

Explanatory notes and examples

Fencing protected trees



SGN 2-09

An innovative use of plywood and accommodation cabins to protect the trunk and roots of this retained tree.



SGN 2-10

Scaffold and boards can be installed around trees that have to be retained within working areas.

Explanatory notes and examples

Fencing protected trees



SGN 2-11

Boxing in trunks provides effective protection, even in the tightest of situations, along with the retention of existing hard surfacing to protect the RPA.



SGN 2-12

If street trees could be harmed during development, they should also be protected even though they may be off site.



SGN 2-13

BS 5837 recommends warning signs are attached to fencing as a reminder of the restrictions within the RPA.

Due to copyright restrictions, the relevant British Standard clauses are summarised, not quoted, as follows:

1. **BS 5837 (2012) Trees in relation to design, demolition and construction – Recommendations:** Clauses 6.2 (Barriers and ground protection) and 7.3 (Tree protection during development) recommend:
 - 6.2.1.1 All retained trees should be protected by fencing and ground protection before any demolition, development, or soil stripping starts.
 - 6.2.1.3 The protected area is sacrosanct. Fencing and ground protection should not be removed or altered unless agreed by the supervising arboriculturist.
 - 6.2.1.5 The supervising arboriculturist should confirm that the tree protection has been installed as agreed before any significant site work starts.
 - 6.2.2.1 The tree protection should be fit for purpose, i.e. preventing inappropriate work in the RPAs of retained trees, and be maintained to remain rigid and complete.
 - 7.3.2 Where structures are to be removed from RPAs, fencing and ground protection should be installed up to the edge of the structure to protect the underlying soil.

Ground protection

SGN

3



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Summary guidance for site operatives

Ground protection

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Work under the normal site risk assessment procedures and comply with the wider site safety rules.
- Brief operatives entering root protection areas (RPAs) by the supervising arboriculturist before work starts.

Other relevant SGNs

- Monitor works in RPAs by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).

Important reminders

- Ground protection will be fit for purpose, i.e. prevent damage to the underlying soil and roots in RPAs.
- Ground protection will be installed at the locations shown on the tree protection plan.
- Ground protection locations will not be altered without prior approval of the supervising arboriculturist.
- Where feasible, retain existing hard standing to act as ground protection.
- Ground protection will not be removed at the end of construction without prior approval of the supervising arboriculturist.

Explanatory notes and examples

Ground protection

Purpose

SGN 3 describes where ground protection will be installed, what form it can take, and how long it should remain in place to effectively protect trees to be retained, based on the recommendations in *BS 5837 (6.2 and 7.3)*.



General principles and clarifications

Ground protection is an effective means of preventing damage to the RPAs of retained trees during development activity. In practice, a range of approaches can be used, including retaining existing hard surfacing or structures that already protect the soil, installing new materials, or a combination of both. Whatever the chosen option, the result will be that the underlying soil (rooting environment) remains undisturbed and retains the capacity to support existing and new roots.

Ground protection will be installed at the locations shown on the tree protection plan and agreed by the local planning authority before any construction activity starts on site. It will remain in place until there is no risk of harm from the development activity. No ground protection will have its location changed or be removed without consulting the supervising arboriculturist. Furthermore, the condition of the ground protection will be regularly monitored to ensure it remains fit for purpose, i.e. sufficient to prevent damage to the RPAs of retained trees.

Explanatory notes and examples

Ground protection



SGN 3-01

Metal plates and heavy plywood cover this entire area while the piles are being installed and the building is constructed above the RPA.



SGN 3-02

Heavy-duty plywood set onto a compressible woodchip layer and pinned into position is suitable to spread the loading from pedestrian access.



SGN 3-03

ArborRaft is very effective on flat areas to spread load and reduce compaction. Its main benefits over other cellular products are that there is no need to fill it with stone, which saves costs, and it is reusable. The UK supplier is Wrekin Products: wrekinproducts.com

Explanatory notes and examples

Ground protection



SGN 3-04

Plywood fixed to a wood frame is another effective method of protecting soil from pedestrian compaction.



SGN 3-05

A scaffold framework attached to the main scaffold fencing can be used to support either scaffold planks or plywood to create an elevated platform with a gap beneath.



SGN 3-06

Cellular products are a very effective means of providing ground protection where heavy vehicle use is expected. Here, it is being used to temporarily widen an existing road, to be removed once the construction is finished.

Explanatory notes and examples

Ground protection



SGN 3-07

Custom designed sectional metal tracks can be joined to support very heavy traffic use through sensitive areas.



SGN 3-08

Ground protection must be used where repeated pedestrian traffic could cause compaction in sensitive RPAs. It can be as simple as plywood, pinned to the ground, or custom designed plates that interlock to spread the load.



SGN 3-09

A combination of retaining existing surfacing and using temporary construction cabin accommodation can be a very effective means of preventing damage to sensitive areas.

Explanatory notes and examples

Ground protection



SGN 3-10

Steel plates can be an effective way of temporarily reinforcing weak surfacing over a construction access during the development activity.



SGN 3-11

A temporary concrete slab cast directly over existing low load bearing surfacing is an effective way of ensuring that the soil beneath is protected from compaction during development. This is removed once the heavy use is finished.



SGN 3-12

Temporary concrete slabs on slopes are an effective way of preventing soil damage during the transport of materials on and off site.

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1. BS 5837 (2012) Trees in relation to design, demolition and construction – Recommendations: Clauses 6.2 (Barriers and ground protection) and 7.3 (Tree protection during development) recommends:

- 6.2.1.1 All retained trees should be protected by fencing and ground protection before any demolition, development, or soil stripping starts.
- 6.2.1.3 The protected area is sacrosanct. Fencing and ground protection should not be removed or altered unless agreed by the supervising arboriculturist.
- 6.2.1.5 The supervising arboriculturist should confirm that the tree protection has been installed as agreed before any significant site work starts.
- 6.2.3.1 Where deemed appropriate by the project arboriculturist, protective fencing can be set back and the RPA protected with ground protection. Where feasible, existing hard surfacing scheduled for removal should be retained to act as temporary ground protection during construction.
- 6.2.3.2 If the set-back exposes unmade ground, new temporary ground protection should be installed as part of the tree protection measures before site works start.
- 6.2.3.3 New temporary ground protection should support all anticipated loading and prevent compaction in the RPA.
- 6.2.3.4 The location and design of ground protection should be shown on the tree protection plan and detailed within the arboricultural method statement.

- 6.2.3.5 The objective of ground protection is to avoid soil compaction and prevent adverse impacts on tree root function.
- 7.3.2 Where structures are to be removed from RPAs, fencing and ground protection should be installed up to the edge of the structure to protect the underlying soil.
- 7.3.3 All demolition plant should either operate outside the RPA, or run on ground protection installed before demolition starts.

Pollution control

SGN

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Summary guidance for site operatives

Pollution control

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Manage pollution control under the normal site risk assessment procedures and comply with the wider site safety rules.
- Where a significant risk of root protection area (RPA) contamination is identified, put pollution control measures in place to manage that risk.

Other relevant SGNs

- Monitor works in RPAs by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).

Important reminders

- Make provision for emergency spillage clean-up.
- Mix cement and wash vehicles as far away from RPAs as possible.
- Use bunding and impermeable membranes to prevent liquid contaminants reaching RPAs.
- Use impermeable membranes to prevent leachates from poured concrete contaminating RPAs.
- Keep pollution control measures in place until there is no significant risk of RPA contamination.

Explanatory notes and examples

Pollution control

Purpose

SGN 4 describes why pollution control is necessary, what form it will take, and how long it will remain in place to effectively protect retained trees, based on the recommendations in *BS 5837 (5.5, 6.2.4, 7.4, 7.5, and A.2)*.

General principles and clarifications

Pollution control is intended to prevent pollutants contaminating RPAs and it will be necessary wherever risk assessment identifies a significant risk of harm arising from this cause. Spilt solid or liquid chemicals that reach RPAs can kill existing roots and may prevent new roots growing, so provision will be made to minimise the risk of soil contamination within the normal risk management protocols for the site. If identified as necessary in the risk assessment process, pollution control measures will include physical means of containing spillages and procedures for clearing them up if they occur.

All cement mixing and vehicle washing points will be located outside RPAs, with provision to contain any spillages. Where the contours of the site create a risk of polluted water or toxic liquids running into RPAs, a precautionary measure of bunding or a frame, sealed with heavy-duty plastic sheeting sufficient to prevent contamination, will be used to contain accidental spillages. Where wet concrete is poured within RPAs, an impermeable liner will be used to prevent contamination of the soil from any leachate. Pollution control measures will remain in place until there is no significant risk of RPA contamination.

Explanatory notes and examples

Pollution control



SGN 4-01

The storage of fuels or any toxic chemicals is not permitted in RPAs.



SGN 4-02

Where fuel or other chemicals are stored on site, risk assessment will be carried out to identify if emergency spillage kits are needed to restrict the environmental impact of accidents.



SGN 4-03

Soil bunding or a supporting framework covered in heavy-duty plastic sheeting will be installed where there is a risk of spillages contaminating RPAs. This specifically applies to cement mixing areas and vehicle washing facilities.

Explanatory notes and examples

Pollution control



SGN 4-04

Cement washings are toxic to plants and must be contained in a way that prevents contamination of adjacent RPAs.



SGN 4-05

The leachate from poured wet concrete is toxic to plants and must be prevented from contaminating RPAs by using an impermeable membrane to stop any leakage into the soil.



SGN 4-06

When pouring wet concrete in RPAs, methods must be used to prevent spillage and contamination beyond the installation.

Explanatory notes and examples

Pollution control

**SGN 4-07**

Impermeable liners must be used to prevent contamination of the RPA from the leachate that originates from poured concrete.

**SGN 4-08**

Even small chemical spillages can harm trees, so provision must be made to capture all leakages at the point of storage.

Technical reference

Due to copyright restrictions, the relevant British Standard clauses are summarised, not quoted, as follows:

1. BS 5837 (2012) *Trees in relation to design, demolition and construction – Recommendations*: Clauses 5.5 (Tree protection plan), 6.2.4 (Additional precautions outside the exclusion zone), 7.4 (Permanent hard surfacing within the RPA), 7.5 (Special engineering for foundations within the RPA), and A.2 (Avoiding damage to trees), recommend:

- 5.5.6 To avoid contamination from pollutants, account should be taken of the effects of slope on the movement of potentially harmful liquid spillages towards RPAs.
- 6.2.4.3 Materials that could harm trees should be stored and handled well away from RPAs.
- 7.4.4.5 Concrete should not be poured within RPAs unless an impermeable liner has been installed to prevent contamination by the highly alkaline leachate.
- 7.5.5 Pile type should be selected to minimise the potentially toxic effects of uncured concrete, e.g. sleeved bored pile or screw pile.
- A.2.1 Care should be taken to avoid accumulating adverse impacts on retained trees from materials such as uncured concrete, diesel oil, and vehicle washings.

Site cranes and piling rigs

SGN

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Summary guidance for site operatives

Site cranes and piling rigs

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Work under the normal site risk assessment procedures and comply with the wider site safety rules.

Other relevant SGNs

- Monitor works in root protection areas (RPAs) by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).

Important reminders

- Programme fixed site cranes to automatically avoid contact with retained trees or instruct operatives to do so manually.
- Use a banksman to ensure that mobile cranes and piling rigs moving around the site do not hit retained trees.
- Where necessary, create working space during demolition by facilitation access pruning and tying back branches, as specified by the supervising arboriculturist.

Explanatory notes and examples

Site cranes and piling rigs

Purpose

SGN 5 describes the precautions that will be taken to prevent damage to branches during the installation, use, and removal of fixed and mobile site cranes, and mobile piling rigs, near retained trees, based on the recommendations in *BS 5837* (5.5, 6.2.4, 7.3, and 7.5).



General principles and clarifications

Site cranes can be permanently fixed on site for the duration of the development activity or temporarily brought on to site for specific lifting tasks. Both fixed position and mobile cranes can damage branches and trunks by physically hitting them with the machine and the loads being moved.

Where possible, permanent site cranes will be automatically programmed to avoid retained trees. If programming is not possible, operatives will be trained to avoid retained trees through

the normal site risk management procedures. Mobile cranes and piling rigs will normally be kept away from protected trees by fencing.

However, if low branches extend over the fencing, damage to the tree will be avoided by either facilitation pruning or manually tying them clear of the work area, as specified by the supervising arboriculturist. All movement of mobile plant near trees with branches that extend beyond the fencing will be overseen by a banksman to ensure that there is no contact.

Explanatory notes and examples

Site cranes and piling rigs



SGN 5-01

Where possible, fixed-position cranes should be programmed to automatically avoid retained trees. If that is not possible, operatives should be trained to avoid retained trees as part of the normal site risk management procedures.



SGN 5-02

Access for any plant near trees will be restricted by protective fencing. However, where branches extend over fencing and there is a risk of damage from mobile cranes, operatives should be briefed to avoid them and be guided around the site by a banksman.



SGN 5-03

Loads can be lifted around the site over and around trees, but operatives should be briefed to avoid contact with tree crowns.

Explanatory notes and examples

Site cranes and piling rigs



SGN 5-04

Care should be taken to avoid damaging retained trees during the installation and dismantling of fixed-position site cranes.



SGN 5-05

Tall piling rigs have the potential to damage branches up to 20m off the ground and so protective fencing should be used to prevent this where such rigs are used.



SGN 5-06

Facilitation pruning to reduce the length of branches extending over fencing or tying long branches back are ways to prevent damage by piling rigs.

Due to copyright restrictions, the relevant British Standard clauses are summarised, not quoted, as follows:

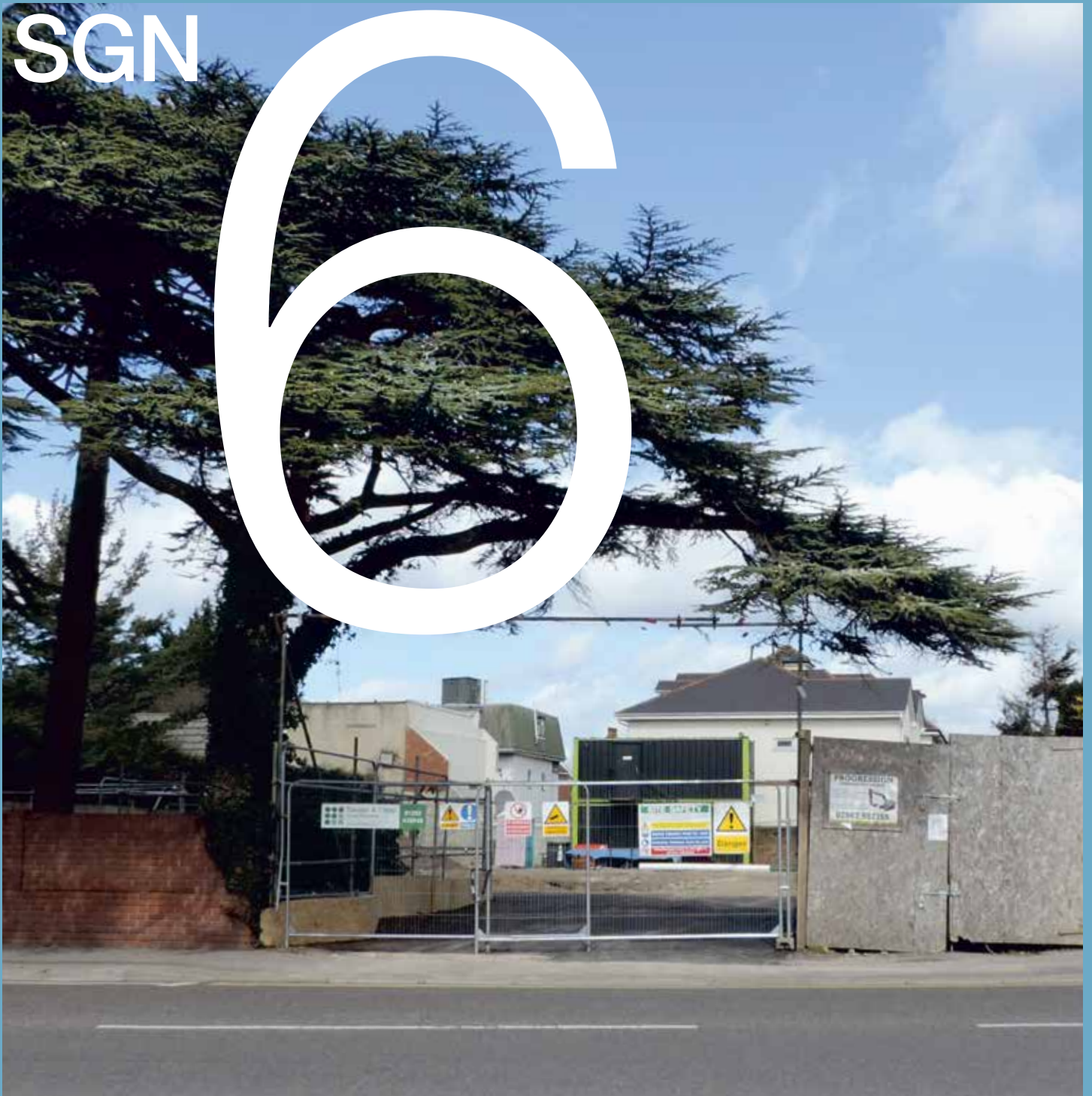
1. BS 5837 (2012) *Trees in relation to design, demolition and construction – Recommendations*: Clauses 5.5 (Tree protection plan), 6.2.4 (Additional precautions outside the exclusion zone), 7.3 (Tree protection during demolition), and 7.5 (Special engineering for foundations within the RPA), recommend:

- 5.5.6 To avoid damage to retained tree crowns, working space for cranes, plant, scaffolding and access should be allowed for.
- 6.2.4.1 Planning of site operations should account for wide loads, tall loads and plant with booms, jibs and counterweights (including drilling rigs) to prevent them hitting retained trees. Adequate clearance from trees should be maintained by using a banksman when using plant near trees.
- 7.3.1 If necessary, access facilitation pruning or temporarily tying branches back should be carried out to provide working space during demolition. A pruning or tying specification should be prepared by an arboriculturist.
- 7.5.5 Where piles are to be installed in RPAs, the smallest practical pile diameter should be used because it reduces the size of the rig.

Height restrictions

SGN

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Summary guidance for site operatives

Height restrictions

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Work under the normal site risk assessment procedures and comply with the wider site safety rules.

Other relevant SGNs

- Monitor works in root protection areas (RPAs) by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).

Important reminders

- Restrict the height of vehicles entering controlled areas using a height bar above the entrance.

Purpose

SGN 6 describes the precautions that will be taken to prevent damage to branches of retained trees from high vehicles, based on the recommendations in *BS 5837* (5.5, 6.2.4, 7.3, and 7.5).

General principles and clarifications

Access will be limited at the entrance point to routes with low branches using a height restriction

bar above the entrance, with an implication that materials will be unloaded outside sensitive areas and moved with smaller vehicles.



SGN 6-01

This temporary access through a woodland was height-restricted to preserve low branches that formed important screening of the new building from outside the site.



SGN 6-02

Height restriction bars are commonly used on urban sites to prevent accidental damage to low branches.

Technical references

Due to copyright restrictions, the relevant British Standard clauses are summarised, not quoted, as follows:

1. **BS 5837 (2012) Trees in relation to design, demolition and construction – Recommendations:** Clauses 5.5 (Tree protection plan), 6.2.4 (Additional precautions outside the exclusion zone), 7.3 (Tree protection during demolition), and 7.5 (Special engineering for foundations within the RPA), recommend:
 - 5.5.6 To avoid damage to retained tree crowns, working space for cranes, plant, scaffolding and access should be allowed for.
 - 6.2.4.1 Planning of site operations should account for wide loads, tall loads and plant with booms, jibs and counterweights (including drilling rigs) to prevent them hitting retained trees. Adequate clearance from trees should be maintained by using a banksman when using plant near trees.
 - 7.3.1 If necessary, access facilitation pruning or temporarily tying branches back should be carried out to provide working space during demolition. A pruning or tying specification should be prepared by an arboriculturist.
 - 7.5.5 Where piles are to be installed in RPAs, the smallest practical pile diameter should be used because it reduces the size of the rig required, which reduces the reliance on ground protection and any access facilitation pruning.

Removing surfacing and structures in root protection areas

SGN



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Summary guidance for site operatives

Removing surfacing and structures in root protection areas

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Work under the normal site risk assessment procedures and comply with the wider site safety rules.
- Brief operatives entering root protection areas (RPAs) by the supervising arboriculturist before work starts.

Other relevant SGNs

- Monitor works in RPAs by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).
- Design access to avoid soil compaction (See *SGN 3 Ground protection*).
- Minimise excavation into original undisturbed soil (See *SGN 7 Excavation in root protection areas*).

Important reminders

- Manually break up and remove debris from the RPA using appropriate tools, e.g. pneumatic breaker, crow bar, sledgehammer, pick, mattock, shovel, spade, trowel, fork, and wheelbarrow. Have secateurs and a handsaw available to cut exposed roots to be removed.
- Remove debris from the RPA without disturbing the adjacent rooting environment, e.g. lifting out with a machine located outside the RPA or manually carry out over ground protection.
- Where appropriate, use machines with a long reach if they can work from outside RPAs, or from protected areas within RPAs without encroaching onto unprotected soil.
- Where appropriate, leave below ground structures in place if their removal will cause excessive RPA disturbance.

Explanatory notes and examples

Removing surfacing and structures in root protection areas

Purpose

SGN 8 describes the practical requirements for removing surfacing and structures in RPAs, based on the recommendations in *BS 5837 (7.3)*.

General principles and clarifications

For the purposes of this guidance, the following broad definitions apply:

- **Surfacing:** Any hard surfacing used as a vehicular road, parking, or pedestrian path, including tarmac, solid stone, crushed stone, compacted aggregate, concrete, and timber decking. This does not include compacted soil with no hard covering.
- **Structures:** Any man-made structure above or below ground including service pipes, walls, gate piers, buildings, and foundations. Typically, this would include drainage structures, car-ports, bin stores, and concrete slabs supporting buildings.

In principle, roots frequently grow adjacent to and beneath existing surfacing and structures, so great care is needed during access and demolition. Damage can occur through physical disturbance of roots and/or the

compaction of soil around them from the weight of machinery or repeated pedestrian passage. This is not generally a problem while surfacing and structures remain in place because they spread the load on the soil beneath and further protective measures are not normally necessary. However, once that protection is removed and the soil below is exposed, the potential for damage to roots becomes an issue.

Careful consideration should be given to retaining structures and surfacing in place, if that will result in less disturbance to retained roots. For example, if a new wall needs to be constructed on the footprint of an existing wall, it might be better to retain the original footing and build on that, rather than remove it and install a new footing.

In summary, there should be no vehicular or repeated pedestrian access unless existing ground protection is retained or new protective measures are installed. All exposed RPAs must be protected until there is no further risk of damage.

Explanatory notes and examples

Removing surfacing and structures in root protection areas



SGN 8-01

Machines with a long reach can be used to lift out heavy surfacing and structures if the machine sits outside the RPA and the exposed surface is protected before there is any further access.



SGN 8-02

Careful lifting of cemented-in sets round this tree allowed them to be re-laid on a permeable sand base, improving the water input into the soil around the trunk.



SGN 8-03

These trees had impermeable surfacing right up to their trunks, which had to be removed by hand before installing new structures.

Explanatory notes and examples

Removing surfacing and structures in root protection areas



SGN 8-04

This old concrete footing close to a large mature tree was retained, thus avoiding excessive disturbance of roots below it.



SGN 8-05

The RPAs for the retained trees around the boundary are protected by a combination of fencing and ground protection.



SGN 8-06

If structures are firmly incorporated into roots, it may be best to leave them in place rather than attempt to remove them and irreversibly damage the tree.

Due to copyright restrictions, the relevant British Standard clauses are summarised, not quoted, as follows:

1. BS 5837 (2012) *Trees in relation to design, demolition and construction – Recommendations*: Clause 7.3 (Tree protection during demolition) recommends:

- 7.3.2 RPAs up to the edge of structures to be removed should be protected.
- 7.3.3 Demolition plant should either operate outside the RPA or run on ground protection installed before work starts.
- 7.3.4 Demolition of buildings near retained trees should be done inwards within the footprint of the existing building.
- 7.3.5 Where possible, and after consultation with the supervising arboriculturist, it is preferable to leave redundant structures in RPAs to avoid damage to tree roots.
- 7.3.6 Existing surfacing should be removed with care and any machine should work backwards over the area to prevent damage to any exposed RPA. It is preferable to leave any existing sub-base in situ if new surfacing is to be laid.

Installing/upgrading surfacing in root protection areas

SGN



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Summary guidance for site operatives

Installing/
upgrading
surfacing in root
protection areas

Administration

- Unauthorised damage to protected trees is a criminal offence and could lead to enforcement action.
- Work under the normal site risk assessment procedures and comply with the wider site safety rules.
- Brief operatives entering root protection areas (RPAs) by the supervising arboriculturist before work starts.

Other relevant SGNs

- Monitor works in root protection areas (RPAs) by the supervising arboriculturist (See *SGN 1 Monitoring tree protection*).
- Design access to avoid soil compaction (See *SGN 3 Ground protection*).
- Follow the guidance in *SGN 4 Pollution control*, if concrete is poured within or near RPAs.
- Minimise excavation into original undisturbed soil (See *SGN 7 Excavation in root protection areas*).
- Follow the guidance in *SGN 8 Removing surfacing and structures in root protection areas*, if existing surfacing is to be removed before installing new surfacing.
- Follow the guidance in *SGN 10 Installing structures in root protection areas*, if the surfacing is to be installed on supports, i.e. piles, pads, or posts.

Important reminders

- For ground without existing surfacing, remove any loose material at the soil surface by hand and do not excavate into existing soil levels unless approved by the supervising arboriculturist.

Summary guidance for site operatives

Installing/ upgrading surfacing in root protection areas

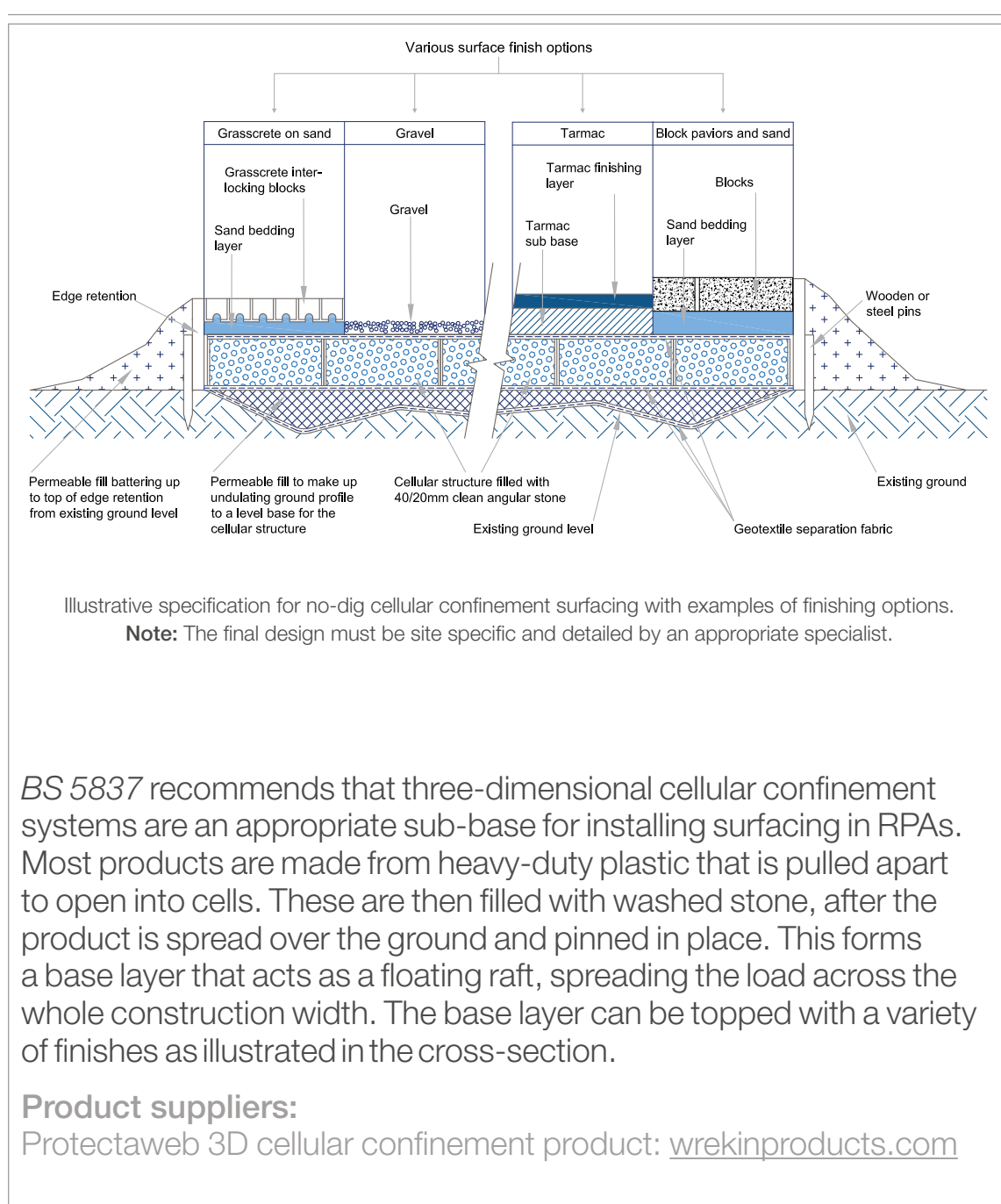
- For ground with a vegetation layer, excavations may be appropriate to remove the turf layer and surface vegetation, but this must be agreed by the supervising arboriculturist.
- All new surfacing must be set back from trunks and buttress roots by at least 50cm, unless otherwise agreed by the supervising arboriculturist.
- Fill low points on undulating surfaces to an even level with any high points using an agreed granular material such as sand or stone.
- Do not mechanically compact new fill or existing soil.
- If a three-dimensional cellular confinement system is used, install it according to the manufacturer's technical specification.
Note: The cellular fill will be washed angular stone with no fines, as specified by the manufacturer.

Explanatory notes and examples

Installing/
upgrading
surfacing in root
protection areas

Purpose

SGN 9 describes the practical requirements for installing new surfacing and upgrading existing surfacing in RPAs, based on the recommendations in *BS 5837* (7.4).



General principles and clarifications

Conventional surfacing installation based on excavating and compacting a supporting sub-base is unacceptable in RPAs because it can damage roots and the rooting environment. This harm is caused by killing roots, compacting soil structure, and impeding water/gaseous exchange through the soil. Adverse impact on trees will be reduced by minimising the extent of these changes in RPAs.

New surfacing solutions

Important elements of an effective design include protecting roots and the rooting environment during installation, a load spreading capability to prevent localised compaction, and providing adequate permeability for water and gasses to support living roots. The main approaches are:

- three-dimensional cellular confinement systems filled with washed stone laid directly onto the soil surface;
- concrete slabs cast directly onto the soil surface; and,
- surfacing supported above the soil surface on top of piles, pads, or posts.

The specific design of the chosen approach is an engineering issue that will take account of the bearing capacity of the soil, the intended loading, and the frequency of loading. The detail of product and specification are technical matters to be provided by an appropriate specialist.

Dealing with undulating surfaces and establishing a tolerable level of excavation

The precise location and depth of roots within the soil is unpredictable and will often only be known when careful digging starts on site. Ideally, all new surfacing in RPAs will be no-dig, i.e. requiring no excavation, but this can sometimes be difficult on undulating surfaces. New surfacing normally requires an evenly graded sub-base layer, which can be made up to any high points with granular, permeable fills such as crushed stone or sharp sand. This sub-base will not be compacted as would happen in conventional surface installation. Some limited excavation can be necessary to achieve this and need not be damaging if carried out carefully and large roots are not cut. Tree roots and grass roots rarely occupy the same soil volume at the top of the soil profile, so the removal of