



Anglian Water Ground Investigations

What will I see and hear?



Introduction

This booklet explains what ground and archaeological investigations are and how we will be carrying out these activities as part of the new network of strategic pipelines. You will see us carrying out these investigations at phase 2 of the landowner journey.

Ground investigations mean just that - we investigate the ground by digging or drilling some holes so we can see the conditions below the surface. It is the best way to understand a site.

What are we looking for?

Our investigations will provide a clearer picture of the type of soils, rocks, and groundwater along the

planned pipeline routes. We will also test for strength and stability of the ground and our archaeologists check for any evidence of historical land use.

Who carries out the work?

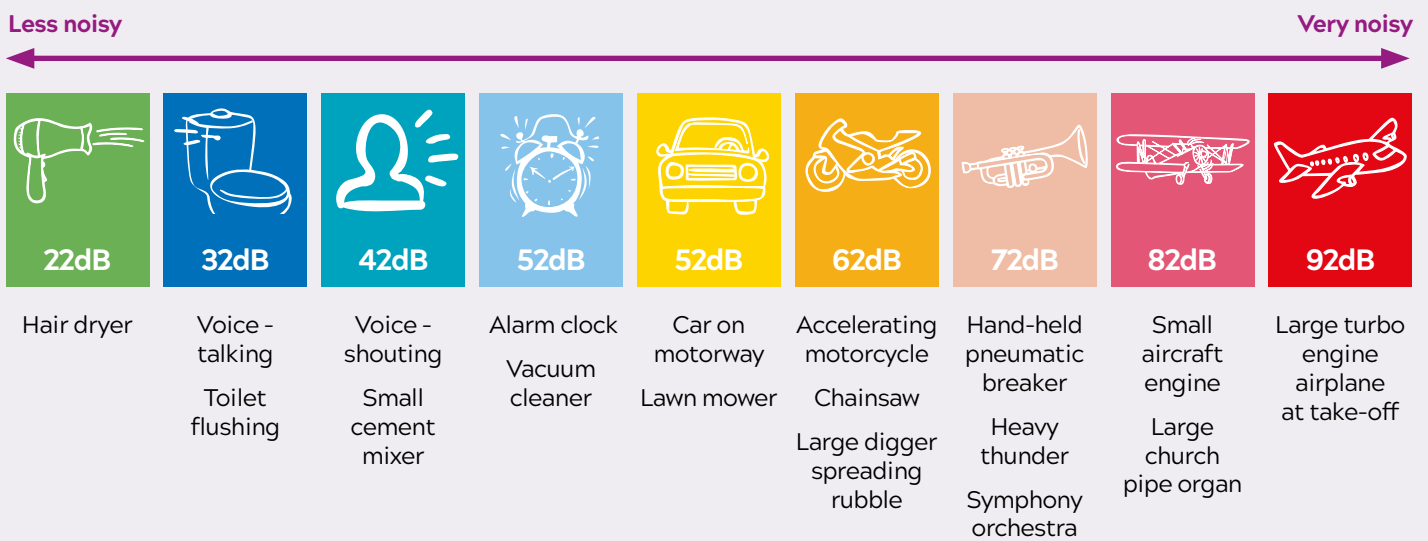
Our ground investigations will be carried out by approved ground investigations specialist contractors.

Is it noisy?

Due to the nature of the work, some of the techniques used will be noisy. We have tried to give an indication as to how much noise each technique creates. The noise level will be influenced by the ground we're working on, for example, working on hard rock will likely result in higher noise than soft soil.

Below is a scale to demonstrate everyday noise levels in comparison to the noise of our equipment at a distance of 100 metres away.

Noise levels scale (in decibels dB)



Non-intrusive surveys (above ground)

Geophysical surveys are non-intrusive techniques. That means they don't break the surface of the ground and allow us to understand what is going on under the surface. The equipment used for each of the techniques described below is generally self-contained with its own powerpack and can be transported in the back of a van.

Electromagnetic conductivity tests the ability of the ground to conduct an electric current. These detect things like underground metal tanks, utility pipes and potentially contaminated groundwater.

Seismic refraction and reflection uses sound waves to measure changes in soil and rock to understand the ground conditions and structure.

Ground-penetrating radar (GPR) uses radar pulses to create a profile of ground beneath the surface, down to 15 metres.

A **magnetometer** is used to measure changes in the strength and direction of a magnetic field to detect buried objects or deposits.

Microgravity is used to detect underground cavities or changes in ground density, flagging up where the ground is potentially hazardous.

Resistivity uses a low voltage electric current to record changes in resistance between steel pegs and can detect and map underground features and patterns.

Geophysical surveys

Our teams will use a magnetometer. This is a machine that records changes in the magnetic resistance of the ground.

Some archaeological remains e.g. pottery, have differing magnetic resistance. A magnetometer can pick up this resistance compared to the surrounding ground.

We may need to temporarily mark our route using small wooden pegs/canes or flags. These are usually in place for a few days although this can vary depending on the size of the area.



Techniques we will use

Our teams will let you know which technique we intend to use, and why.

Each of the techniques are used for a different purpose, and none can give a complete picture of what archaeological remains might be present below the ground. For this reason, we use a combination of intrusive and non-intrusive surveys. Deciding which method we will use will depend on a number of things. These include the type of geology, land use, what archaeology we expect in the area and county archaeologist requirements.

Walkover survey/site visits

We use this technique to assess land on foot as a 'walkover' survey. The land will be accessed on foot (vehicles will be parked at pre-agreed stopping points) and our teams will take photographs and make notes.

Fieldwalking surveys

Fieldwalking surveys are carried out on foot. This will usually mean a team of two surveyors marking an area with pegs then walking across the area and recording any archaeological remains on the surface. The archaeological remains will be located or 'mapped' on a plan and taken away for analysis.

Metal detecting surveys

We use this technique to assess the land on foot. We will walk across the land with metal detectors. Anything we find will be dug up with a trowel and taken away for analysis.

Hand-held surveys

Sometimes for larger, wider areas the land might be suitable for a push or pull-along cart. The cart will be pulled by hand, although it may be pulled by a quad bike. Our teams will take care not to damage the ground.



Pull-along cart system
Source: Magnitude Surveys 2020



Quad-bike towed cart system
Source: Magnitude Surveys 2020

Noise level

Quad bike (54dB at 100 m)

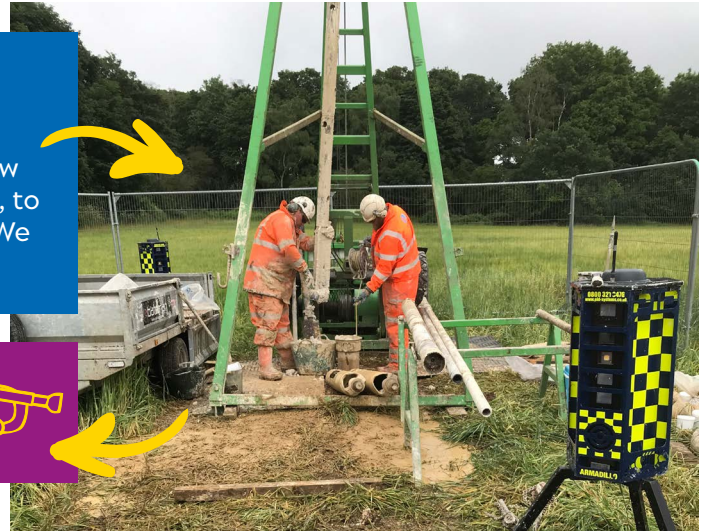


Intrusive surveys (below ground)

The following is a summary of the main techniques we use, with examples of what you will typically see on a site.

Cable percussion borehole

A mobile A-frame, standing up to 7-metres high is usually towed behind a vehicle to get to site. A hollow steel pipe is hammered and drilled into hard ground, to provide access to the soil so samples can be taken. We use this technique to gather soil samples.



Noise level

Cable percussion borehole (70dB at 100 m)



Cable percussion borehole
Image courtesy of Socotec

Rotary core borehole

We use this technique to gather soil samples. A rig uses a rotating drill to make a core through hard soils and rocks. Often used in combination with a cable percussion.



Noise level

Rotary core borehole
(52dB at 100 m)



Rotary core borehole
Image courtesy of Socotec

Dynamic probing

We use this technique to profile the ground. A diesel motor-driven hammer pushes a cone into the ground. It can be used in difficult to access sites.

Noise level

Dynamic probing
(70dB at 100 m)



Cone penetration testing

We use this technique to gather soil samples in softer soils. From within a small truck, a cone-shaped metal rod is pushed down into the ground to investigate the soil.

Noise level

Cone penetration testing
(54dB at 100 m)



Cone penetration testing truck

Image courtesy of Socotec

Trial pits

We use this technique to look for features in the soil profile. A digger/excavator is used to create a pit so we can see the profile of the ground and test soil samples. Trial pits might be located in areas with potential for archaeological remains. If this is the case, excavations will be monitored by an archaeologist to record any artefacts or deposits that are disturbed by the ground investigation works.

Noise level

Trial pits
(54dB at 100 m)



An excavator on our Norwich to Wymondham route



Window sampling
We use this technique to profile the ground. A small rig is used to hammer a steel tube into the ground. A geoarchaeologist may also be present to monitor and/ or sample the ground.

Noise level
Window sampling (70dB at 100 m)



Window sampler rig
Image courtesy of Socotec

Plate load tests
We use this technique to test ground stability. A steel plate is placed on the ground and a large excavator presses onto it to measure how much the ground moves.

Noise level
Trial pits (54dB at 100 m)



A plate load test
Image courtesy of Socotec

Archaeological investigations

Our archaeological investigations will check to see if our work is likely to disturb any buried archaeological remains such as evidence of human activity in the past. For example, pottery, stone tools and changes to the land such as pits and ditches.

What are we looking for?

Our teams will check the significance of any archaeological remains and, if found, will work out the best way to preserve or excavate them.

What happens if we find artefacts?

All finds (or artefacts) remain the property of the landowner. A transfer of ownership form will be issued once any finds need to be archived.



Finds will be taken away for cleaning, recording and analysis. All finds remain the property of the landowner. However, the normal process is that ownership is transferred from the landowner to the local museum or archive store through completion of a transfer of ownership form.

Archaeological trial trenching

We will dig trenches to check for archaeological remains beneath the topsoil, mostly in areas where there is known archaeology and with the agreement of the county archaeologist. Each trench will require an access route and will have a working area for soil storage, usually topsoil, one side of the trench and subsoil on the other side.

We will use machinery to dig the trenches, ranging from a small excavator with a trenching bucket to a road-approved digger.

A trench on our Bexwell to Bury St Edmunds route, 2021



A typical archaeological trench is shown above. Reparations are made for crop losses.

What will the site look like afterwards?

Once finished, the hole (either a trench or borehole) is either filled or fitted with instruments, for example, gauges to measure water levels. Any meters left in the hole will be covered by small steel casing. We will leave every site as we found it. All instruments will be removed after a pre-agreed period and holes will be filled in.

The tables below are a summary of the main ground investigation and archaeological techniques we will use.



Table 1: Ground investigation techniques

Technique	Purpose	Depth	Diameter	Backfilled	Noise level in decibels (dB) at 100 m away	People required to operate	Approximate time taken to complete*
Cable percussion borehole	Gathering soil samples	5-40 metres	150mm	Yes	70dB	3	Up to 5 days
Rotary core borehole	Gathering soil samples	5-70 metres	150mm	Yes	52dB	3	Up to 5 days
Hand auger borehole	Gathering soil samples	0.5-2.5 metres	Up to 100mm	Yes	Minimal	2	A few hours
Cone penetration testing	Gathering soil samples in softer soils	Up to 20 metres	Up to 50mm	Yes	54dB	2	About half a day
Dynamic probing	Profiling the ground	10 metres	35mm	Yes	70dB	3	1 day
Window sampling	Profiling the ground	10 metres	86-116mm	Yes	70dB	3	Up to 1 day
Trial pits	Looking for features in the soil profile	2-3 metres	0.5-3 metres	Yes	54dB	1-2	About half a day
Plate load tests	Testing ground stability	N/A	N/A	Yes	54dB	1-2	About half a day

*Time taken to complete may vary depending on weather conditions

Table 2: Archaeological and geophysical surveys

Technique	Purpose	Depth	Diameter	Backfilled	Noise level in decibels (dB) at 100 m away	People required to operate	Approximate time taken to complete*
Walkover survey/site visits	Assessing land on foot	N/A	N/A	N/A	Minimum	2-3	1 day
Geophysical surveys	Assessing land on foot	N/A	N/A	N/A	Minimum	2	1 day
Hand-held surveys	Assessing land on foot	N/A	N/A	N/A	Minimum	2	1 day
Hand-held surveys by quad bike	Assessing land using quad bikes	N/A	N/A	N/A	50dB	2	1 day
Fieldwalking surveys	Assessing land on foot	Superficial (between 15-23cm below ground level)	N/A	N/A	Minimum	2-3	1 day
Metal detecting surveys	Assessing land on foot	Superficial (between 15-23cm below ground level)	N/A	N/A	Minimum	2-3	1 day
Archaeological trial trenching	Identifying whether archaeological remains are buried beneath the topsoil	Up to one metre, but typically 0.3 m to 0.7 m deep with localised hand-dug excavations	Up to two metres	Yes	54dB	A minimum of four people	More than a week

*Time taken to complete may vary depending on weather conditions



Want to compliment one of our team?

Every day we strive to deliver a great service, and make sure our customers are happy with the work we do. So, if you'd like to compliment one (or more) of our people, we'd love to hear from you. It's quick and easy to do, and we'll make sure the person sees it too. Scan me.



Or alternatively, please visit www.anglianwater.co.uk/compliments

Contact details for land access, surveys and pipeline enquiries

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For more landowner information and an explanation of these phases, please visit anglianwater.co.uk/about-us/our-strategies-and-plans/new-water-pipelines/landowner-journey/

