

# Managing King's Mill Reservoir to protect the wildlife

at Mill Water's heritage site

**TN**  
TEACHER'S NOTES

## TITLE SLIDE

In this lesson you will learn how King's Mill Reservoir is an important place where a wide variety of wildlife live – known as a wildlife habitat, as well as somewhere people can participate in a range of water-based activities. You will learn how important it is for the Reservoir to be properly maintained so that all the different species that are dependent on it can thrive. You will also find out what steps are being taken to maintain this popular wildlife and leisure site for future generations to enjoy.



## SLIDE 2

### WHAT IS A RESERVOIR?

There are lots of different types of water bodies. These can be as big as an ocean or as small as a pond in a garden. There are natural water bodies and man-made water bodies.

A reservoir is a man-made lake where water is stored. Most reservoirs are formed by constructing dams across rivers. A reservoir can also be formed from a natural lake whose outlet has been dammed to control the water level. The dam (a big wall) controls the amount of water that flows out of the reservoir. Reservoirs are primarily for the storage of water to supply homes, factories, as well as to irrigate farmland.

In the UK there are nearly 6,000 reservoirs in operation which are managed by water companies, such as Severn Trent, which supplies water to homes across Nottinghamshire. Reservoirs are really important because they supply water even

when there hasn't been much rain. This is particularly important in hot countries, for example Thailand, where the reservoirs store water from the wet season to prevent flooding, which is then released during the dry season for farmers to grow rice.

Hundreds of reservoirs around the country were built during the Victorian era during the Industrial Revolution to serve the nearby water-powered factories, and many of these – like King's Mill Reservoir, are no longer needed for their original purpose. These decommissioned reservoirs continue to play an important role in preventing flooding however and are now valued as places for wildlife conservation and leisure.

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### SLIDE 3

#### WHY WAS KING'S MILL RESERVOIR CREATED?

The King's Mill Reservoir at Mill Waters was created in 1839. There was already a pond on the site which had powered the medieval King's Mill flour mill. The pond was enlarged to provide a larger head of water to power all the water mills which had been created along the River Maun. The reservoir was able to provide a bigger and more reliable supply of water to the mills even when the River Maun was low.

William Bentinck, the fourth Duke of Portland, was responsible for creating the reservoir, as he recognised it would help the mills (or factories) on his land to be far more efficient and competitive. The reservoir was dug out and a dam built to control the water supply.

The job of digging out the reservoir was given to the local unemployed, including soldiers returning from the war with France. It took them two years. The Derby Mercury reported the completion of the reservoir on 6th February 1839 and noted that it had provided 'employment to hundreds of poor men during the late panic in trade'.

Historian and painter Albert Sorby Buxton states in his Mansfield notes that donkeys also played a part: "In making the banks of the King's Mill Reservoir donkeys with packs on their backs were employed, trampling up and down to solidify the ground."

The mill owners contributed towards the creation of the reservoir, which cost around £9,000, equivalent to over £652,000 today!

The old King's Mill was submerged when the reservoir was flooded, and a new mill and miller's cottage were created on the right of the turnpike from Mansfield to Sutton.

### SLIDE 4

#### HOW DOES THE WATER GET IN AND OUT OF THE RESERVOIR?

Before we look at what lives in the reservoir, you need to understand why the water level of the reservoir goes up and down.

When the reservoir was created, a dam was constructed with thousands of tons of limestone and clay. The dam builds up a lot of water from the River Maun to fill up the reservoir.

A bypass channel at the northeast side of the reservoir allows a small amount of water to run into the reservoir at the same height as the river - which means that fish, invertebrate and plankton can get into the reservoir.

A number of sluices let out small streams of water at different points from the reservoir and a larger overflow spillway at the southeast of the reservoir creates a small waterfall which goes into a plunge pool underneath the Portland Viaduct, to stop the reservoir flooding.

When the river level is low, typically in the summer months, less water flows into the reservoir.

But there is another reason why the reservoir's water level goes up and down... the water cycle.

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### SLIDE 5 THE WATER CYCLE

There are four stages of the water cycle:

- Evaporation - when water leaves the reservoir when it is heated by the sun
- Condensation - as the evaporated water cools it condenses to form clouds and the water becomes a vapour
- Precipitation - as the vapour cools, it turns back into a liquid forming tiny water droplets (mist and fog is precipitation too).
- As the droplets get bigger, they become too heavy for the cloud and fall as rain, which collects on the ground to form (or join) a water body.

The cycle then starts all over again.

There is a useful animated clip on BBC Bitesize about the water cycle here: <https://www.bbc.co.uk/bitesize/topics/zkgg87h/articles/z3wpp39>

There is a fun activity you can do to create your own water cycle - called 'Rain in a bag'.

Due to climate change, the water level of the sea is rising as ice sheets and glaciers melt; there is also greater evaporation from water bodies which is resulting in extreme rainfall. Our reservoirs and dams play an especially important role in protecting urban areas from flooding when there is heavy rainfall.

### SLIDE 6 THE FOOD CHAIN

How creatures live in relation to their surroundings is known as ecology. Ecology is important because it shows us how changes in the environment affect the survival of living things. For example, when pollution kills certain living things, the animals that feed on them may also die. The work of ecologists has convinced many people to conserve, or protect, the environment so that wildlife can flourish.

The food chain is an important part of ecology, showing the link between plants and animals and how energy is passed from one to the other. The food chain always starts with a green plant, a producer, because green plants can make their food by photosynthesis (using sunlight to convert nutrients in carbon dioxide and water).

A living thing that eats other plants and animals is called a consumer. A predator is an animal that eats other animals. The animals that predators eat are called prey. Predators are found at the top of a food chain.

If we look at the food chain in King's Mill Reservoir we will find bacteria and algae in the water; these are the producers, which provide food for invertebrates (creepy crawlies), dragonflies, as well as fish, frogs and toads - the consumers. The ducks and swans eat the fish, dragonflies and insects. Small mammals and birds around the reservoir are also part of the food chain, with the heron at the top, which feeds on small mammals and sometimes the ducks. As an indicator species, we know that if the heron becomes unwell there is something contaminating the food chain.

There is a short clip explaining the food chain on BBC Bitesize: <https://www.bbc.co.uk/bitesize/clips/z96r82p>

\*If you want to go into more detail about the food chain, take a look at Lesson 3: Go wild at Mill Waters.

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### SLIDE 7

#### WHAT IS A EUTROPHIC WATER BODY?

King's Mill Reservoir is a eutrophic water body, which means that dissolved nutrients from surrounding farmland (and elsewhere) have been absorbed into the water making it a very good place for plants to grow. If the water is not managed properly it could get overly rich, which will mean that too much algae will grow, which would have a negative impact on the wildlife living there.

Algae and microscopic organisms are at the bottom of the food chain; when extra nutrients get into the water (known as eutrophication) the algae grows in abundance and develops on the surface of the water. This prevents light absorption necessary for the underwater life; the water becomes murky and the reservoir cannot support as many animals such as fish and birds.

One of the main causes of eutrophication is phosphates from fertiliser, but it can also occur if chemicals, for example from laundry and industrial effluent (waste) get into the water. Phosphates are acidic - which means that they are a high pH level. The survival of creatures, in, out and above the reservoir, as well as in the surrounding banks and dykes depends on the water being at the right 'pH' level (around 7.4 on the pH scale) for living creatures to survive.

(Lesson 2 provides a practical activity to test the acidity of the Reservoir.)

### SLIDE 8

#### OTHER RISKS TO THE ECOLOGY OF KING'S MILL RESERVOIR

Aside from phosphate contamination (mainly from the fertiliser off nearby farmland), there are other risks to the ecology of King's Mill Reservoir, such as grit, gravel and heavy metals like lead, mercury, and cadmium off the nearby roads. During periods of heavy rain these flow off the road surface into the roadside, through the soil and into the reservoir. Other less common metals such as cobalt, chromium, lithium and iron can also affect the health of the reservoir's ecosystem.

Human waste in the form of discarded food and packaging also poses a threat to the wildlife. As well as spoiling the beautiful natural surroundings, scattering bird feed and leaving food waste at the site can attract vermin (namely rats) which are known for spreading diseases.

Although well intentioned, feeding the ducks and swans can also be detrimental to their wellbeing. Although they may require additional food during the harsh winter months (shredded lettuce, corn and peas are best), feeding during the summertime may interfere with the food cycle and can make them poorly if they eat too much. Feeding the ducks can also make them dependent on people, which can put them at risk.

If there are large quantities of semi-decomposed leaf and plant debris, oxygen levels in the water will be reduced, which is detrimental to fish and

other aquatic life in the reservoir. Eventually, algae develop on the surface of the water, the water becomes murky and there is less oxygen available for the animals living in the reservoir.

To help stop this happening Ashfield District Council have planted oxygenating pond plants, some of which are partly submerged or completely under the water. These plants take up dissolved nutrients in the water which reduces the growth of unwanted algae, as well as giving off oxygen. The reed beds around the site are also cut back every four years to prevent the build-up of nutrients and dead plant material.

Additional wetland plant species have also been planted at the neck of the inlet to the reservoir to help filter contaminants coming in from the River Maun. The site is home to a rare aquatic plant called short-leaved water starwort and special care is being taken to protect this.

A sewage works, King's Mill Hospital and other places of industry can be found a short distance from the reservoir. There are regulations in place protecting reservoirs and farmland from effluent (waste) from nearby industries, so regular monitoring of the reservoir's water quality is important to ensure that no potential contamination goes unnoticed.

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### **SLIDE 9** **SILT BUILD-UP**

Silt is mud or earth deposited from running water - in the case of King's Mill Reservoir, from the River Maun, as well as from the edges of the reservoir itself. Sediment is the dirt deposited at the bottom of a liquid. Sediment at the bottom of a water body consists of particles of rock and dirt.

Over the years silt and sediment had built up at the bottom of the reservoir which means that it has become much shallower in places, the impact of which was:

- an increased risk of flooding
- the potential loss of fish and wildlife
- a risk that boats would be unable to sail in the shallower water
- a bad smell and dense algae blooms

### **SLIDE 10** **HOW SILT WOULD FILL UP THE RESERVOIR** **IF NO ACTION WERE TAKEN**

This diagram shows a sediment depth map taken in 2017, with the darker colours denoting the deeper patches. If no action were taken, the silt levels would increase over time, with the darker colours on the map eventually spreading across the reservoir and impacting in the ways mentioned previously.

### **SLIDE 11** **WHAT WORK WAS DONE TO MANAGE THE** **SILT IN THE RESERVOIR?**

Between September 2019 - May 2020 Ashfield District Council undertook a programme to desilt the reservoir, with funding from the National Heritage Lottery Fund.

The work involved moving between 4000-5000 m<sup>3</sup> of silt from the bottom of the reservoir and using it to create raised areas for nesting birds. The works took place over the winter months when the aquatic life (wildlife in the reservoir) was most dormant.

Four islands at the main inlet were created which have been planted with reeds and a wetland shallow area close to the adventure base has also been planted with reeds.

The silt has been used to create new habitats which in the short-term will create new areas for invertebrates and mid to long-term will encourage birds to breed.

The council's dredging works means that the reservoir now has the same amount of silt in it as it did in 1984 and it is once again safe for sailing, because they can be sure that boat keels will not get lodged on the bottom of the reservoir. First and foremost, the desilting works have minimised the risk of increasing pollution in the Reservoir because shallower water is more prone to eutrophication and increased algae blooms.

The dredging works were carried out very carefully so that the wildlife and the existing wildlife habitats were not disturbed. The conservation work does not stop there; the council have committed to the regular removal of silt within a 25-metre distance from its embankment.

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### LEARNING ACTIVITIES

#### 1. Class discussion

Refer to Handout 1 Location of King's Mill Reservoir and use the slides to prompt discussion about the location of the reservoir and potential threats to its ecology.

#### **Suggested prompts:**

##### **What around the site poses a potential risk to the Reservoir?**

(King's Mill Hospital, the farming fields, the roads, the sewage works...)

##### **Why is algae such a bad thing if small animals can feed on it?**

(It stops oxygen getting into the water so smaller creatures can't survive. Drinking water contaminated with blue-green algae can also be harmful to people and dogs. The water also smells bad.)

##### **The silt levels increase every year in the reservoir, which is detrimental to the ecology and also poses a risk to the sailing club, can you think of any other reasons the silt needs to be controlled?**

(There has been a lot more rain in recent years because of climate change so the Reservoir needs to be able to act as a defence against flooding. It can't do that job if it's too shallow.)

##### **Why do people visit the Reservoir and why should they care about the way that it is looked after?**

(If the Reservoir wasn't managed eventually it would dry up and much of the wildlife would die. People would stop visiting because the area had become overgrown. The Reservoir has an interesting heritage (connected with the history of the mills) but it is also a beautiful nature reserve.

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## LEARNING ACTIVITIES

2. Create your own 'Rain in a bag' to see the water cycle in action

Watch this short instructional film on YouTube to find out how to create your own 'Rain in a bag'

<https://youtu.be/9zIBpP9pZws>

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### LEARNING ACTIVITIES

#### 3. Presentation task

You are a wildlife ranger at King's Mill Reservoir and have been asked to give a short talk to a community group who are interested in learning a bit more about the wildlife and ecology of the site.

Prepare a short talk for them about the food chain including details of the key species that live in and around the Reservoir, and in particular which foods they need to survive. Include some of the risks to the ecology of the site and what visitors can do to help protect the wildlife.



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### LEARNING ACTIVITIES

#### 4. Writing exercise

Imagine that you are employed by Ashfield District Council and are responsible for managing the Mill Waters site.

You have received the National Lottery Heritage Funding and are eager to get on with the dredging works to remove silt from the Reservoir. First, you need to inform users of the site about why the works are taking place and also allay any fears they may have about harm that the works may be causing the wildlife at the Reservoir.

Taking on board all that you have learnt write a notice which can be displayed in the information panels on the site to tell people why the desilting is happening, how this will benefit the wildlife and ensure that the water-based activities can continue. Detail any other ways that the Council is looking after the ecology of the Reservoir.