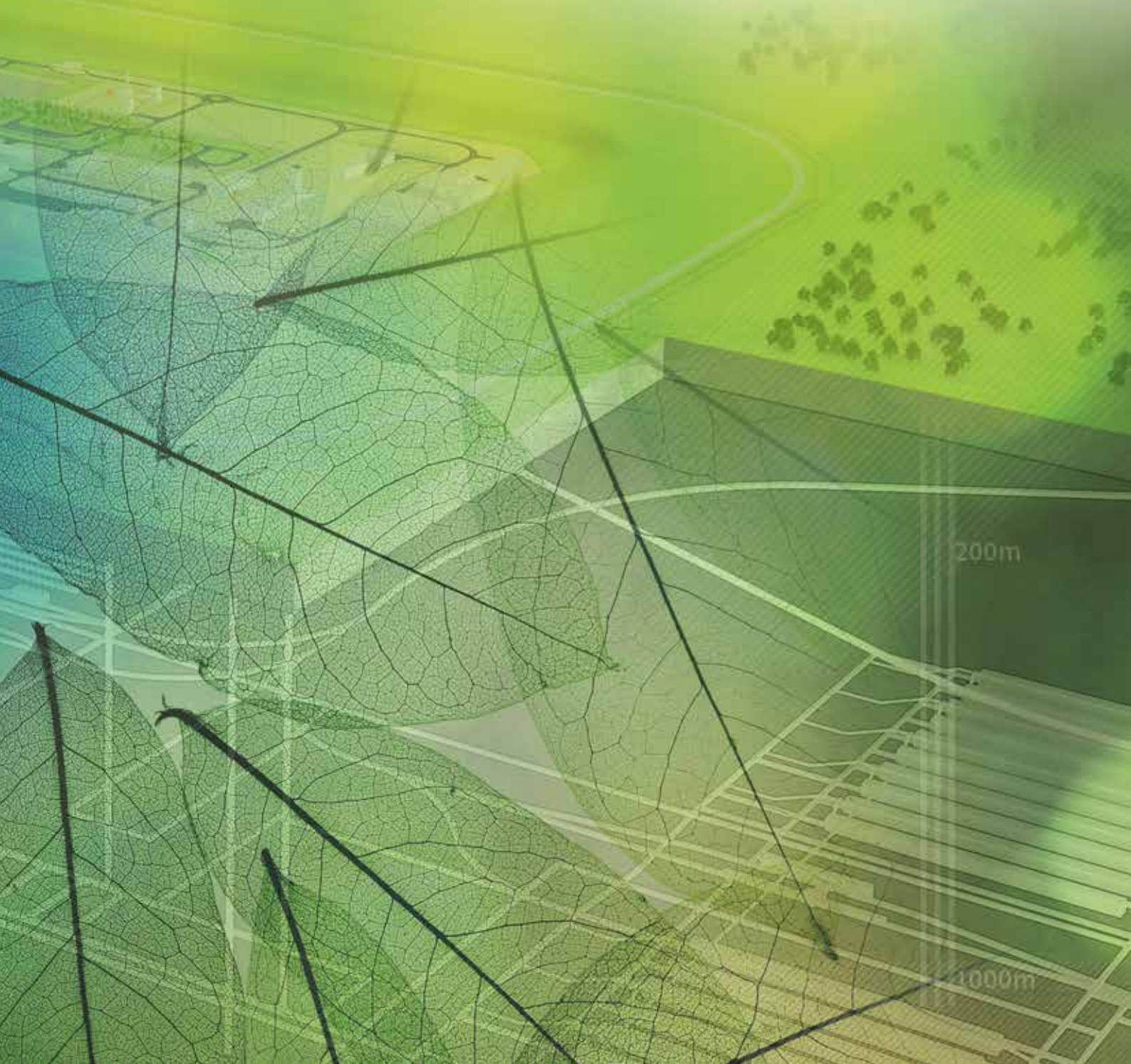


# Making Sense of Geological Disposal



# A permanent solution for the UK's radioactive waste

Radioactive waste is radioactive material for which we have no further use. It is hazardous, so needs to be carefully managed to protect human health and the environment.

Most of our radioactive waste is low level waste and can be disposed of at existing specialised surface facilities in the UK. The rest, higher activity radioactive waste, currently stored at over twenty nuclear sites around the country, needs a different route to disposal and it is internationally accepted that the safest and most sustainable option for higher activity waste is through geological disposal – permanently putting radioactive waste deep underground.

Geological disposal uses both engineered barriers and the hundreds of metres of rock overlying the disposal facility to isolate the waste so that no harmful quantities of radioactivity ever reach the surface environment. The specially-engineered vaults and tunnels deep underground that will house the waste are called a geological disposal facility (GDF). Many other countries which also have advanced civil nuclear programmes, like the UK, have all opted for geological disposal, including Canada, Finland, France, Sweden, Switzerland, Japan and the USA.

The policy for geological disposal is being led by the Department for Business, Energy and Industrial Strategy (BEIS) and delivered by us, Radioactive Waste Management (RWM), a subsidiary of the Nuclear Decommissioning Authority (NDA). We are responsible for all aspects of delivering a geological disposal facility.

## Where does radioactive waste come from?

The UK was one of the first countries to use nuclear power to provide electricity to heat and light our homes and power our industry. Today, it accounts for around one fifth of the UK's electricity supply. We also use radioactive materials in some medical and industrial processes, research and defence activities. Nuclear power and radioactivity are part of our everyday lives – whether we switch on the kettle to make a cup of tea or use radiation to treat diseases like cancer.

## Types of radioactive waste

Radioactive waste is not all the same. It is classified into three main types depending on the amount of radioactivity it contains and how much heat it produces: high level waste, intermediate level waste and low level waste.

### High Level Waste

This is the most radioactive of wastes and is left over from reprocessing spent nuclear fuel from nuclear reactors. This waste is turned into a glass in a process called vitrification. The radioactive decay in high level waste generates a significant amount of heat which needs to be carefully considered when planning storage and disposal.

### Intermediate Level Waste

Intermediate level waste is not as radioactive as high level waste and does not generate as much heat. Intermediate level waste can be a solid or liquid and comes from the operation and decommissioning of nuclear power stations, reprocessing of fuel and other uses of radioactive material. Liquid intermediate level waste is converted to a solid by mixing it into other materials such as cement.

### Low Level Waste

Low level waste is radioactive waste which only has low levels of radioactivity but is not suitable for disposal as ordinary household waste. It may be solid or liquid and includes soil, rubble and building materials from nuclear sites and protective clothing which has been worn in nuclear facilities.

High level waste, intermediate level waste and the small amount of low level waste, that is not suitable for disposal in existing disposal facilities, are sometimes grouped together and called higher activity radioactive waste.

Radioactivity decays naturally over time, so radioactive waste is managed in appropriate facilities until it becomes harmless. The time this decay takes can be as long as hundreds of thousands of years, depending on the type of waste and its radioactive content.



## How do we manage radioactive waste?

Most of our radioactive waste is low level waste and can be disposed of at existing specialised facilities in the UK, for example, the Low Level Waste Repository in Cumbria.

Today, the UK's higher activity radioactive waste is being packaged in specially engineered robust containers and stored at nuclear sites around the country.

The stores are designed to be secure and to withstand severe weather, earthquakes and intrusion. Whilst surface storage can provide a solution for a few decades, it is not a permanent solution as the stores will need to be rebuilt and the waste repackaged.

More waste will be created as existing nuclear facilities reach the end of their lives and are decommissioned. In addition, any new nuclear power stations will produce further waste and so we need to plan for this as well.

## The permanent solution

In 2006, the Committee on Radioactive Waste Management (CoRWM), an independent advisory committee on the long-term management of higher activity radioactive wastes made a recommendation to government that geological disposal, coupled with safe and secure interim storage, is the best available approach for the long-term management of higher activity radioactive waste.

The committee had taken into account a number of different options for managing our most radioactive waste, considered scientific advice, overseas experience and undertaken public and stakeholder engagement. CoRWM reiterated its commitment to geological disposal in 2013.

### Why should the UK take action now?

*We are the generation which has benefitted most from the use of radioactive materials over the previous decades. We should also take responsibility for permanently disposing of the wastes we generate.*

## What is geological disposal?

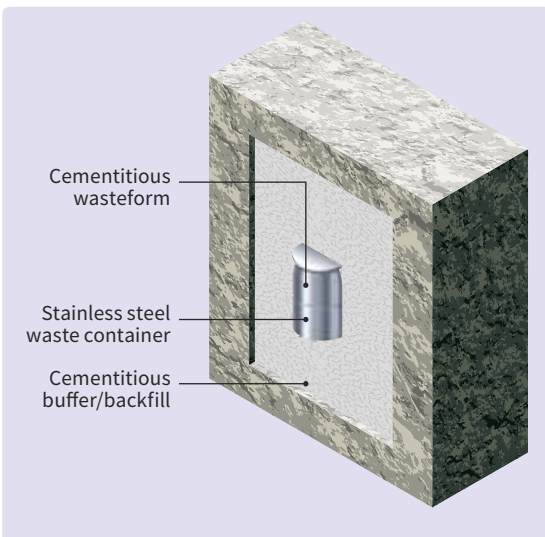
Geological disposal uses multiple barriers to isolate radioactive waste and contain the radioactivity deep underground. This prevents harmful quantities ever reaching the surface environment. The multiple barriers are:

- the solid form of the radioactive waste itself
- the waste container, typically made of metal or concrete
- the material placed immediately around the waste containers to add further protection. We call this buffer or backfill
- other engineered features of a GDF such as the seals in tunnels or vaults
- the stable underground environment in which the facility is built

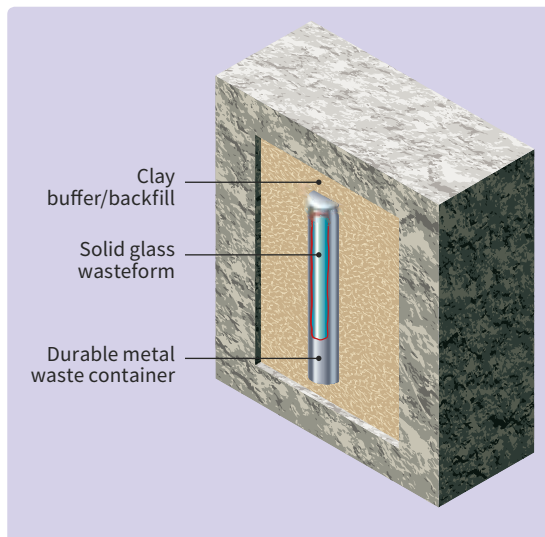
A GDF will be constructed between 200 metres and 1000 metres underground. At this depth the waste will be much better protected in the event of earthquakes, tsunamis and long term environmental changes such as future ice ages.

After all of the waste has been placed in the facility and the tunnels and vaults backfilled, the access tunnels and shafts will be permanently sealed to provide safety without the need for further action.

**An example multi-barrier system for intermediate level waste**

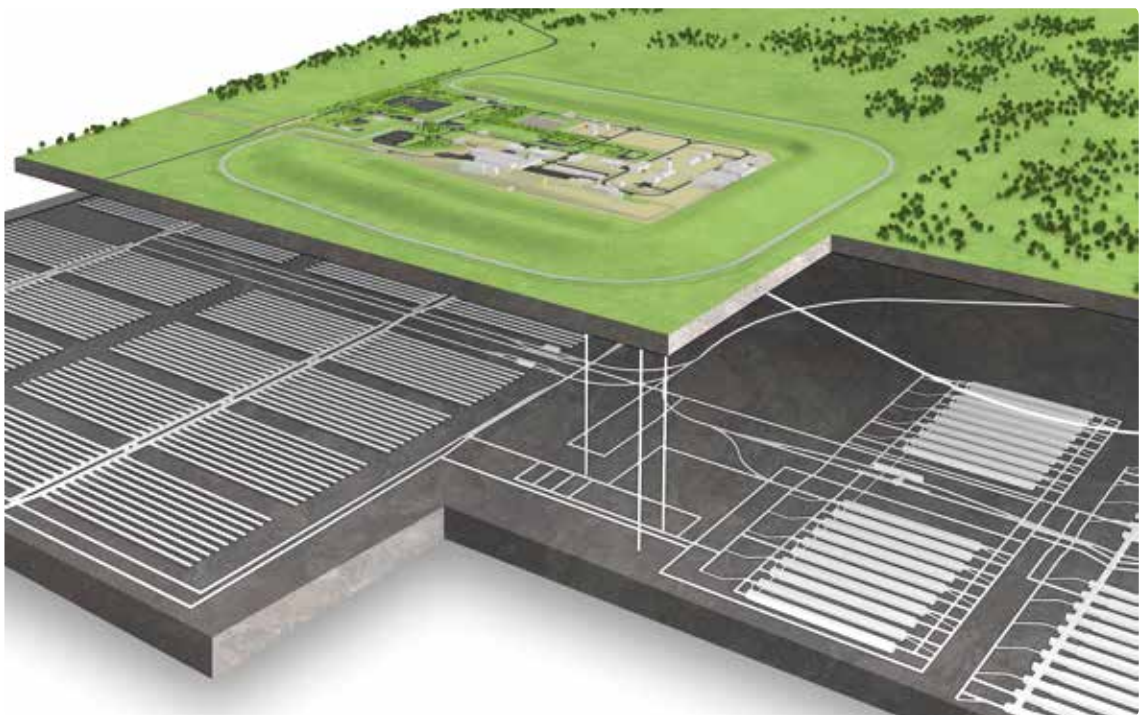


**An example multi-barrier system for high level waste**

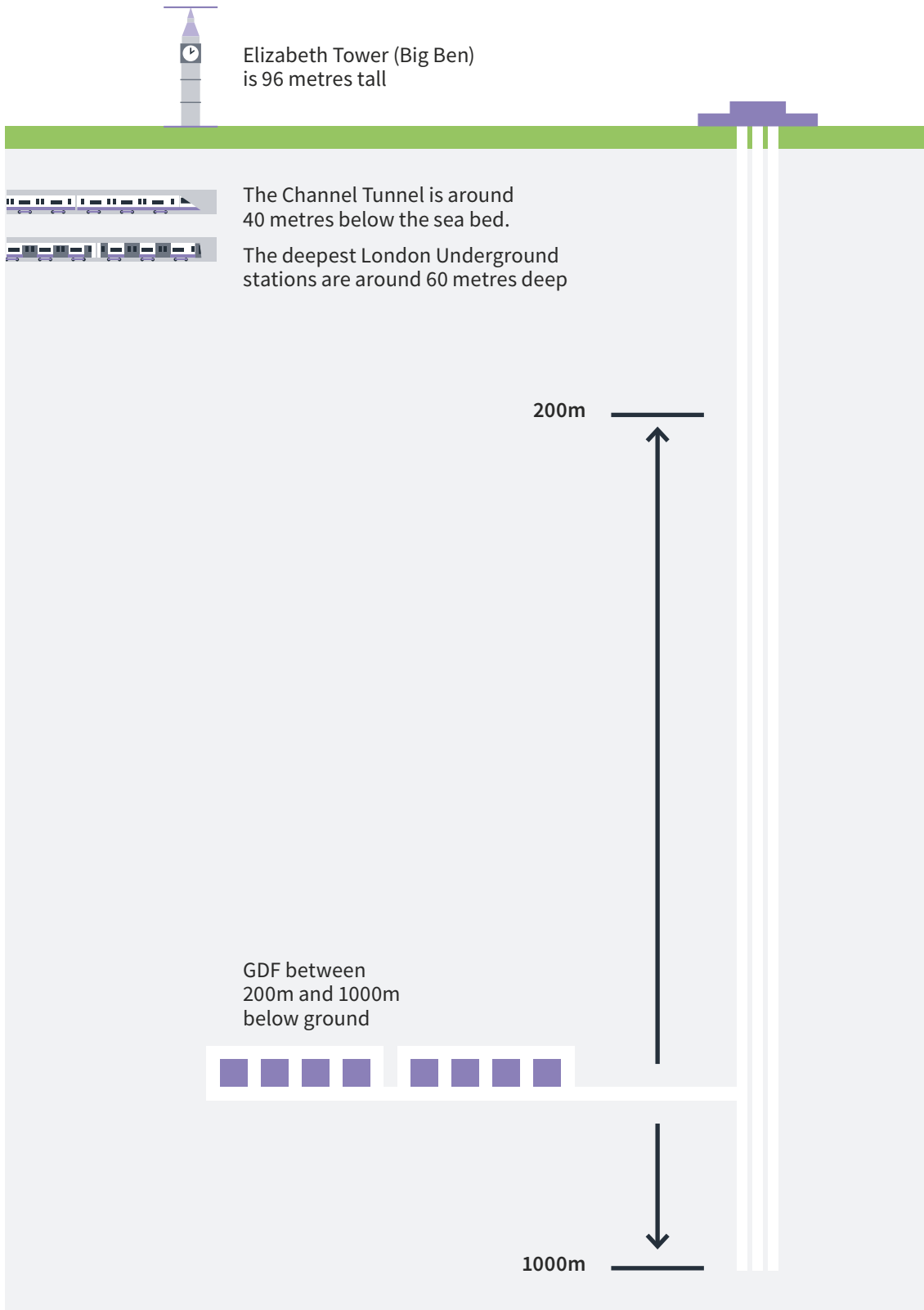


## What will a GDF look like?

A GDF will have both surface and underground facilities, linked by access tunnels and shafts. The surface site will receive waste packages from the rail and road network, and transfer them to the underground disposal facility. Underground, the facility will cover an area of approximately ten to twenty square kilometres. It does not need to be located directly below the surface site and could be separated by a distance of several kilometres. For example, a surface facility on the coast could provide access to a GDF under the sea bed.



## How deep will a GDF be?



## A UK plan

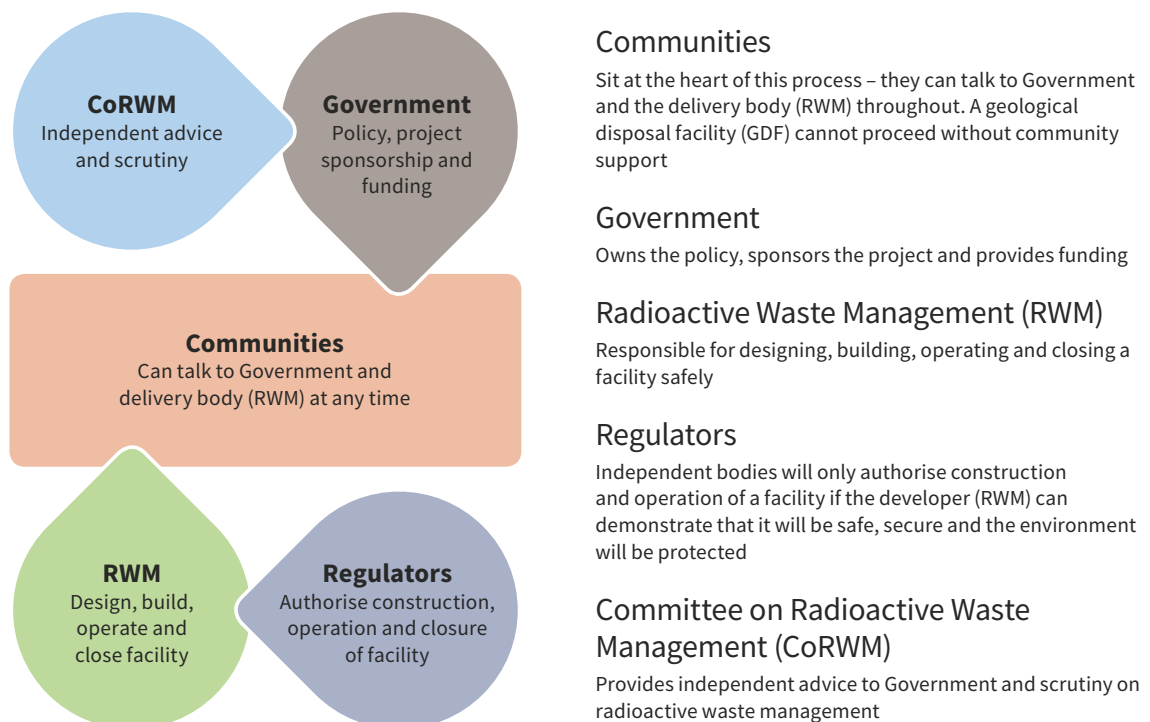
In July 2014, the government published a White Paper called ‘Implementing Geological Disposal.’ It highlighted that to identify potential sites where a GDF could be located, the UK government favours an approach based on working with communities that are willing to potentially host a GDF in their area.

A GDF could be located in England, Wales or Northern Ireland. Scotland has its own policy and RWM will work with the Scottish government to ensure that radioactive waste in Scotland is managed safely.

The White Paper sets out three main actions to complete before the siting process can begin.

- **National Geological Screening**, a programme led by RWM to provide information on the geology of regions across England, Wales and Northern Ireland
- **Preparing to work with communities**, a government policy on how interested communities should be represented and involved. This will include details of how investment will be distributed
- **Developing land-use planning processes** to guide future planning applications for building a GDF

## Geological Disposal: roles and responsibilities





## Radioactive Waste Management (RWM) – about us

We are a public organisation that will plan and deliver a GDF. We have over 30 years experience in carrying out scientific research and development to support geological disposal. We work closely with our international colleagues to share knowledge and collaborate in research projects and tests in underground facilities.

We speak at conferences and events around the country to raise awareness of geological disposal in preparation for our search to find a suitable site for a GDF in a willing community.

We also provide advice to waste producers on how to retrieve, condition and package radioactive waste now in ways that it will make it suitable for disposal in the facility once it has been built.

Safety underpins everything we do. There are strict safety requirements for all aspects of geological disposal which are enforced by the Office for Nuclear Regulation, the Environment Agency, Natural Resources Wales and the Department of Agriculture, Environment and Rural Affairs, Northern Ireland.

## International progress

Some countries with advanced nuclear programmes have moved further ahead with their plans for geological disposal facilities than the UK.

Finland has received the go-ahead to start construction of a GDF from its safety authorities. Construction is underway and the facility is expected to be operating by 2023.

Sweden expects to receive the equivalent approval in 2017 for its GDF in Forsmark, on the east coast of the country.

The GDF in France will be near Bure, in the north east of the country. Detailed underground investigations are being carried out. The site was chosen after a consent-based process which considered sites across the country.

Canada launched a call in 2009 for communities to volunteer and 23 came forward. The Canadian waste management organisation has narrowed this down to eight communities and is continuing to work with these to identify a suitable location.

Switzerland is expected to start detailed investigations at its favoured locations in 2017.

Other countries are at a similar stage to the UK.



## What happens next?

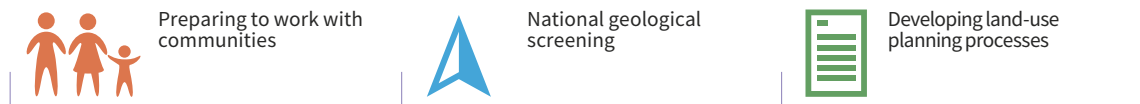
Once the preparatory work is complete, the siting process will be launched. Interested communities will be invited to come forward to find out more about potentially hosting a GDF.

A GDF will be a major national infrastructure project generating jobs, growth and significant investment. It will provide skilled jobs, supply chain opportunities, innovation and investment in local communities that extends into the next century and beyond.

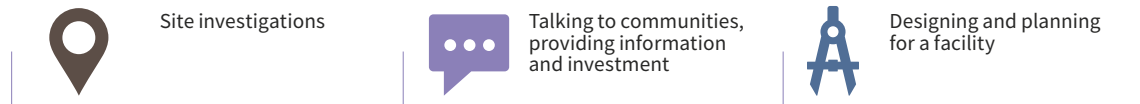
We will carry out detailed investigations of the surface and underground geology, alongside research to evaluate its suitability. This is likely to take around 15-20 years. The construction, operation and closure of the facility will take over 150 years. Identifying a site, constructing and filling a GDF cannot be rushed.

## Making it happen timeline

### Initial actions




### 15-20 years




### 100+ years




 **Investing in the local community:**

- Up to £1m a year per community involved in process.
- Then, up to £2.5m a year per community.
- £££ continued investment

 **Making it safe:**

Office for Nuclear Regulation and environment agencies – independent bodies which will only authorise construction and operation of any facility if RWM can demonstrate that it will be safe, secure and the environment will be protected.

 **Engagement:**

Communities can talk to Government and RWM at any time. There will be open dialogue throughout the entire process and a test of public support will be carried out before construction of a geological disposal facility can begin.

## Finding out more

If you have any specific questions, we would be pleased to hear from you.  
Please contact us at: [gdfenquiries@nda.gov.uk](mailto:gdfenquiries@nda.gov.uk)

## Feedback

Readers are invited to provide feedback on this guide as a means to improving the information we make available. Feedback should be emailed to:

**[rwmfeedback@nda.gov.uk](mailto:rwmfeedback@nda.gov.uk)** or sent to:

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Revision 1  
February 2017. Please look out for further updates or contact [gdfenquiries@nda.gov.uk](mailto:gdfenquiries@nda.gov.uk)