Teacher Guide

Not in my back yard

Finding locations for future energy developments

British Geological Survey

How to use these resources

These resources consist of a teacher guide, an introductory video, 3 worksheets and a class certificate. While it is intended that you use all of these resources, you may wish to pick and choose the most relevant parts to suit your class and lesson needs.

The lesson is interdisciplinary and includes elements of numeracy and literacy. We have included a curriculum link in the lesson outline, but the lesson is relevant to many parts of the curriculum.

You can share feedback on the resources by emailing BGSengage@bgs.ac.uk

What is the British Geological Survey?

The British Geological Survey is a world-leading geological survey and global geoscience organisation, focused on public-good science for government and research to understand earth and environmental processes.

Our vision is for a safer, more sustainable and prosperous planet and a future based on sound geoscientific solutions.

Why have we created this lesson?

Delivering clean energy at the scale required to achieve net zero by 2050 in the UK requires world-class science.

The British Geological Survey, on behalf of UK Research and Innovation, has set up the UK Geoenergy Observatories, which are platforms for world-class geoscience, unlocking evidence and knowledge for future and current generations.

In particular, the UK Geoenergy Observatories have been set up to understand how geothermal energy, hydrogen, carbon capture and storage, and storage solutions for wind, solar and tidal energy can reduce our carbon emissions.

This lesson is intended to support teachers with curriculum-relevant materials while enthusing, exciting and inspiring pupils with the research of the UK Geoenergy Observatories.

What are energy developments?

Energy developments refer to infrastructure that is used to harness, transmit, distribute, store or manage energy.

Traditional examples include power stations, high-voltage transmission lines, local substations, oil refineries, petrol stations, gasometers and gas pipelines.

With the move towards renewable energy, many more forms of energy development are emerging. These include windfarms, solar farms, ground-source heat pumps, mine water heat developments, hydrogen fuel plants and thermal energy storage facilities.

Energy developments often interact with the geological subsurface. It is vital that energy resources are developed responsibly.

What are the 3 As?

The 3 As are a way of evaluating a potential energy development. The 3 As are accessibility, availability and acceptability.

Accessibility refers to how easy it is to capture the energy and get it to where it is needed. Energy resources are not distributed evenly and sometimes the area with the highest concentration of a particular resource is far away from the population who would benefit from it.

Availability describes how often the energy is available. Many forms of renewable energy are variable or intermittent. The availability of a renewable resource may also be constrained by how quickly a resource is naturally replenished.

Acceptability refers to the opinions of the local community and other stakeholders. It covers things like the protection of habitats, whether water sources will be affected, provision of local jobs, impact on the landscape as well as spoiling views and creating noise or traffic.

How can resources be used responsibly?

The responsible use of the Earth's energy resources is a complicated topic.

All energy developments have potential impacts, both positive and negative. It is important the decisions on the future of energy are based on facts and evidence.

Citizens and decision-makers need access to information that is unbiased to allow them to make informed decisions.

Energy underpins our everyday lives, so it is an important topic that affects us all.

Note on fracking

Hydraulic fracturing is included as an example of a local energy development in one of the worksheets in this lesson. There is currently a moratorium on fracking in England, Scotland and Wales so this hypothetical development would not be allowed to proceed.

What are the UK Geoenergy Observatories?

Climate change means that there's never been a more important time to understand the natural environment.

In the UK, a network of observatories has been established to deliver essential new data from underground. The scientific data can help us to understand how geothermal energy, hydrogen, carbon capture and storage, and storage solutions for wind, solar and tidal energy can reduce our carbon emissions.

Each observatory in Cheshire, Glasgow and elsewhere delivers a different body of knowledge. The UK Geoenergy Observatories inform how geoenergy can help to deliver clean economic growth.

Publicly run, owned and funded, each observatory contributes to world-class science that puts the UK at the forefront of delivering clean energy at the scale required to achieve net zero by 2050.

You can find out more at ukgeos.ac.uk

Site of geoenergy observatory, Glasgow

Lesson Outline

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Finding locations for future energy developments

British Geological Survey

Learning Intention

To investigate and discuss the placement of future energy developments.

Curriculum links

National Curriculum > Key stage 3 >Geography > Human and physical geography
Pupils should be taught to understand, through the use of detailed place-based exemplars at a variety of scales, the key processes in human geography relating to the use of natural resources.

Curriculum for Excellence > Third level > Science > Planet Earth > Energy sources and sustainability
By contributing to an investigation on different ways of meeting society's energy needs, I can express an informed view on the risks and benefits of different energy sources, including those produced from plants.
SCN 4-04b

Resources

- Teacher guide
- Introductory video
- Worksheet 1 – A stone's throw
- Worksheet 2 – Local energy developments
- Home activity – The ideal location
- Class certificate
- Answer sheets for worksheets and home activity

Some forms of renewable energy have faced local opposition.

Hook into the lesson

Play the introductory video.

The video introduces the concept of the 3 As that can be asked when examining the development of the Earth's energy resources: accessibility, availability and acceptability.

The video asks the following questions, providing an opportunity to pause and discuss:

What sources of energy do you know?
What make an ideal location to harness renewable energy?

Warm-up Activity

Give pupils **Worksheet 1 – A stone's throw.**

Pupils rank hypothetical developments (such as prisons and shops) from those they would like closest to their home to those farthest from their home.

Ask pupils to share some of their thinking.

Main activity

Give pupils **Worksheet 2 – Local energy developments.**

Working in groups of 4, pupils put forward arguments for and against an energy development in a hypothetical community before reaching a group decision.

Afterwards, ask each group to share their energy development with the class and whether they have decided to let it proceed or not.

Ask pupils:

What is the impact of these decisions taken all-together?

Prompt pupils to think about:

- Whether there is a fault line under the UK, which can be checked using the worksheet map.
- The different forms of geothermal energy available, as introduced in the video.

Plenary

Lead a discussion with the class about the challenge of finding locations for future energy developments.

Ask pupils:

What information is needed to judge whether a local energy development should proceed?

Potential answers should cover impacts (positive and negative) on residents, businesses, local area, region and the planet. Examples include environmental impact, climate change, cost of energy, stability of energy supply, skilled jobs, noise, smell, views, traffic, tourism and house prices.

To celebrate the completion of the lesson, you can display the class certificate, which states **'our class rocks!'**.

Home activity

Give pupils **Home activity – The ideal location**.

Pupils plot features on to a map of a fictional town and follow a set of rules to identify the ideal location for an energy development.

Worksheet 1

Not in my back yard

A stone's throw

British Geological Survey

Name: _____ **Date:** _____

You are going to rank hypothetical developments (such as prisons and shops) from those you would like closest to your home to those farthest from your home.

'Not in my back yard' or NIMBY is a term that describes a situation where residents are opposed to proposals to place a new development in their community but, at the same time, are unopposed to the new development being placed elsewhere.

For example, residents might not want a landfill site close to their home but are happy to have one farther afield.

Where do you stand?

Rank the following statements in order by giving them a number from 1 to 10. Write number 1 next to the place you would like closest to your home. Number 10 will be farthest from your home.

Rank	Development
	High security prison for 500 prisoners
	Shopping centre with over 50 shops
	Recycling centre for household waste
	Primary school and playground for 200 pupils
	Animal shelter for up to 1,000 rescued pets
	Fire station operating 24 hours a day, 365 days a year
	Football stadium with capacity for 32,000 fans
	Chicken farm for 20,000 birds
	Park with indoor sports facilities
	Fulfilment warehouse for online retailers

Worksheet 2a

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Hydrogen storage

"We propose to store large quantities of hydrogen fuel under the local golf course.

The geology under the golf course is well suited for the flammable gas to be pumped underground and stored in a former salt cavern. The storage facility will enable surplus power from the nearby windfarm to be converted into hydrogen fuel and stored until it is needed. The hydrogen will be available for sale, to fuel cars and vans with zero emissions, reducing the town's reliance on fossil fuels."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Petrol station owner**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Golf course owner	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2b

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Heat extraction from old mines

"We propose to extract heat from the water in the old coal mine under the local country park.

The water in the flooded mines is a steady 15 degrees Celsius all year round, warmed by natural geological processes. We plan to drill a well in the corner of the park down into the mine below so we can pump up the warm water. A heat pump will extract the useful heat and we will boost the temperature with an electric heater. The renewable and zero-emission system will feed into a district heating system that will supply heating and hot water to the hospital, school and local businesses."

Pupils Name:	Pupils Name:
Role: School headteacher	**Role: Park cafe owner**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Unemployed resident	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2c

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Heat storage in old mines

"We propose to store surplus heat energy in the flooded coal mine under the industrial estate.

During the summer months, there is a bounty of heat energy available from the sun. We plan to store this surplus heat by warming the water in the flooded mine. We will drill into the mines beside the pottery factory and install heat exchangers. The water will stay warm for months, allowing us to extract the heat in winter when it is colder. This zero-emission system will help to provide hot water and heating for nearby homes and businesses."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Gas boiler engineer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Pottery factory owner	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2d

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Hydraulic fracturing

"We propose to extract natural gas from shale rock under the local dairy farm.

Shale gas can be found in shale deposits under the vast fields of the dairy farm. We plan to use a process called hydraulic fracturing to remove the gas, which can be used as fuel for home heating and cooking. The process is also known as fracking and it involves drilling into the rock and pumping fluid into the ground at high pressure to make it crack apart and release the trapped gas. We will monitor contamination of water underground and any microearthquakes."

Pupils Name:	Pupils Name:
Role: Farm owner	**Role: Local resident**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Water company employee	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2e

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Carbon capture and storage

"We propose to store large quantities of carbon dioxide under the sea, off the coast from the local beach.

Under the sea is an old oil field, which is suitable for the long-term storage of the greenhouse gas. Carbon dioxide will be transported via pipeline from the nearby gas-fired power station, which supplies the majority of the electricity in this region. By stopping the carbon dioxide from making it into the atmosphere, this system will reduce future greenhouse gases being emitted."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Local surfing champion**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Gas-fired power station employee	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2f

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Ground-source heat pumps

"We propose to install ground-source heat pumps to heat the local castle.

Currently this popular wedding venue uses gas boilers to provide heating and hot water. This existing system releases carbon dioxide into the atmosphere. We plan to replace the system with ground-source heat pumps that extract heat from the ground via a loop of buried pipes. This zero-emission system will use electric heaters to boost the temperature from the ground. To install the pipes, we need to cut down 50 trees as their roots are in the way."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Castle gardener**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Castle owner	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2g

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Compressed air energy storage

"We propose to store energy in the form of compressed air under the site of the former chemical works.

Deep under the former chemical works is an old salt mine which is suitable geology for the storage of large quantities compressed air. We plan to install a system that takes excess energy from the nearby windfarm to power a compressor. The compressor pumps air into the old salt mine and is expected to be no noisier than a chainsaw, at 120 decibels. When local homes and businesses need power and the wind is not blowing, this compressed air will be used to generate electricity. Our process is supported by natural gas and will result in some carbon dioxide being emitted."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Musician and sound engineer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Windfarm engineer	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2h

Not in my back yard

Local energy developments

British Geological Survey

Name: _____ **Date:** _____

Instructions

1. Read the proposal as a group.
2. Assign a role to each member of your group.
3. Acting within your role, have a think about your views on the proposal.
4. Write down some points for or against the proposal.
5. As a group, decide whether the proposal should go ahead.

Proposal

Geothermal power

"We propose to extract heat from deep under the town to generate electricity.

Our research shows that the temperature of the Earth under the town at a depth of 5,000 metres is over 100 degrees Celsius. We plan to drill several wells across the town to access this renewable source of energy, including under the town's east car park. The steam from the wells will spin a turbine to generate a steady supply of electricity. Excess heat can be supplied to nearby homes and businesses too. Some greenhouse gases will be released when we drill our wells."

Pupils Name:	Pupils Name:
Role: Local homeowner	**Role: Drilling engineer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:
Pupils Name:	Pupils Name:
Role: Gas-fired power station employee	**Role: Environment officer**
Points for the proposal: Points against the proposal:	Points for the proposal: Points against the proposal:

Worksheet 2 - Answers

Not in my back yard

Local energy developments

British Geological Survey

Prompts

These prompts may help pupils complete the task.

What might be the impact of the proposal on:

- Jobs
- Noise
- Smell
- Views
- Traffic
- Tourism
- House prices
- Pollution
- Release of greenhouse gases
- Safety
- Fire hazards
- Cost of energy
- Stability of energy supply

Home activity

Not in my back yard

The ideal location

British Geological Survey

Name: _____ **Date:** _____

You are going to plot features on a map to help you find a location.

Heat under our feet

A nearby town is sitting on free renewable heat.

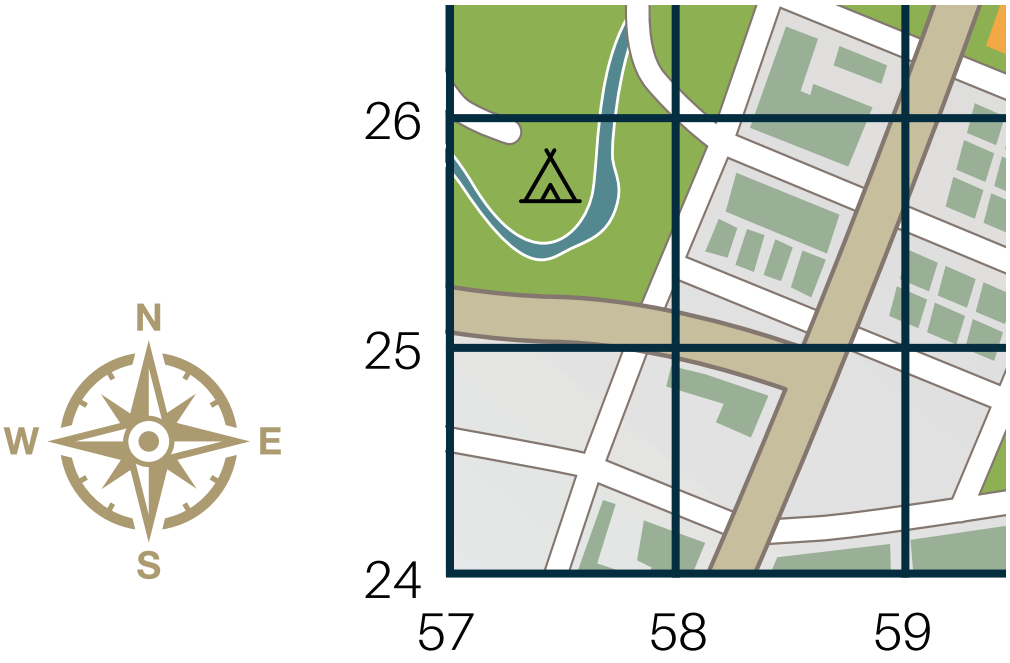
The geology under the town makes it possible to extract geothermal heat, which can be used to warm nearby buildings with zero emissions.

To access this resource, the town plans to drill a well. But the town has set some strict rules to ensure the well does not impact designated places.

Help the town find the ideal location for the well.

Reading a map

Some maps use four-figure grid references to help pinpoint locations within a square.



For example, the campsite marked as ⛺ is in square 5725.

To get the first two numbers, start at the left of the map and go east until you find the bottom-left corner of the square that features the campsite.
Here it is 57.

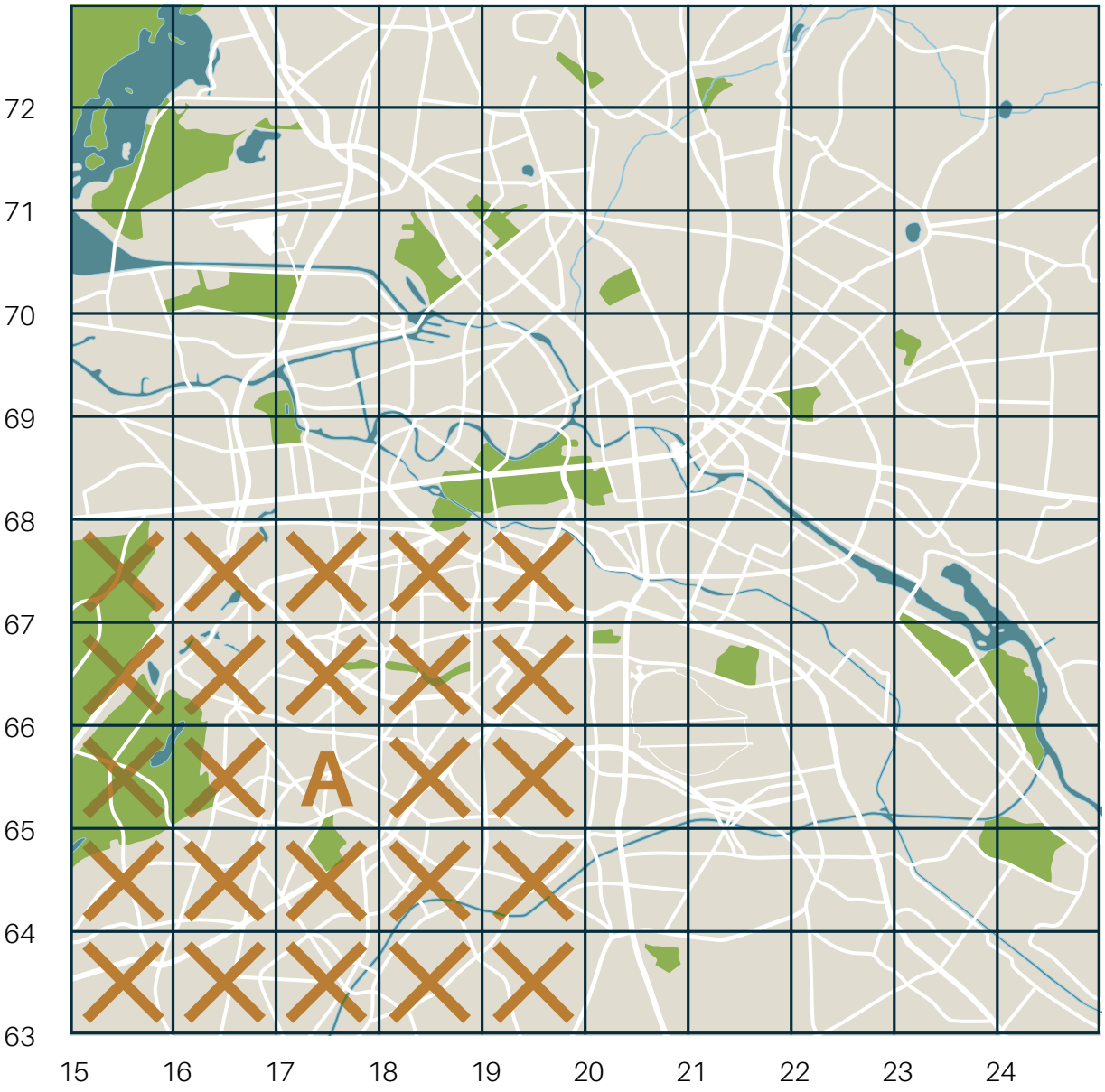
To get the second two numbers, start at the bottom of the map and go north until you find the bottom-left corner of the same square.
Here it is 25.

Features

Mark these features on the following map by writing the symbol in the relevant square.

Feature	Symbol	Grid reference
Example: Army munitions depot	**A**	**1765**
Hospital	H	2071
Factory	F	2365
Television studio	T	1672
Site of Special Scientific Interest	S	2169
Laboratory	L	2065
College	C	1569

Town Map



Eliminating locations

On the map you will see there are a number of squares that have been crossed out. The well cannot be drilled at these locations because the town's rule:

'the well cannot be closer than 2 squares to an army munitions depot'.

This means that any square that is a distance of 2 squares or closer, in any direction, must be eliminated.

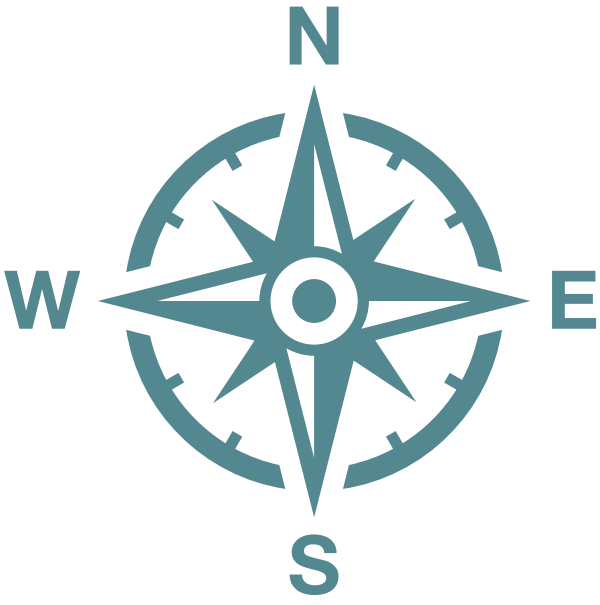
Town's rules

Narrow down where the well can be drilled by following rules below. Eliminate squares as you go.

- **Example: The well CANNOT be closer than 2 squares to an army munitions depot.**
- The well CANNOT be closer than 1 square from a hospital.
- The well CANNOT be closer than 1 square to a factory.
- The well CANNOT be closer than 1 square to a television studio.
- The well CANNOT be closer than 2 squares to a Site of Special Scientific Interest.
- The well CANNOT be closer than 1 square to a laboratory.
- The well CANNOT be closer than 1 square to a college.
- The well CANNOT be in a square that contains a river.
- The well MUST be in a square that contains green parkland.

Result

In which square can the well be drilled?



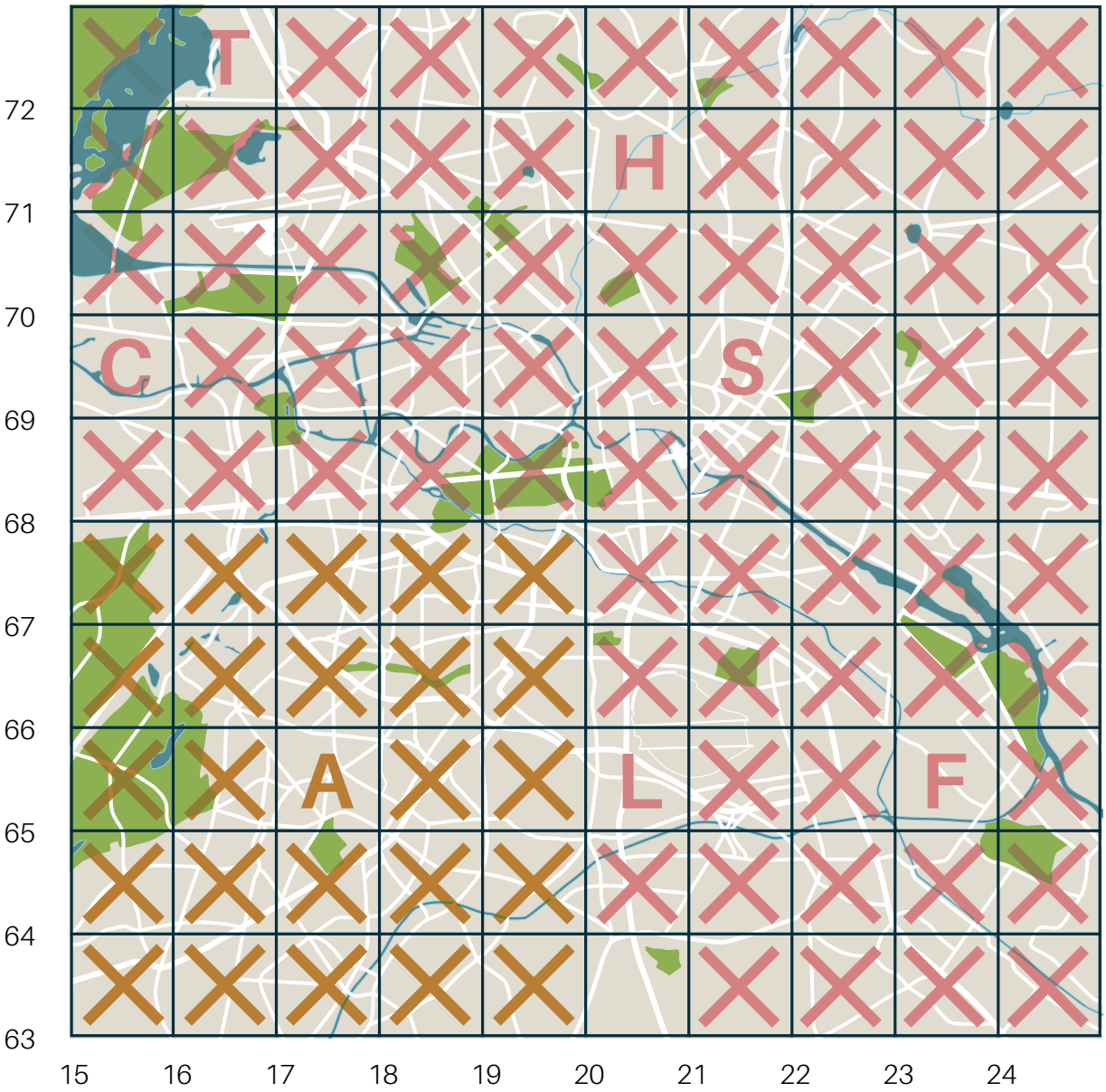
Home activity - Answers

Not in my back yard

The ideal location

British Geological Survey

Town Map



Result

In which square can the well be drilled?

2063