★	★	★	★
Infiltration	○	★	★	★	★	★	★	★	★	★	
Water quality	○	★	★	★	★	★	★	○	★	★	★
Water recycle	★	○	★	○	★	○	○	★	○	○	○
Amenity	○	★	★	○	★	★	★	○	★	★	★
Biodiversity and habitat	★	★	★	○	★	★	★	○	★	★	★
Education	○	★	★	○	★	★	★	○	★	★	★
Microclimate	○	○	★	○	★	★	○	○	★	○	★

○ Unlikely benefits

★ Benefits could be achieved through good design

★ Likely benefits

YOUR TURN

Now that you know all the SuDS features, identify which of the features you could try to implement in your school, home or local environment.

ACTION

Complete a benefit matrix to show the potential impact if you implemented your SuDS features.

MAKE RAIN HAPPY

PROTECTING YOUR ENVIRONMENT USING SUSTAINABLE DRAINAGE

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