PCA Guidance Note:
Safe and Effective Excavation and Burial

Excavations are frequently used on construction sites, also in residential and commercial properties, as a means of controlling, limiting or eradicating Japanese knotweed and other invasive weeds. However, excavations are a hazardous area of work and require risk assessments, method statements and a thorough understanding of the issues involved.

The purpose of this advice note is not to provide formal advice to any contractor considering excavations, but rather to provide information on some key points and to encourage consultation of more information available online.

Hazards that may arise when excavating include (but are not limited to):

- Underground services.
- Proximity of adjoining buildings, walls and other structures, which could endanger operatives, general public, clients, etc. if they collapse.
- Collapse of sides of pit, endangering operatives, general public, clients, etc. Such collapse could be caused by many factors, including (but not limited to) poor excavation methods, soft soil, inclement weather and/or proximity of plant/vehicles, etc.

Remember: No ground can be relied upon to stand unsupported in all circumstances.

Depending on circumstances, 1 m^3 of soil can weigh in excess of 1.5 tonnes.

Every year, people are killed or seriously injured by collapses and falling material while working in excavations.

1. Excavations

As a general rule, the sides of all excavations will need to be battered. The degree of batter will vary according to your assessment of the situation and may change as the site circumstances change. As a minimum it should be 45° but the angle may need lessening on some soils and in some conditions. The work should be planned by a competent manager and site supervision should be done by a competent person.

The manager of the operation should be competent by experience, training and qualifications. They should be able to assess the risks involved in this operation and provide a safe working methodology in combination with the site supervisor. We would advise that an appropriate qualification for this role might by either the Site Manager's Safety Training Scheme (SMSTS) or the Managing Safely qualification from IOSH (Institute of Occupational Safety and Health).

The site supervisor must be competent in directing excavations and should be able to demonstrate appropriate training such as the Site Supervisors Safety Training Scheme (SSSTS) qualification as well as qualifications and experience in dealing with Japanese knotweed. The site supervisor will need to be present at all times during works and to formally inspect the excavation at the start of each shift to confirm that works are safe to proceed or after any incident which might affect the safety of the operatives.

The HSE have produced a number of advice notes and guidance and some of these are listed at the end of this section. The contractor and Supervisor should be familiar with these documents and their contents. We would also recommend consulting the CITB Construction Site Safety series (GE700) – more information on excavation planning, supervision and management is available within Book D: High Risk Activities and elsewhere in the series.

1.1 Site Assessment

An assessment of the site should be made before any works commence. All relevant hazards should be noted and incorporated into a Risk Assessment and Method Statement (RAMS) document. This will include an assessment of all services (both overhead and underground), access arrangements, proximity of buildings, walls, etc. and any other site-specific issues (which could include railway lines, canals and waterways, sub-stations and underground pipe lines). Be aware there are some circumstances that require third party permissions pre-works (e.g. excavating on a disused landfill site requires permission from the Environment Agency) and there may be other historic issues on the site (e.g. disused tunnels, old storage tanks, etc.) that could present a hazard.

A CAT scan of the area to be excavated will need to be carried out by a competent person before any excavations can commence. This will typically need repeating as the excavation proceeds. Service plans should be obtained and referred to and be available on site for use.

A site assessment to consider environmental issues will also need to be conducted, which will include consideration of protected species, such as bats, dormice, badgers, etc., as well as other Schedule 9 species. You may need to employ an ecologist to make a protected species assessment on large sites.

Unexploded ordnance (bombs, etc.) may also be an issue to consider on sites. This may need further assessment by a specialist company and if there is a known risk then additional safety procedures and staff training may need to be place before works commence.

1.2 Soil analysis

Soil analysis will also be required on most sites to ensure that the soils to be excavated are not contaminated in other ways (e.g. heavy metals, asbestos, etc.). Sites where contamination issues may

be identified from the site history might include such historical or current activities as (but is not limited to):

- Gas works sites
- Brownfield sites which have been used for metal fabrication, old foundry sites, etc.
- Fuel stations
- Vehicle servicing areas
- Vehicle scrapyards and breaking areas
- Coal yards
- Chemical manufacturing
- Sites where contamination is obvious and present e.g. surface asbestos contamination
- Old landfill sites (unregistered or registered)
- Old mine working sites

Other hazards may also exist outside of the above. For instance, old tanning works are at higher risk of containing anthrax spores.
The normal procedure required by landfill site operators (such as BIFFA, FCC, etc.) is to take samples to conduct a preliminary assessment (of, for example, metals, pH, organics) and at this stage they will need details of the site history.

Further details regarding Waste Classification are given in **PCA Guidance Note**: Waste Classification for Works in a Commercial Setting and you may decide to contact PCA registered consultants specialising in this area.

1.3 Pre-treatment of Japanese knotweed

Japanese knotweed and other invasive weeds should be pre-treated prior to excavation. Ideally, a programme using non-residual herbicide (e.g. glyphosate based) should have been in place for at least one season, pre-excavation. This will reduce the viability of the plant and is generally accepted as good practice. It is often required by landfill sites prior to acceptance and is necessary for cell burials.

1.4 Vertical Excavations

No vertical excavation (no matter how temporary) should take place up to or in the near vicinity of a structure or building, unless under the immediate direction of a qualified structural engineer. No vertical excavation can be considered as either stable or safe unless supported.

Vertical excavations near buildings or structures run the risk of allowing the compacted ground under the foundations of becoming less stable – and even being squeezed out from under the foundations. This may lead to subsidence and the need to underpin the structure or could lead to the building/structure becoming structurally unsafe and even collapsing. Hence the requirement for a competent and properly insured structural engineer to direct any (and all) such excavations.

Vertical excavations are not safe to work in or around. In the vast majority of cases, they will not be useful in remediating Japanese knotweed sites, as people will need to enter excavations to check for knotweed and/or install root barrier. This would not be safe to do so if excavation supports had not been installed. This is why the default position for excavations should always be that they are safely battered at all times.

Please note that under the Construction (Design & Management) Regulations (CDM), it is a specific criminal offence to adversely affect the stability of structures. Section 19 of the CDM Regulations states that "Buildings and Structures must not be allowed to become unstable during work and any support used must be adequate for the job".

1.5 Method Statement, Risk Assessment and Permit to Work

A comprehensive risk assessment and method statement (RAMS) should be drawn up for every excavation. This should detail all known and suspected hazards/risks (e.g. prevention of falls; even battered slopes may be deemed hazardous) and how to safely work around them. The RAMS is then normally submitted to the main contractor who may make amendments before an on-site induction after which all parties agree to the final content. The sub-contractor will then have a tool-box talk with his team about the RAMS, which they all sign. Then the main contractor issues the permit to work (this is typically done every week but may be more frequent).

Every RAMS is unique to the site and situation. If additional issues arise, circumstances change or new hazards are identified, the RAMS will need to be updated to reflect this.

1.6 Working safely on site

Due to the serious hazards associated with excavations it is essential to identify and control all risks to health. To maintain the required precautions, a competent person must inspect excavation supports or battering at the start of the working shift and at other specified times. No work should take place until the excavation is safe.

NB: Soil battering may either be a slope (e.g. one graded to 45° or shallower, depending upon the site conditions and any assessment) or by creating a step batter (literally a batter which is created by forming small steps along the side). Any battering must be properly carried out in accordance to best practice, to your RAMS and to ongoing feedback from the site supervisor.

Required/Recommended further reading:

HSE Preventing Accidents in excavations
http://www.hse.gov.uk/construction/lwit/assets/downloads/excavations.pdf

HSE Structural Stability during excavations
http://www.hse.gov.uk/construction/safetytopics/excavations.htm

HSE CIS47 (rev1) Inspecting excavations http://www.hse.gov.uk/pubns/cis47.pdf

HSE HSG 144 The Safe use of Vehicles on Construction Sites
http://www.hse.gov.uk/pUbns/priced/hsg144.pdf

HSE CIS64 Excavation: What you need to know as a busy builder
http://www.hse.gov.uk/pubns/cis64.pdf

HSE HSG150 Health and Safety in Construction http://www.hse.gov.uk/pUbns/priced/hsg150.pdf

HSE HSG47 Avoiding danger from underground services
http://www.hse.gov.uk/pUbns/priced/hsg47.pdf

HSE Construction micro-organisms: Anthrax from contaminated land and buildings
http://www.hse.gov.uk/construction/healthrisks/hazardous-substances/harmful-micro-organisms/anthrax.htm

CITB Construction Site Safety - GE700/18. https://shop.citb.co.uk/GE70018.aspx

PCA Guidance Note: Waste Classification for works in a Commercial setting. https://www.property-care.org/professionals/invasive-weed-control/invasive-weed-control-technical-document-library/

2. Cell burials

Cell burials are perhaps the most challenging and potentially hazardous operation that any Japanese knotweed contractor will undertake. In addition to the points covered in Section 1 above (Excavations) consideration must be given to the cell design/dimensions, the installation of root barrier membranes and obtaining consent from the Environment Agency. Creation of a cell typically involves working at depths from between 4 - 5 m, sometimes deeper. These depths need careful consideration to ensure that safe working methods are specified and carried out.

2.1 Legalities

All wastes arising from a JKW site are classified 'Controlled waste' so should normally only be disposed of at licenced sites. However, Environment Agency policy has been that, where site burial is considered, they would not prosecute *provided the correct guidelines are followed*. These include *consulting with the Environment Agency before the works take place*.

As part of this process we need to look at the material:

- Are there any other contaminants in the material?
- Will these present a problem to the ground water table?
- How do we demonstrate this?

Normally this assessment is achieved through soil testing (see 1.2 above) and the results can be submitted to the Environment Agency as part of the process of obtaining consent. It is possible to create a Japanese knotweed cell burial where hazardous waste is also present, *provided you have the Environment Agency's specific consent to do so*.

The consent to create the cell should be obtained from the EA in writing (letter or email) and it is advisable to keep a copy of this. This should go into the contract file and be retained.

2.2 Pre-treatment

Conduct at least one (and preferably more) applications of a glyphosate-based herbicide to the Japanese knotweed (in the growing season), which should be at done at least 3-4 weeks prior to excavation works commence. It may be necessary to commence herbicide treatments in the previous season or earlier, if a winter or spring cell burial is planned. *Do not use a residual herbicide*.

It is not usually appropriate to screen the soil before creating a cell. While screening may be done to extract some of the knotweed rhizome it will not alter the cell design in any way and is costly in terms of time, money and fossil fuel usage. For example, all soil (whether it has passed through the screener or not) will remain contaminated with Japanese knotweed and it is still classed as controlled waste according to the Environment Agency's Code of Practice. Please note that no contractor or other body has any powers to declassify the controlled waste status of the soil regardless of what work they may or may not have completed to the material.

2.3 Record keeping

Record the location of the cell using GPS and add the location to title deeds. Complete an Operating and Maintenance file insert with a location plan. Pass to the client.

2.4 Cell design and calculations

The first step to designing and calculating the cell's dimensions is to calculate the volume of the controlled waste that the cell will need to contain. In this discussion document we will use an example of a stand of Japanese knotweed covering a visible area of 12 x 8 m.

Question: What is the expected volume of Japanese knotweed-impacted material that the cell will need to hold?

We might assume that the Japanese knotweed rhizome spread is 2 m in every direction out from the visible stand and also an average of 2 m deep. Therefore, the volume calculation would be (12+2+2) x (8+2+2) x 2 (depth) = 384m³. However, when soil is excavated it expands as it is released from compaction and you cannot re-compact it again. Therefore, you need to add 10% of the volume to allow for this. So, 384 + 10% = 423m³. It is advisable to round this up as it is almost impossible to make a cell larger once filled and additional controlled waste will be generated when haul roads are

decontaminated and machinery cleaned. For this particular example, we will assume the cell needs to hold 450m³.

Question: How do we make the cell stable and safe for workers?
The usual way is to batter back the sides. You need to consult the guidance for the slope batter (see HSE guidance) as some materials (such as wet clay or sand) need a much shallower slope than others. Typically, if the ground is dry and stable, a batter of 45º is acceptable.

If we assume a 2 m depth cell with 2 m of clean soil above it, the receival pit for the cell will be 4 m deep (on stable ground). The cell will look something like this:

The actual cell is shown outlined in red. The blue double arrow shows the 2 m minimum layer of clean soil.

Question: How do you calculate the cell dimensions?
For the purposes of this example, we want the cell to hold 450m³ (see above).
In this example, the base of the pit is 4 m below the ground level and the top of the cell is 2 m below the ground level.
On average, the cell layers will need to hold 450m³ of soil.
i.e. at 3 m below ground level (the halfway point of the cell) the surface area will need to be 225m².

We will assume that one of the width dimensions at the 3 m depth will be 15 m. If we divide 225 by 15, we get 15. Therefore, at 3 m depth, the dimensions of the cell will be 15m x 15m.

It is a good suggestion is to try to aim for a squarish cell if possible. A long rectangle is feasible but be aware it will require more root barrier as a proportion. But don't worry if it is not square – this is merely an example. We could just as easily use 16 x 14 m, which would be nearly correct too.

This does not tell us the cell dimensions or the root barrier needed; it only tells us how to calculate a technical mid-point in the cell. Fortunately, the next bit is easy! A 45º batter goes up 1 m and out 1 m. So to calculate the top of the cell, add 1 m for each metre up and for each side.

Therefore, in this example, the 15m x 15m dimensions at 3 m below ground level becomes 17m x 17m at the top of the cell (2 m below ground level), 21m x 21m at ground level and 13m x 13m at the bottom of the excavation.

Question: Is the land area on site large enough for a cell holding the expected volume?
We know how much material the cell needs to hold. However, what options do we have for the design? Assume the client has an area that will not be built on (Public Open Space – POS) that may be suitable. For this example, it measures 40m x 50m.

We have selected the completely encapsulated option. i.e. root barrier all around the cell. This means that we must have 2 m (minimum) of clean material on top of the cell. Note: *minimum* – it is better to make the cell larger than necessary than to have to dig a second cell because the first one wasn't large enough. The alternative option to an encapsulated cell is to have a 5 m minimum clean material layer above it, in which case the cell only needs root barrier on the top rather than below and around as well. However, this option involves excavating to greater depths (typically 7-8 m) and most insurance companies won't cover this unless you are a professional and qualified ground worker. It is worth noting that if you are considering **any** cell burial, you should check to ensure your insurance covers the works.

If we look at the above cell dimensions, we can see that the proposed cell (surface dimension of 21m x 21m) will comfortably fit within the POS. Therefore, the cell burial solution should be a viable one for this site – which may not always be the case!

Root barrier

The root barrier specification is laid out in the Environment Agency Knotweed Code of Practice. *(Although this document is no longer actively supported by the EA it remains available online)*

To calculate the root barrier dimensions, look at the dimensions for the cell top. In the example we have been considering, this will be 17m x 17m. We suggest rounding this up to 18m x 18m for overlapping and joining purposes. You will need two pieces of root barrier this size: one for the base and sides of the cell itself and one for the lid. When the lid is placed onto the top of the cell it will need heat welding to seal the whole cell.

While the cell is being filled **it needs to be compacted**. You can use remote controlled trench rollers, excavators (using the tracks) or normal driven rollers. If necessary, the contents of the cell can be rolled in layers (100-150mm thickness). Compacting the cell like this will lessen the degree to which it will subside in the future, though if (for example) a car park is to be placed over the cell you will still need to take measures to prevent surface movement (e.g. installing a geogrid).

It is essential the root barrier is undamaged during and following cell installation. Therefore, begin operations by laying a protective layer of soil or sand on the base of the burial cell to prevent the excavator tracks ripping the membrane.

Placing a layer of soil across the base of a burial cell.

Battered sides (beneath barrier) and step batter at 2 m depth to facilitate safe installation of root barrier.

Haul roads will be required to move the contaminated waste from the point of origin to the cell. These will need to be decontaminated and all arisings added to the cell prior to the top layers of root

barrier being put into place. In addition to this, all machinery will need decontaminating (manually and with a pressure washer) and all arisings placed into the cell before it is sealed.

2.5 Additional risks to consider for cell burials

There are many potential issues to consider when planning and undertaking a cell burial. These include, but are not limited to:

- Build-up of CO2 and/or other noxious gases during the excavation (possibly from machine usage in or close to the cell);
- Ground or surface water filling the excavation;
- Changes to ground during works – e.g. heavy rainfall may destabilise a previously safe excavation.

2.6 Cell design additional points

The photographs in the Environment Agency Knotweed Code of Practice show ply sheeting being utilised as shuttering to support the sides of a burial cell. This is not normal practice, since battering the sides to a safe angle, renders any shuttering unnecessary. In addition to this, ply sheeting presents a risk of fracturing, which could produce splinters that could damage the root barrier.

An additional design feature that has been used successfully is to install a step batter. This involves creating a step in the batter at the cell top point, (i.e. 2 m depth from ground level). This serves two purposes. First, it marks the 2 m level all around the cell. Second, it provides a safe working platform for the root barrier installation.

2.7 Site hygiene and management

A Knotweed Management Plan should be in place for any cell burial and this should include details of site hygiene and management. Each site is different, but generally speaking, a cell burial will involve the movement of large amounts of soil across a site. Two or more site supervisors may be needed, as well as other workers, to manage a cell burial. Typically, the cell receival pit is created first. Then the Japanese knotweed is excavated, loaded into dumper trucks and moved on a designated haul road across the site to the cell, where it is tipped and the material spread by a second excavator before being compacted. Please note it is usually necessary to decontaminate the machinery at each end of the haul road to minimise any spread of material onto the road. To be on the safe side, the haul road must be decontaminated at the end of the work.

2.8 Contractor Competence

If you have any doubts or concerns (as a contractor or as a manager/supervisor) about your experience and/or competence to undertake a cell burial and/or excavation works, you should carefully consider whether you should undertake this type of work. If you are in any doubt about your technical ability to safely do this type of work you should seek support from either the PCA or another PCA member who specialises in this type of work.