Central Coast Council

Guideline for the Relocation of Large Tree Hollows

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Introduction

Central Coast Council and Greater Sydney Local Land Services Greater Sydney present this guideline for relocating large tree hollows based on some practical experience in Wyong NSW. It is hoped that the procedures presented help consultants and landowners looking for opportunities to enhance wildlife habitat benefit from our experience.

Re-using natural hollows could be considered in a situation where an ecological study recommends that an area can be enhanced to support more diverse wildlife. Ideally, the area would be large and protected from disturbance, such as a conservation area or a managed offset.

In Australia over 300 native animals utilise tree hollows. In south-east Australia this number comprises 17% birds, 42% mammals and 28% reptiles (Gibbons and Lindenmayer 1997). Typical hollow-dependent wildlife include micro-bats, possums, gliders, owls, parrots, antechinus, ducks, rosellas and kingfishers as well as snakes, frogs and skinks. Many species that use hollows have been listed under the *Threatened Species Conservation Act 1995* (NPWS 1999).

Large hollows that are preferentially selected by larger species, such as owls, are often a limited resource in a forest and woodland landscape. Such large hollows generally take up to 250 years to form within mature myrtaceous trees (Eucalyptus, Angophora and Corymbia species). Over time these trees have been subjected to various natural forces such as wind, heat, fire, lightning, rain, insect attack, fungi, bacteria and structural defects from other tree impacts (Gibbons and Lindenmayer 1997). Eucalypts often self-prune by shedding their lower branches as they grow, exposing the heartwood at this location. Whilst the external, living cambium of the tree may remain healthy, such openings and injuries may allow the entry of fungi (which can cause wood decay). This is supplemented with the internal and often extensive work of chewing insects such as termites and beetles (NPWS 1999).

Why Relocate a Hollow?

Hollows are usually lost during vegetation clearing for various developments (residential, industrial, mining, agricultural etc). Environmental approvals may require that lost habitat is replaced elsewhere on the site or augmented (i.e. with nest boxes). An alternative approach is to re-use natural hollows rather than installing artificial habitat and chipping the valuable natural resource.

The re-use of large hollows has been demonstrated to provide higher potential for uptake success by comparison to artificial nest boxes. Council monitoring of a relocated hollow section and large nest boxes designed for owls placed at Wadalba NSW showed that the hollow received regular activity and use over the winter period from Sulphur-crested Cockatoo (nesting), Barn Owl, Common Brushtail Possum, Australian King Parrot, Sugar Glider, Feather-tailed Glider, Galah and the Southern Boobook owl. By comparison, the nest boxes received no owl activity and the activity by remaining species was less diverse and inconsistent.

Powerful Owl, in particular, shows preference for natural hollows, with only one known successful uptake of a nestbox in Victoria in an area where breeding activity was observed but no natural large hollows were present (McNabb and Greenwood 2011).

The following guideline is based on two Case Studies: The relocation of a large ‘hollow section’ and the relocation of a complete ‘trunk section’. These two separate activities were undertaken specifically to supplement the number of natural large hollows for Powerful Owl in an area affected by development where Powerful Owls were known to be breeding. The projects were undertaken approximately 4 years apart.

Guideline Overview

This guideline has been prepared for the relocation of: **1) A large hollow section** and **2) A complete trunk section into a living recipient tree** for the benefit of preserving large hollows for hollow-dependent wildlife. There is some overlap between the two methods that is not duplicated, so we encourage you to read through both procedures before deciding on which one to use in your situation.

Consider relocating a hollow trunk in the following situations:

- Very large and heavy trunk hollow sections that are too big to be supported in the canopy of a recipient tree.
- To simulate a complete natural looking trunk section surrounded by a living canopy to enhance Powerful Owl habitat.
- If the live large hollow is high and (because height is important for Powerful Owl) the height is to be maintained.
- The section contains several high quality hollows that can be moved together in the same section.

If targeting Powerful Owl, the relocation of a complete trunk section would be a more suitable outcome as this method is a more natural looking result. If targeting Masked Owl, the relocation of a complete trunk section may also be a suitable option if the cavity of the hollow extends a long way down the trunk, as this species is know to utilise deep trunk hollows.

Powerful Owl (Ninox strenua)

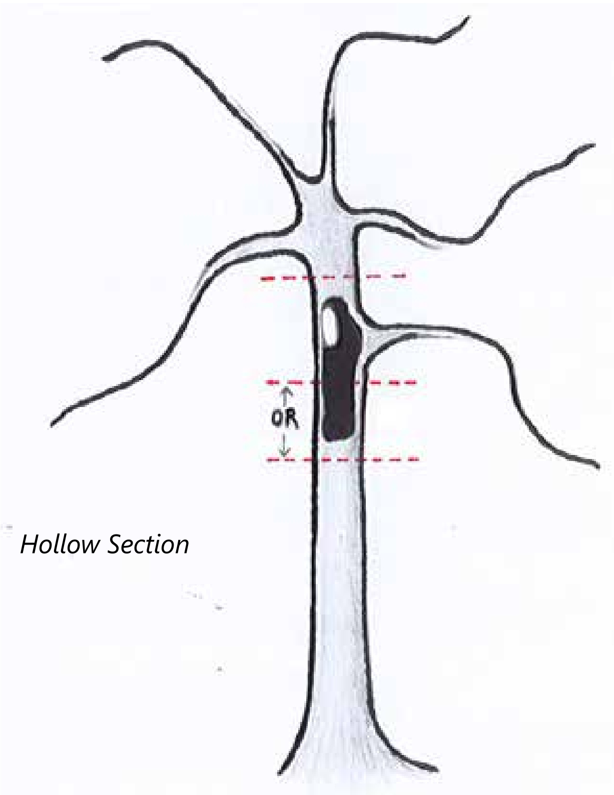
Hollows are important for Australian wildlife

COSTS: At the time of preparing this 2016 guideline, approximate costs for equipment hire are $455 p/hr (80 tonne crane), $330 p/hr (60 tonne crane), $230 p/hr (per x1 franna crane, 2 are needed), $130 p/hr (semi-trailer), $1500 -$2000 p/day (tree climbing crew) and $170 p/hoop (wiring hardware to secure trunk section, 3 or 4 needed). Prices do not include GST. Costs for ecologist, arborist, additional hardware, cameras and tools are additional.

TIMING: Placement of large hollows before the end of February will allow Powerful Owls to familiarise themselves with the nesting location prior to the following breeding season. Whilst this is documented to begin in May, birds may pair up and select breeding areas as early as late March.

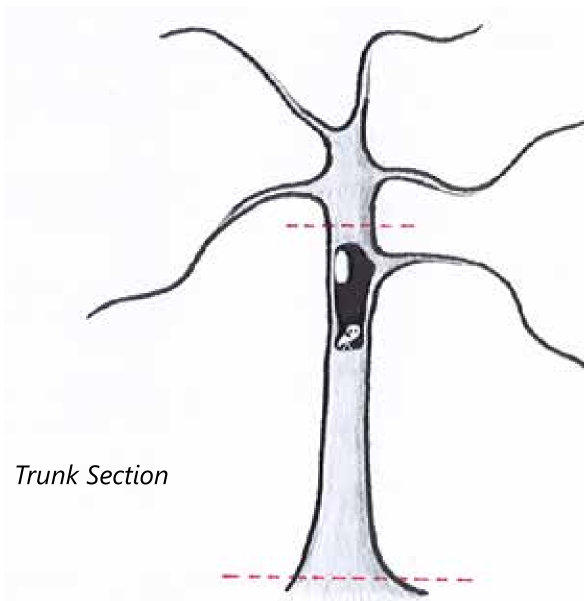
Definitions:

Hollow section - the section of the tree containing the hollow chamber from the entry hole to the base of the cavity. A section may be shortened to reduce the distance between the entry hole to the base of the cavity by cutting above the natural floor and adding a floor at a desired length to create a section of a manageable size.



Hollow Section

Trunk section - the entire trunk from ground level up to above the hollow chamber. Branches not containing any hollows may be removed for manageability.



Trunk Section

Owls are hollow-dependent

A Sugar Glider – gliders are hollow dependent

Recipient tree - the tree that will receive either the relocated hollow section or the relocated trunk section. Fixation methods to the recipient tree are required to prevent or minimise impact to the health and structural integrity of the recipient tree and ensure a safe and long-term outcome.

Case Study - Relocation of a Hollow Section

A large hollow section of a Spotted Gum within an approved subdivision was recovered and relocated into the Wadalba Wildlife Corridor in 2011. This hollow was found to be in use by Powerful Owl for nesting during pre-clearance surveys. Following the completion of this breeding event and given the identified importance of the hollow, efforts were undertaken to relocate the 3m hollow section for placement into a recipient tree within the reserve. The location of the recipient tree was selected in consultation with experts after an investigation into nearby suitably positioned large trees of good condition.

The recipient tree was considered to be the obvious choice for the following reasons:

- ✓ It was also a Spotted Gum so that the hollow section would blend in well with the bark
- ✓ It was the largest tree remaining on the northern face of the Wadalba mountain
- ✓ It had a similar basal diameter to the original tree, was structurally sound and in good enough health to withstand the added weight of the hollow section
- ✓ It contained a solid fork high in the tree
- ✓ It was located close to the original tree and just above a small quarry which the male used for roosting
- ✓ The tree was located at the head of the small gully that runs along the edge of the development area. This gully was the other most suitable roosting habitat remaining to the north of the Wadalba reservoirs. This gully was found to be utilised by the female and fledglings during the early tree clearance stages
- ✓ A similar lean angle could be facilitated due to shape of the fork

Subsequent monitoring found that both the hollow section was being used by owls, possums, gliders and other birds.

Hollow in the original living tree and two Powerful Owl juveniles that were raised in the original hollow

Steps for Relocation of Hollow Section

The following diagram shows an overview of procedures required for relocating a hollow-bearing section of a tree. Specific steps are given for lowering, preparation, transport and placement

Step 1. Obtain approvals and permissions	1. The proponent to undertake an Environmental Impact Assessment relating to removal of hollow-dependent fauna habitat 2. Receive approval from consent authority to remove and relocate hollow section 3. Obtain permissions from land owners, if required
Step 2. Perform a Risk Assessment	1. The proponent to undertake risk planning to consider public safety, work health and safety, integrity of trunk section whilst being moved, failure of recipient tree, inclement weather causing delays to schedule 2. Review and update as the scope changes, if required
Step 3. Inspect hollow trees	1. Ecologist to survey hollow tree for use by fauna 2. Tree climber to assess depth of cavity and quality of hollow 3. Collect samples of bones, feather, eggs shells, owl pellets and have identified by an expert, if required
Step 4. Select recipient tree	1. Ecologist to assess recipient tree for a clear flyway in the direction of suitable roosting habitat, in a position away from noise, lighting, regular visitation or vandalism 2. Arborist to assess structural integrity of tree 3. Assess that hollow section can be placed 10 - 15m high
Step 5. Plan relocation	1. Team of experts to assess specific situation in terms of target hollow-dependent species, hollow integrity, options for relocation, costs and logistics 2. Choose method of relocation 3. Chose timing for relocation
Step 6. Lower hollow section	1. Remove residing fauna, if required 2. Dismantle tree section and lower to the ground in a resting place **See hollow section lowering procedure** (page 8)
Step 7. Prepare hollow section	1. Prepare and treat **hollow see procedure for hollow section prepration** (page 9)
Step 8. Transport and placement of hollow section	1. Lift and move hollow section from resting position to recipient tree 2. Attach to recipient tree: See **procedure for hollow section transport and placement** (page 12) 3. Install infa-red cameras, if required
Step 9. Monitor hollow use	1. Ecologist to watch the hollow at dusk and evening during following breeding season of target species (for two breeding seasons at a minimum) 2. Tree climber to retrieve and or replace batteries and SD cards in cameras, if required

Step 6.2 Lowering Hollow Section

The procedure for cutting and lowering the hollow section requires tree climbers and a crane or friction drum for lowering.

PROCEDURE

Cut limbs and trunk above hollow	1. Using a chainsaw, cut unnecessary limbs 2. Attach cloth sling to section 3. Recover termite mud from hollow, if required
Cut and lower section	4. Select cutting point see **NOTE 1** 5. Cut section 6. Lower with friction drum or crane **NOTE 2**

NOTES Lowering Hollow Section

1 Select cutting point: If the hollow is to include the complete chamber then the cut should be positioned low enough to conserve enough termite mud to prevent the base of the chamber from collapsing. Further wedge cuts will be made at the base so the initial cut should be placed further down the section to allow for these later refinements.

Alternatively, the chamber may shortened to make it lighter for placement into the recipient tree. Termite mud should be collected from the hollow and added as natural bedding material over the false capped base. The decision to reduce the length of a hollow would be decided by the ecologist/ specialist based on the needs of the target species.

2 Lower the section: The section is to be lowered carefully (not cut and dropped) to prevent damage. The decision to lower by friction drum or crane will be made by the tree climber based on its weight and size. Typically a crane will lower sections weighing over 1 Tonne. A friction drum will require a suitable high point remaining elsewhere in the tree.

Step 7.1 Prepare and Treat Hollow Section

The procedure for preparation and treatment of the hollow section requires tree climbers and ground team.

PROCEDURE

Prepare shape of hollow section	1. Clean up hollow cavities with chainsaw **NOTE 1** 2. Cap base with a sturdy floor **NOTE 2** 3. Wedge-cut base **NOTE 3**
Treatment of bark and wood	4. Spray with 3 coats lanolin oil, if bark is to be retained **NOTE 4**
Prepare hollows	5. Screw galvansied builders strapping **NOTE 5** 6. Place termite mud into cavity (100mm deep) for bedding

NOTES Prepare and Treat Hollow Section

1 Clean up cavities: The entry point, internal chamber and base should be cleared of any unnecessary timber debris. This may need to be cut away with a small chainsaw or battery operated hand cutter from the inside or a long shafted chainsaw from the outside. Excess termite mud may also need to be dug away to widen the base of the cavity. Care should be taken to prevent the termite mud from collapsing out. If this happens all of the mud will need to be cleared away and then replaced following the capping with a solid floor. The widening of the internal chamber can make a hollow that was initially suitable for a small owl into a chamber suitable for Powerful Owl. Powerful Owls select chambers greater than 45 cm diameter and greater than 100 cm deep (DEC 2006).

2 Cap base: The base of the hollow should be capped with a solid floor. If the top of the section was cut also then a roof cap needs to be added to protect from the elements. Weatherproof sheet material is to be securely affixed to the section and it must be strong enough to retain the termite mud. Weather resistant screws (not nails) should be used. Two sections of sheet will need to be fitted to the wedge-cut base. The edges of the sheeting are to be cut away so that it matches the outer profile of the section (no eaves).

- Only marine plywood with a minimum of 10 mm thickness can be used. Cut with a sharp blade by hand or power saw (not chainsaw) so that the edges are cut smoothly, minimising potential water entry and delamination of the ply sheets.
- The plywood is to be coated with two coats of external paint on both sides and around the edges of the base end (supporting termite mud) and only the outside and edges of the upper roof end (capping the open chamber). The colour of paint should be selected to match the hollow section.
- Gaps should be sealed with an appropriate weather proof gap filler / silicon / glue. Paint over gap filler.
- Drill a 5 mm hole into the lowest edge of the base to facilitate drainage of water out of the chamber. If this is drilled prior to final placement of the section then the lowest edge will need to be predicted according to the final position.

NOTES Prepare and Treat Hollow Section cont.

3 Wedge-cut base: A wedge-cut is to be made by chainsaw into the base of the section where it will rest into the trunk or branch of the recipient tree. The angle and direction of this cut should be carefully considered based on the desired orientation of the hollow. Therefore, the recipient tree must be selected and the placement decided before this cut can be made.

The final placement of the section top or roof (particularly if attached vertically to a recipient trunk) should not be flat and likely to pool water.

4 Lanolin: If the hollow section is to retain its bark to mimic the recipient tree, then the bark is to be sprayed with three coats of lanolin oil. Lanolin is a natural oil derived from wool that has termite resistant qualities. It may be applied with a pump spray. The selected product should be suitable for use on timber products (i.e. thinner for wood penetration). We suggest Lanotec Timber Seal and Timber Seal Plus. The bark will eventually dry and crack away requiring further oil treatment of the heartwood in one or two years' time.

Alternatively, let the bark dry and crack over a few months, peel away and then treat the heartwood with lanolin. The peeling process will be more rapid in warmer months and if exposed to sunlight, so care must be taken as rapid drying may also dry and crack the heartwood. Once the bark has been peeled away the heartwood should be either sprayed with two coats of lanolin oil or painted with external paint. If paint is used, a sample of the bark from the recipient tree should be taken for colour-matching. Two tone colour matching is preferred to achieve a natural finish

5 Galvanised builders strapping: Builders strapping should be wrapped around the edge of cut ends and drilled tightly into place to prevent drying and cracking of the end grain.

Lifting the hollow section into place. Note cloth harness and wedge-cut at base.

Strapping to prevent drying and cracking of bark and heartwood

TIP

Termite Mud The base of the hollow should contain termite mud at a minimum thickness of 100 mm. If this is not naturally in the base then it will need to be collected from the source tree and placed inside. This bedding provides good egg incubation properties and drainage.

TIP

If the hollow section or trunk section is stored on the ground temporarily, a check for ground-dwelling fauna in the hollows before installation is a good idea.

Steps 8.2: Transport and Placement of Hollow Section

The procedure involves the placement of the hollow section into a selected recipient tree and involves the use of an appropriately sized crane to lift the section and tree climbers to fix the section into place.

PROCEDURE

Pick up hollow section and place in recipient tree	1. Attach cloth sling, considering weak points 2. Crane to lift hollow section and position close to base of recipient tree **NOTE 1** 3. Tree climbers to guide the placement of the section onto the supporting branch
Fix hollow section to recipient tree	4. Screw galvanised builders strapping around both components **NOTE 2A** OR use steel cable and turnbuckles **NOTE 2B** 5. Use blocks and particle board to protect the live tree **NOTE 3**

NOTES Transport and Placement of Hollow Section

1 Crane to lift and position: The section is to be lowered into place within the recipient tree such that the wedge-cut base is fitted into the trunk (if fitted against a large limb) or fitted into the base of a large limb (if fitted against the trunk). Cuts to the base or limbs may be required to best fit the section into place, however cuts to the recipient tree should be avoided.

Recipient tree prior to installation of recovered hollow.

Placement of the hollow section by crane and tree climber

TIP

There are two methods for fixing the hollow section to the recipient tree depending on the weight and size of the section. All fasteners and hardware used to affix the section to the recipient tree are to be suitable for external use. (e.g. galvanised, stainless steel, brass).

Metal strapping with pine blocks around the recipient tree and particle board in between the two.

Cable attachment with pine blocks around the recipient tree and turnbuckle between the two trees. (Note: this photo is of a relocated trunk section not hollow section)

NOTES Transport and Placement of Hollow Section cont.

2A METHOD 1: Galvanised builders strapping is wrapped around both the hollow section and recipient tree. The strapping is to be directly attached to the hollow section by 45 mm long bugle screws approximately every 250 mm so that fits tightly around the circumference. Each screw can be angled away from the last so that the strapping pulls tight as the next screw is placed.

The strapping is not to be tightly wrapped against the recipient tree as this will restrict the flow of water and nutrients through the cambium, particularly as the tree grows and the strapping tightens.

The guage of the strapping and number of hoops required will be dependent of the weight and length of the hollow section to attach.

2B METHOD 2: Galvanised steel cable and turnbuckles are wrapped around both the hollow section and recipient tree section. This method is suitable if the hollow section is placed vertically onto the recipient trunk. The cable can be directly tightened by turnbuckles however as with Method 1, half round treated pine spacing blocks are to be placed between the cable and the recipient tree section so that the cable does not cut into the living cambium. No screws into the hollow section or recipient tree are required for this method as the tension on the cable can be easily controlled with the turnbuckles.

As this is a very strong method only two cable hoops will be required regardless of the size and weight of the hollow section. This method may only be used if the circumference of both the hollow section and recipient tree are large enough for the long turnbuckle to be located in the distance between them.

Hardware required for each hoop includes 1 x 9 m length of 10 mm galvanised steel wire, half round cypress pine blocks (up to 6 per hoop), 2 x 10 mm thimbles, 6 x 10 mm U bolts, and 1 x 20 mm galvanised swivel turnbuckle. This hardware can be sourced from Ecoline Pty Ltd (PO Box 490, Lithgow NSW 2790) who supply for the Treetops Adventure Park at Wyong Creek.

At each end of the turnbuckle the cable runs through the eyelet and back onto itself around a thimble to prevent the wire crimping. The cable is then attached to itself via three U bolts at a minimum width of 40 mm apart. These may be tightened by hand wrench however should ideally be set at a torque of 3n/m. One end of the cable attachment to the turnbuckle may be fixed off prior to the placement however the other end must be completed after wrapping the cable around both tree sections and pulled tight. Therefore a hand or torque wrench will be needed with a 16 mm socket bit and a cordless grinder to cut off any excess wire.

NOTES Transport and Placement of Hollow Section cont.

3 Protect the tree: Half round treated pine spacing blocks are to be placed between the strapping and the tree so that the strapping may be pulled tight around without cutting into the tree itself.

At each block a bugle screw or coach bolt is to be screwed through the strapping, the block, the outer cambium and slightly into the heartwood. Therefore this screw needs to be a minimum length of 100mm to ensure this. This will stop the hollow section slipping around the recipient section.

A sheet of treated particleboard is to be placed between the hollow section and resting section (trunk or branch). In time it will deteriorate and permit continued growth of the recipient tree girth.

TIP

Surveillance cameras - The mounting of surveillance cameras for monitoring the hollows should ideally be installed whilst the tree climbers are still within the tree. Pre-drill and mark holes with spray paint while the section is on the ground. Cameras should be mounted to view entry to and from the hollow entrances and to prevent movement triggers from nearby or obstructing leaves/branches moving in the wind. Camera batteries will need to be changed prior to the breeding season of the target species if this does not coincide with the hollow installation.

Sulphur-crested Cockatoos seem to be equally content in a relocated hollow section and in artificial nest boxes

Constructed large nest boxes colour matched for Spotted Gum recipient tree

Case Study - Relocation of a Trunk Section

A large Spotted Gum that appeared to contain 2 or 3 large trunk hollows was located within an approved road reserve. Barn Owl was previously observed as utilising one of the hollows however the other hollows were considered suitable for use by a Powerful Owl pair. Following discussions with experts, it was considered that relocation of the entire trunk section would provide the highest potential for success for use by Powerful Owl.

The entire 19 m long trunk section containing several hollow sections was relocated to an Ironbark within a nearby reserve. The ironbark had two parallel vertical trunk sections offering a suitable fit as a recipient tree. Prior to placement the hollows were excavated to make them more suitable for nesting and the entire section was prepared. The final placement and attachment to the recipient tree was undertaken in December 2015.

Large hollow tree prior to relocation and below installed against recipient tree

Steps for Relocation of Hollow Trunk

The following diagram shows an overview of procedures required for relocation a hollow-bearing trunk. Specific steps are given for lowering, preparation, transport and placement.

Step 1. Obtain approvals and permissions	1. The proponent to undertake an Environmental Impact Assessment relating to removal of hollow-dependent fauna habitat 2. Receive approval from consent authority to remove and relocate hollow tree 3. Obtain permissions from land owners, if required
Step 2. Perform a Risk Assessment	1. The proponent to undertake risk planning to consider public safety, work health and safety, integrity of trunk section whilst being moved, failure of recipient tree, inclement weather causing delays to schedule 2. Review and update as the scope changes, if required
Step 3. Inspect hollow trees	1. Ecologist to survey hollow tree for use by fauna 2. Tree climber to assess depth of cavity and quality of hollow 3. Collect samples of bones, feather, eggs shells, owl pellets and have identified by an expert, if required
Step 4. Select recipient tree	1. Ecologist to assess recipient tree for a clear flyway in the direction of suitable roosting habitat, in a position away from noise, lighting, regular visitation or vandalism 2. Arborist to assess structural integrity of tree 3. Assess that hollow section can be placed 10 - 15m high
Step 5. Plan relocation	1. Team of experts to assess specific situation in terms of target hollow-dependent species, hollow integrity, options for relocation, costs and logistics 2. Choose method of relocation 3. Chose timing for relocation
Step 6. Lower hollow section	1. Remove residing fauna, if required 2. Dismantle tree section and lower to the ground in a resting place **See prodecure for hollow trunk lowering procedure** (page 16)
Step 7. Prepare hollow section	1. Prepare and treat hollow trunk **see procedure for hollow section prepration** (page 17)
Step 8. Transport and placement of hollow section	1. Lift and move hollow section from resting position to recipient tree 2. Attach to recipient tree: See **procedure for hollow tunk transport and placement** (page 19) 3. Install infa-red cameras, if required
Step 9. Monitor hollow use	1. Ecologist to watch the hollow at dusk and evening during following breeding season of target species (for two breeding seasons at a minimum) 2. Tree climber to retrieve and or replace batteries and SD cards in cameras, if required

Step 6.2 Lowering Trunk Section

The procedure for cutting and lowering the trunk section requires tree climbers and a crane or friction drum for lowering.

PROCEDURE

Cut limbs and trunk above hollow

1. Assess how the trunk will fit within branches of recipient tree
2. Using a chainsaw, cut unnecessary limbs
3. Attach sling to trunk to take weight of tree

Cut and lower section

4. Select cutting point **NOTE 1**
5. Cut tree at ground level while crane holds the weight of the tree
6. Lower with crane into storage position **NOTE 2**
7. Cut base of tree on angle

NOTES Lowering Trunk Section

1 Select cutting point: The cutting point and angle at the base of the trunk are to be carefully considered.

The cut at the base should ideally be made as close to the ground as possible, thus requiring a long shafted chainsaw. This is so that the trunk length is kept as long as possible and the hollows remain as high as possible at the final resting point.

The angle of the cut can also be done at this time or later when the tree is resting on the ground. The angled cut should assist to ensure that the trunk section falls towards the recipient tree in the final resting location. Therefore the long point of the cut (which is the first point to touch the ground when lowered by crane) should be the side furthest away from the recipient tree. The angle of the cut should also consider the existing slope of the ground at the recipient tree which typically slopes away from the trunk. Thus the angled cut should be greater than this slope.

2 Lower into position: The crane will gently lower the trunk to the temporary storage location where the bark will dry and the hollows can be prepared. If the section is to be moved to the recipient tree straight away, a truck or two franna cranes will need to be available to work with the large crane at this time.

The trunk section is to be placed off the ground to prevent any fungal decay and insect entry. Sandbags placed on top of cut log sections (from the larger removed branches) are to be used for this purpose.

Marking desired angle cut

Finish cut to the mark

Step 7.1 Prepare and Treat Trunk Section

The procedure for preparation and treatment of the hollow section requires tree climbers and ground team.

PROCEDURE

Prepare for storage	1. Erect temporary protective fencing around trunk section 2. Clean up hollow cavities with chainsaw
Treatment of bark and wood	3. Spray with 3 coats lanolin oil, if bark is to be retained 4. Spray with wood preservative **NOTE 1** 5. Plug with filler foam **NOTE 2**
Prepare hollows	6. Screw galvansied builders strapping around cut ends 7. Place termite mud into cavity (100 mm deep) for bedding

NOTES Prepare and Treat Trunk Section

1 Spray with wood preservative: The entire base of the trunk section and slightly up the sides is to be treated against fungal rot and insect attack as this surface will be placed directly onto or dug slightly into the ground. A diffusible wood preservative and in-ground paste used for timber fence posts should be used (we recommend TWA Woodcare product).

2 Filler foam: Any internal cavity opening at the cut base end should be cleaned out and plugged with filler foam to prevent ground contact with existing internal termite mud and reduce potential for termite access in the untreated area.

Trunk section protected from vandalism with temporary fencing. Signage may also be needed

Cleaning up hollow cavities with a chainsaw

Lanolin treatment of bark (See hollow section preparation 2.1 for details) on the same day the tree was cut

Peeling away of bark and slight cracking on the top side of the trunk exposed to the sun for four months after lanolin treatment. The underside was well preserved and could not be peeled away.

Base following angled base cut

Strapping to reduce splitting of end grain and in-ground paste treatment

In-ground paste treatment and filling of internal cavity

Cracking of bark and heartwood after a few months

Steps 8.2 Transport and Placement of Trunk Section

This procedure involves the transporting of the trunk section from the initial location to the recipient tree and placement of the trunk section against a recipient tree. An appropriately sized crane to lift the section and tree climbers to fix the section into place is required.

PROCEDURE

Transport section to recipient tree	1. Attach cloth sling(s), considering weak points 2. Franna cranes to lift trunk section and position close to base of recipient tree **NOTE 1A** OR move by truck **NOTE 1B**
Slew section into position	3. Tree climbers to trim canopy of recipient tree to fit trunk **NOTE 2** 4. Crane to move section into position next to recipient tree **NOTE 3** 5. Temporarily strap trees together with rachet straps **NOTE 4**
Fix section to recipient tree	6. Use steel cable and turnbuckles **NOTE 5** 7. Use blocks to protect the live tree

NOTES Transport and Placement of Trunk Section

Transporting of the trunk section can be undertaken by one of two methods. It may be carried on the rear of a truck or carried by two franna cranes, one at either end.

1A METHOD 1: Transporting by franna cranes requires a franna crane located at each end of the trunk section. They can access and pick up the section from one side or from the end. Both cranes have a fixed boom out the front that suspends a steel carrying cable. The boom can be extended a small distance but cannot swivel to the side. Therefore in transit the front franna crane drives in reverse and the rear crane drives forward. The driving needs to be slow and coordinated to prevent the log section swinging and damaging the cranes or pulling them over.

Franna cranes are more manoeuvrable than a truck and are more capable of making passage through a winding forest vehicle trail.

As there may be access limitations for the truck and road distance limitations for the franna cranes a combination of both transporting methods may be required. Access to the recipient tree needs to be provided for both the crane lifting the section into place as well as the transport method. All terrain cranes are available however each of the required vehicles have off road limitations therefore care should be taken to ensure that the recipient tree is accessible to all vehicles.

1B METHOD 2: If transported by truck, a crane will be required on the same day to both lift the section onto the truck and then off again at the destination. Therefore this will require both truck and crane charges for the complete time. Transporting by truck will permit use of roads and enables a faster transit period which is best for larger distances to the recipient tree.

Transporting the trunk section by franna cranes

Recipient tree with canopy

Recipient tree with trimmed canopy

2 Trim canopy: The canopy edge of the recipient tree should be cut away so that the trunk section can be slewed across into place from the crane boom above the canopy.

3 Crane to lift tree into position: When lifting by crane, the trunk section should be secured with a cloth sling or harness (not chains) to prevent damage to the outer surface of the trunk section. Structural weak points (e.g. hollows) should also be considered. The sling should be attached as close to the top of the section as possible so that it can be carried as close to vertical as possible to assist with gaining close and secure contact with the recipient tree.

4 Rachet straps: When the trunk is slewed into place by the crane, the base of the trunk will likely require ratchet straps to pull it into the base of the recipient tree.

Crane costs are on an hourly rate; therefore another large heavy duty ratchet strap may be used to temporarily secure the trunks together at a higher point so that the crane may be no longer needed. These temporary straps are to be kept in place until all of the final wire hoops are placed and tightened by the tree climbers. This is a slow process and if the move by franna crane or truck was undertaken earlier the same day then the final securing of wire may lead into the following day.

Lifting vertical from the temporary storage location

Slewing the trunk into the recipient tree

NOTES Transport and Placement of Trunk Section cont.

5 Steel cables and turnbuckles: (see hollow section placement as well page 12) The trunk section is to be secured against the recipient tree with galvanised steel cables and turnbuckles. This is the method utilised by the Treetops Adventure Park at Wyong Creek.

This is a very strong attachment method and therefore only 3 or 4 cable hoops will be required. Three hoops were used to secure the 19 m long 9 Tonne trunk section.

Hardware required for each hoop includes 1 x 9 m length of 10 mm galvanised steel wire, half round cypress pine blocks (up to 6 per hoop), 2 x 10 mm thimbles, 6 x 10 mm U bolts, and 1 x 20 mm galvanised swivel turnbuckle. This hardware can be sourced from Ecoline Pty Ltd (PO Box 490, Lithgow NSW 2790) who supply for the Treetops Adventure Park.

The treated/cypress pine spacing blocks are to be placed between the cable and the recipient tree section so that the cable does not cut into the living cambium. The long turnbuckle is to be located in the gap between the trunk section and recipient tree so that it may be tightened with a tension rod.

A hand or torque wrench will be needed with a 16 mm socket bit to tighten the U bolts and a cordless grinder to cut off any excess wire. When the cable is set in place with sufficient tension and the pine blocks are sufficiently placed around to protect only the living tree, then the turnbuckles can be tightened by twisting them around with a tension rod (or hammer).

Pulling the base into position with rachet straps

Fixing to the recipient tree

The finished installation

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