



CONSERVATION REPORT FOR A NATIONAL RESTING PLACE

Patrya Kay

Repatriation Records Officer
Repatriation and Indigenous Community Access
National Museum of Australia

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Disclaimer

This report was originally written to provide conservation advice for the proposed National Resting Place in Canberra. Therefore, much of the information relating to the suggested method for achieving sustainable environmental control in the Storage Room is specific to the Canberra climate. However, the general considerations discussed are applicable to other environments.

CONSERVATION REPORT FOR A NATIONAL RESTING PLACE

The aim of this paper is to set out Conservation 'best practice' requirements for the housing and long-term care of Ancestral Remains in the proposed National Resting Place, Canberra.

1. KEY TASKS

- Identify sources of information suitable to this task and how they have had to be adapted to meet the needs of this specific project.
- Establish what forms of Ancestral Remains are likely to be held in a National Resting Place. Give a definition of Ancestral Remains.
- Establish what facilities are required to enable Ancestral Remains to be brought into storage in a National Resting Place.
- Establish what facilities are required for the ongoing care and management of Ancestral Remains in a National Resting Place.
- Establish what environmental conditions are required for the ongoing care of Ancestral Remains. This will address both the needs of the remains and the need for the facility to be sustainable over time.

2. METHODOLOGY

Very little has been written which directly addresses the long-term storage of human remains other than as part of a collection in a museum, and nothing has been found which addresses the requirements for a purpose-built National Resting Place that aspires to meet Conservation 'best practice'. Therefore, most of what is written below is based on selective use of the literature, personal experience in caring for the Ancestral Remains in the existing Keeping Place at the National Museum of Australia (NMA), and information gathered as personal communications from other Conservators with experience in designing and maintaining 'best practice' museum storage.¹

The list of forms of remains likely to be deposited with a National Resting Place is derived from those currently held in the NMA Keeping Place and those encountered in the literature. The literature relating to requirements for bringing objects into collections is broadly applicable to the introduction of Ancestral Remains into a National Resting Place. Facilities for receipt (and possibly eventual dispatch), unpacking, labelling, pre-storage treatments including checking/mitigation/treatment of hazards and pests will all be required. While some of these activities are more Registration activities than Conservation activities, in large museums there is always some cross-over and in the case of a National Resting Place all of these activities are likely to be undertaken by a small group of people working in the same area and across all aspects of

¹ Patrya Kay is currently working in the Repatriation section at the NMA as the Records Officer for the NMA Keeping Place. In that capacity she has developed the EMu collections management database to enable documentation and reporting on the Ancestral Remains and has also been responsible for the care of Ancestral Remains in the Store and the day-to-day management of the Keeping Place. Since graduating with an Applied Science Degree in the Conservation of Cultural Materials in 1990, she has worked at the NMA as the Preventive Conservator with special responsibility for the biological component of the collection transferred from the Australian Institute of Anatomy when it closed in 1984. She also worked for 4 years as the Business Administrator for the EMu Collections Management Database.

Ancestral Remains management. Therefore, in this paper these facilities are treated together as part of the Receipt Space for incoming Ancestral Remains.

A literature review of both Conservation and more general building information provides a clear picture of the type of facility and fit out which would provide appropriate care for the Ancestral Remains and at the same time be economically and environmentally sustainable into the future. The NMA currently operates such a facility and a graph of its performance against external and ambient warehouse temperature and relative humidity (RH) over a 6-week period shows clearly the benefits of this type of approach (see Figure 1 and detailed discussion of the graph in Section 3.2).

In the past decade, the Conservation community has reassessed some of its long-held beliefs about environmental requirements for storage. Much of this has been driven by the realisations, firstly, that the old values were rarely able to be met in practice and, secondly, that the anticipated reduction in ongoing funding combined with likely future policies relating to climate issues would require a more energy-efficient approach. A review of recent literature provides a well-researched approach which bases current requirements on the previous environmental history of objects and their current vulnerability to environmental conditions. This can be directly applied to the requirements of Ancestral Remains and will be the basis of the proposals put forward in this paper. Meeting these environmental requirements in a sustainable manner and designing the Storage Room (Store) are inextricably connected.

2.1 Glossary of terms

<i>Term</i>	<i>Definition</i>
Ancestral Remains	The human remains of Aboriginal and Torres Strait Islander people including the whole or part of the body, such as bones, tissue, hair and teeth; inclusive of those human remains that may have been modified such as decorated skulls, water carriers, cremation ash bundles or samples taken for research.
Individuation	The keeping together, wherever possible, of Ancestral Remains as the remains of an individual. One individual may be represented by a complete skeleton or mummy or a single bone. 'Individuating' is the action of associating bones which belong to a single individual.
Keeping Place	A secure storage space where Ancestral Remains can be held until their Community is ready to receive them or, in the case of unprovenanced remains, until they are placed in a permanent Resting Place.
Long-term care	Long-term care in the context of caring for Ancestral Remains with an unknown provenance indicates permanent care within a National Resting Place.
Mortuary practice	Mortuary practices include any culturally specified process (e.g. burial or cremation) the purpose of which is to progress towards the final deposition of human remains (British Museum 2013).
Provenance	Provenance refers to the origin of Ancestral Remains. It may also refer to the record of possession of Ancestral Remains from the time there were removed from Country.
Resting Place	This term covers the final site where Ancestral Remains are placed. It could be a site on Country if the Community has been identified but, in the context of this paper, it refers to a space designed to permanently house unprovenanced remains.

3. SUMMARY OF HIGH-LEVEL FINDINGS

For many Ancestral Remains a National Resting Place will be their permanent home. To provide both the respect that is due to Ancestral Remains and to provide them with 'best practice' Conservation care, the aim of a National Resting Place should be to hold those remains in a condition that is as close as possible to the one in which they were received for as long as they are held in the Store.

To this end, the storage conditions should aim to provide for sustainable, long-term care, and only Conservation treatments which are essential for the survival of the individual remains or for the well-being of all remains in the storage environment more generally, such as pest treatments, should be undertaken.

From a Conservation perspective, Ancestral Remains need to be approached differently from standard museum objects. They are not required for loan or for display and they do not require repair or other treatments to improve their appearance. From this perspective, the following points need to be kept in mind.

Ancestral Remains can take a number of forms – bone, tissue, hair and teeth. There are also remains which have been altered after death for either cultural or scientific reasons, such as cultural artefacts incorporating remains, DNA samples and histology slides (see Section 3.1 for further details). Ancestral Remains which have been through traditional mortuary practices and deposition are most likely to make up the vast majority of remains in the Store. Prior to removal from their deposition sites these remains will have been exposed to environmental extremes such as very high and/or very low temperatures, i.e. greater than 50°C or below 0°C, or very high or low relative humidity (RH), i.e. saturation or desiccation. Because of their environmental history these Ancestral Remains are unlikely to undergo any further physical damage from the environmental parameters proposed here, i.e. 10–25°C and 50% + or –10% RH with a 10% daily fluctuation. This is because any physical damage will have already occurred and any structural stresses will have been released resulting in crack, splits, delamination and other forms of post-mortem damage before they enter a National Resting Place.²

The environmental requirements for permanent storage of Ancestral Remains in a facility sited in Canberra or any similar dry/cool temperate place can be maximised by incorporating passive design rather than relying on artificial climate-control systems. In this context, passive design significantly reduces the impact of external fluctuations in temperature and RH. Even with a sustained slight upward or downward drift in temperature and RH it is unlikely that the remains would be adversely impacted because the buffering provided by the building, and the boxes and cabinets in which the remains are held, would slow the rate of change and allow the remains to adjust to the new conditions very gradually.

Almost all types of Ancestral Remains will be able to be stored in a single storage area. The exceptions to this will be some of those remains which have been modified after death, either by their Community or by the institutions which received them after they were removed from their original context. For example, many institutions in the 19th century and first half of the 20th century used arsenic powders to prevent biological attack on mummified remains. These can never be completely removed. Also, where a skeleton was complete or almost complete, a metal armature was introduced to hold the bones in the same positions as they would have occupied in life.

² Ancestral Remains may also have suffered damage from the pH of the soil, particularly if the soil is wet, or from invasive plant roots, but any ongoing threat these pose usually ceases when the remains are removed from their deposition context. While the physical structure of the remains may have been weakened, any further damage is unlikely to occur if the remains are held in a stable environment and, if considered at risk, are placed on the monitoring schedule for vulnerable remains.

Depending on past storage conditions these armatures may have expanded due to corrosion. Occasionally these modifications create changes in the remains which require adjustment to their environmental or storage requirements. These are likely to be a very small percentage of the Ancestral Remains held in a National Resting Place and can be dealt with on a case-by-case basis (see Appendix 1).

The requirements for bringing Ancestral Remains into the Store are similar to those required for incoming museum collection items. The main difference is the need for greater privacy and access control to ensure respectful treatment for the remains.

The successful permanent care of Ancestral Remains is very much dependent on the initial design of the storage area. If a Mitigated Store has been created which incorporates the best available passive design then ongoing care would only require a system for air circulation (see Section 3.3) and well-managed housekeeping. This would involve programs for cleaning, pest checking, monitoring/maintenance of remains with special environmental requirements and the maintenance of Occupational Health and Safety standards.

3.1 TYPES OF ANCESTRAL REMAINS LIKELY TO BE HELD IN A NATIONAL RESTING PLACE

This list is devised by combining the Ancestral Remains cared for by the NMA, those listed or referred to in various reports (Department of Culture, Media and Sport (UK) 2003, p. 8; British Museum 2013, pp. 1–2; Natural History Museum (UK) 2014, p. 4; Deutscher Museumsbund 2013, p. 9) and those reported by other researchers (Pickering 2020, pers. comm.).

The standard boxes referred to in this section are made from archival card, have no glues for metal components and come in 2 sizes. One is designed to hold cranial remains, and the other post-cranial remains. (Further information about these boxes can be found in Section 3.4.)

<i>Type</i>	<i>Description</i>	<i>Recommended storage</i>
Skeleton, not articulated (complete or nearly complete)	A complete or nearly complete skeleton would include, at the minimum, a cranium or cranial fragment, the pelvis, vertebrae and the long bones of the arms and legs. It may also include a mandible (lower jaw), ribs, shoulder blades and some or all of the other smaller bones.	These bones are able to be held in one or more standard boxes. ³
Mummified remains (complete or nearly complete, assumed to be naturally articulated)	These are remains which have sufficient dried tissue adhering to the bones to hold them in their natural relationship to each other. Depending on how the mummification occurred, culturally or environmentally, it is possible that many of the physical features of the individual may still be	It is highly likely that this type of remains will require a custom-made, museum-standard box.

³ In the NMA Keeping Place the remains of some individuals are split across more than one standard box, with the boxes stored together side-by-side. This approach was taken to enable the remains to be held in the shelving system in the Store. If desired, unarticulated complete, or almost complete, skeletons could be held together, either in one custom-made box, or a decision could be made to have a third size of standard box which would suit this purpose. If the latter is chosen, a section of either the open shelving or the compactus should be designed to hold that size of box. The dimensions of the shelving in the Materials Store would need to be adjusted if this option was chosen (see Section 3.4).

	visible. Alternatively, there may only be a small amount of connective tissue holding all or just some of the bones of the individual together.	
Skeleton, artificially articulated (complete or partial)	These are bones which have been reassembled by a collecting institution using metal rods and wires to hold them in their original relationship to each other. Frequently it is either not possible or not the policy of an institution acting as a Keeping Place to remove the articulating structure without Community approval. The remains will have the dimensions of the original individual.	This type of remains will require a custom-made, museum-standard box.
Decorated remains	These remains, both skeletal and mummified, have been decorated as part of the mortuary practice of their Community. The decoration may involve non-anatomical material such as shells, fibre, wood and/or over-modelling with clay to recreate the appearance of the ancestor. This decoration is important and must be preserved.	These remains can usually but not always be held in a standard box.
Mummified remains (head, individual limbs or other partially articulated remains)	This type of remains represents only part of an individual.	These remains can usually but not always be held in a standard box.
Skull, cranium, calvarium and calotte	The cranium is the upper part of the skull without the presence of the mandible, and the calvarium is the brain case of the cranium without the facial section. The calotte is a dome shape in the top of the cranium, usually removed to give access to the interior of the skull.	These bones are able to be held a standard box.
Skull, cranium, calvarium, calotte, mandible and post-cranial remains (disarticulated)	Post-cranial remains are any of the bones below the base of the cranium, e.g. bones from the torso, arms and legs.	This type of remains will usually fit into one or more standard boxes.
Post-cranial remains, mandible and dentition (small)	These are small bones such as those of the upper and lower jaws, teeth, hyoids, hand and foot bones, and small vertebrae.	These can be held in a standard box or, where an individual is represented by only a single bone or a very small number of bones, they can be held in drawers in closed cabinets. Depending on the nature of the remains, they can be wrapped in tissue to keep a set of remains together.

Post-cranial remains (large, not articulated)	These are larger skeletal elements such as the long bones of the arms and legs, the pelvis, ribs, and/or a full spinal column.	These can be held in a standard box or, where an individual is represented by only a single bone or a small number of bones, they can be held in drawers in closed cabinets.
Post-cranial remains (articulated)	These could represent any section of the body but are most likely to be hands and feet.	These may fit into a standard box depending on the stature of the individual, but it is possible they will require a custom-made box.
Burial packages (bones or ashes wrapped in paper bark)	A burial package is an individual's bones/ashes collected and wrapped in paperbark as part of a Community's mortuary practice.	This might require a custom-made box.
Unidentified skeletal element	These are usually fragments of bones which have been found together.	These can be held in a standard box or, where an individual is represented by only a single bone or a small number of bones, they can be wrapped in tissue and held in drawers in closed cabinets.
Commingled remains (small)	Usually these are the small bones of the hands or feet, or teeth, which cannot be assigned to any individual's other remains. These would usually be grouped based on their most recent provenance.	Depending on the number, they can be held in a standard storage box or wrapped in tissue and held in drawers in a closed cabinet.
Commingled remains (large)	These are large bones or fragments of bone, frequently degraded, which have been found together or grouped together by a previous collector and cannot be individuated.	These can either be held in a standard box or held in drawers in a closed cabinet.
Hair samples	These are cut lengths of hair, which would be held in archival envelopes. If there is any tissue associated with them they would be treated as mummified remains.	If a sample is related to an individual in the Store they should be stored with that person's remains. Otherwise they can be stored in a standard box or in a drawer in a closed cabinet.
Blood samples ⁴	These would usually be held in small, stoppered phials and may well be little more than a powdery residue. Any labelling should be documented.	If a sample is related to an individual in the Store they should be stored with that person's remains. Otherwise they can be stored in a standard box or in a drawer in a closed cabinet.
DNA samples	These are samples created from the bone or tissue of an individual. They would be held in small, stoppered phials. It is essential that any labelling on these phials be documented.	If a sample is related to an individual in the Store they should be stored with that person's remains. Otherwise they can be stored in a standard box or in a drawer in a closed cabinet.

⁴ Biological samples such as blood samples, DNA samples and histology slides must be stored under very specific conditions to retain their original scientific value. It would be extremely unusual for those conditions to have been met by a collecting institution.

Histology slides	These are very thin sections of tissue or bone which have been stained and mounted on microscope slides for analysis.	If a slide is related to an individual in the Store they should be stored with that person's remains. Otherwise they can be stored in a standard box or in a drawer in a closed cabinet.
Objects incorporating Ancestral Remains (other than sorcery objects)	These are most likely to be water carriers made from crania.	Usually these can be stored in one of the standard sized boxes.
Sorcery objects incorporating Ancestral Remains	These objects are considered to be 'sensitive' and it may be desirable to store them separately.	This would be a Community rather than a Conservation decision. ⁵
Grave goods	Grave goods are any item recovered from a burial place. They can include traditional and Western-made items. Where possible they should be stored with the individual they are associated with.	Depending on the nature of the grave goods, they could be stored in the same box as some or all of the associated Ancestral Remains, or held in a separate standard box and stored alongside the box(es) containing the person's remains. Or they may require a custom-made, museum-standard box which should be stored with the remains if possible.
Casts (small, medium and large)	Casts are usually plaster, or occasionally plastic, copies of skeletal elements, the brain or the interior of the skull.	They should be stored in a manner similar to the original element they represent.

Unless they are identified as unstable, all skeletal and mummified remains and objects incorporating remains can be held in the General Storage Area (see Sections 3.1 to 3.3). Their main requirements are a stable RH centred around 50%, temperatures which fluctuate by no more than 10°C daily, and as little vibration as possible. Moisture and vibration are the greatest risks to their long-term survival. For the purposes of storage, remains can be grouped into the following categories.

3.1.1 *Skeletal Ancestral Remains*

Experience at the NMA suggests that the vast majority of Ancestral Remains, excluding casts, will be skeletal (see Appendix 1 for percentages). Bone has two major components – the mineral hydroxyapatite (c.50% by weight) and the structural protein collagen (c.48% by weight). The remaining c.2% is usually only present in fresh bone and is of little relevance to Ancestral Remains (O'Connor, 1987:6). Depending on the environmental history of the remains, it is possible that they may have become de-mineralised if they have been held in wet, acidic conditions. This will lead to a softening of the bone. Remains held in a wet environment where the pH is between 6 and 8 or where the mortuary practices have involved high heat may have lost some of their structural

⁵ At the NMA, human remains that have been incorporated into sorcery objects are kept in the Secret Sacred Store rather than in the Human Remains Store because their use as sorcery objects tends to be more of an issue to Community members than their existence as human remains.

protein which would make the bones brittle. Wet conditions are also likely to have facilitated some mineral substitution or bacterial attack on the collagen leading to staining and/or surface pitting.

Wet bone is also subject to abrasion. This is particularly noticeable in bone which has been buried in wet sand. Where the bone has been completely saturated and then dried there is likely to be delamination, the extent of which is often dependent on how many cycles of wetting and drying have occurred.

Generally speaking, however, bone has a high likelihood of surviving in a structurally stable condition and frequently will show very little evidence of damage, other than staining, to the naked eye. Provided such remains are kept in a Store where the RH is stable and the temperature is not extreme there is unlikely to be further damage.

Storage requirements

Skeletal remains will usually, but not always, enter the Store as individuals. They should be held in acid-free boxes and packed with acid-free tissue. Buffered tissue should not be used because its high pH can have a detrimental impact on the collagen in the bones. More than one box may be required to house an individual and these boxes must be linked by the labels on the boxes and their records on the database. However, where an individual is represented by a small number of skeletal elements, other than cranial, they are usually stored in drawers in closed cabinets. The drawers should be lined with some form of Conservation-standard cushioning material, such as polyethylene foam sheeting.

3.1.2 Mummified Ancestral Remains

Usually mummified remains have both bone and tissue components and, if they have been deliberately mummified as part of a Community's mortuary practice, they may also be decorated.

The tissue is a proteinaceous material composed of collagen and keratin which will swell and lose its structure if waterlogged, or shrink and split in extreme, dry conditions (Singley 1988, p. 79). It would be unusual for tissue to have survived from a wet environment in Australia – this type of survival is usually associated with deposition in acidic peat bogs and requires expert, highly interventive treatment such as substitution of the water by polyethylene glycol, to ensure it does not dry to a powder. Tissue is also subject to biological attack from micro-organisms and fungi in damp conditions.

Ancestral Remains containing tissue were usually collected from very dry environments. Tissue may also have survived if it has been treated in some way, such as by smoking, as part of the mortuary practices of a Community. While its appearance is likely to be significantly changed by its environmental history, that same history will have released any tensions in the structure of the tissue making it stable as long as it remains in a dry environment. Storage in museum facilities with poor environments may have exposed dry tissue to moist conditions which can introduce or reactivate destructive, biological organisms. Such remains may require treatment before they can enter the storage area but as much as possible such treatments should be non-invasive, for example, freezing or anoxic treatments for pests, and UV treatment for moulds.

Storage requirements

Ancestral Remains which are mummified or contain adhered tissue should be boxed, even if the individual is represented by a single bone. They should be held in acid-free boxes and packed with acid-free tissue. Buffered tissue should not be used because its high pH can have a detrimental impact on the collagen in the bones.

If the remains appear to be unstable, the box should be lined with plastic, desiccants added and the plastic lining sealed. This will ensure that the RH remains low and enables these remains to be stored with the skeletal remains. Mummified remains should be put on a maintenance list for regular checking. If there is an odour associated with the remains but no evidence of deterioration, bags of activated charcoal should be included in the box to absorb the smell.

3.1.3 Casts

Casts of Ancestral Remains can be stored in the same way as the skeletal remains. They are likely to be fragile but do not have any additional requirements.

3.1.4 *Fluid-preserved specimens*

These are likely to be held in an unidentified preservative and sealed in glass or perspex containers. The most common preservatives are either alcohol-based or glycerol-and-formalin-based. However, all manner of other preservatives have been used including ship's rum or embalming fluid. Unless accompanying documentation states the nature of the preservative there is little that can be known without opening the container. Fortunately this type of remains is not likely to be numerous. Before being placed in storage the seals need to be checked and, though they already have their own storage container, they do require a specialised area and storage system (see Section 3.6).

3.1.5 *Other types of Ancestral Remains*

These include biological samples, hair samples, and objects incorporating Ancestral Remains. Where these are associated with other remains of an individual they should be stored together. The unlikely exception to this might be biological samples which come from a research organisation where they have been held under conditions which allow them to still have scientific value. Depending on the wishes of Aboriginal and Torres Strait Islander Community leaders, these may need to be stored in an appropriate, dedicated freezer. Otherwise they too can be stored with an associated individual in the General Store Area.

Where there is no association with other remains, these would usually be stored in standard boxes or in drawers in closed cabinets.

3.2 THE STORAGE ENVIRONMENT – RH AND TEMPERATURE

In the last decade, museum professionals have given considerable thought to the environmental conditions needed to safely store museum collections (Serota 2008; Jones 2008; National Museum Directors' Council 2008; Grattan & Michalski 2017; Getty Conservation Institute 2018; American Institute for Conservation 2019; Pagliarino 2019). The traditional, rigidly defined parameters for RH and temperature laid down in the later part of the 20th century (Thompson 1990) are now being re-examined in the light of their value for protecting objects, the energy they consume and the cost required to maintain them.

This is not a cost-cutting exercise at the expense of the safety of the objects or an ill-considered desire to be 'green', but a realistic assessment of what environmental conditions are essential to prevent further damage. 'Heritage science and conservation practice have developed two general approaches to providing the necessary evidence to inform climate specifications; (1) analyses of

the historic climates to which the objects have been 'acclimatised', and (2) analysis of the physical response of the materials and objects to relative humidity (RH) and temperature fluctuations' (Kozlowski 2018).

By applying the first approach of looking at the historic climates to which the remains have previously been acclimatised, it is clear the vast majority of the remains to be held in the National Resting Place will have already been exposed to temperature and RH fluctuations greatly in excess of anything likely to be experienced in the proposed Mitigated Store Room, even if the traditional environmental parameters are relaxed from the standard 20°C + or -2°C and RH 50% + or -5% (AIC 2019). Most of the skeletal and naturally mummified remains to be housed in a National Resting Place will have been through traditional ceremonies for the dead, including primary and secondary burials, deposition in a cave or tree, smoking over a fire, or post-mortem decoration or modification. Any physical damage likely to be caused by exposure to such extremes of temperature and RH, repeated cycling through those extremes, saturation, freezing and biological attack will have already occurred before they were removed to a collecting institution.

By applying the second approach of looking at the physical responses of the remains to RH and temperature fluctuation, it becomes clear that some types of remains require a more tightly controlled environment than others. Given that the remains to be housed in the National Resting Place will have come from universities and cultural institutions and, if returned from overseas, will have passed quarantine requirements, it is unlikely that any active pests, moulds or active biological degradation will be present when they enter the Receipt Space⁶. However, any exceptions to this should be identified and treated as part of the process of preparing the remains to go into the Storage Room. The inclusion of a basic Conservation lab, a freezer and a UV treatment cabinet should allow for all of the predictable treatment requirements to be carried out (see Section 3.6).

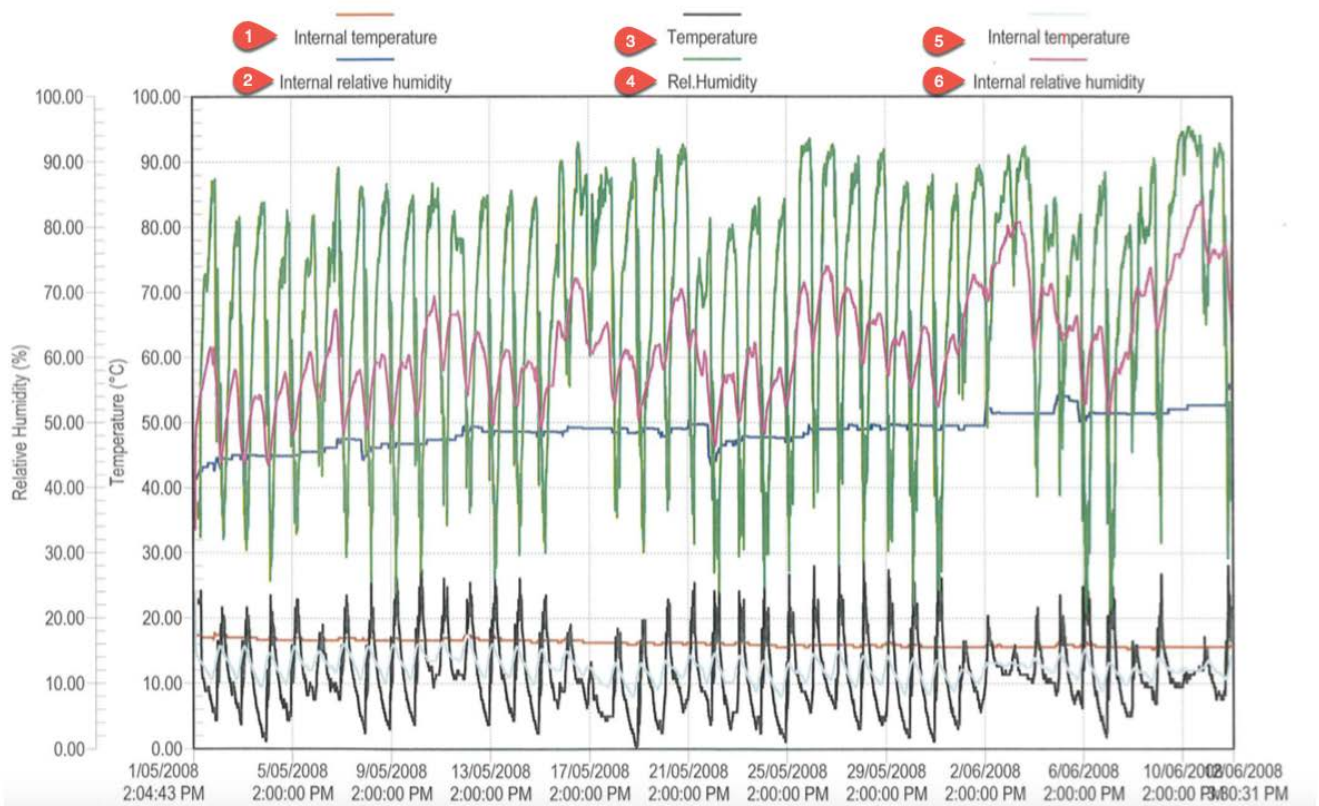
A well-managed Integrated Pest Management Program, Vulnerable Remains Check Program and a storage area built to reflect 'best practice' in passive design should ensure that these issues do not recur for remains once they enter the Store.

3.2.1 *General Storage Area*

Skeletal remains, stable mummified remains, burial packages, grave goods and hair, all of which make up the majority of remains, will have experienced temperature and RH fluctuations well outside the range likely to be found in a storage area of the type outlined in this paper. Such remains can safely cope with a relative humidity between 40% and 60%, with a daily fluctuation of no more than 10%, and a temperature range of 10–25°C without any further physical damage occurring. Casts are also able to be kept safely under these conditions.

⁶ It is possible that some moulds may reactivate or bone fat may continue to seep from remains that had never been buried. Moulds, even dead mould, can cause health problems for staff, and the Occupational Health and Safety protocols should be followed when working with these remains.

Figure 1. Environmental Conditions in the NMA Mitigated Store Compared with External and Warehouse Conditions



Key:

1. Temperature inside the Mitigated Store in the Warehouse
2. Relative humidity inside the Mitigated Store in the Warehouse
3. Outside temperature
4. Outside relative humidity
5. Temperature in the uninsulated Warehouse
6. Relative humidity in the uninsulated Warehouse

This graph compares the temperatures and relative humidities of the air outside the warehouse and inside the warehouse with the Mitigated Store during the period 1/5/2008 to 14/6/2008. Despite fluctuations outside the Store the temperature remains constant at c.18°C and the RH shows only gradual seasonal drift well within the environmental parameters set for the Store.

As can be seen from the graph above, fluctuations of temperature in a Mitigated Store are likely to be minimal. The extension of the minimum acceptable temperature range from 15°C to 10°C is based on a personal communication from Nicki Smith, Senior Conservator at the NMA. Lower temperatures, should they occur in a Mitigated Store, are unlikely to be harmful to remains and they reduce the likelihood of chemical reactions and biological activity.

While damage from previous exposure to extremes of RH and temperature will already have occurred, Ancestral Remains will be vulnerable to further damage from vibration. Consequently, it is important that vibration be minimised. Delaminating bones and loose teeth are particularly vulnerable to vibration. A facility constructed on a concrete slab laid directly onto the ground provides the best structural vibration minimisation. The choice of storage system can also assist with vibration minimisation, e.g. the criteria for the choice of a compactus should include the design requirement that vibration is dampened when the shelves are being moved.

3.2.2 Specialised storage

The exceptions to the conditions outlined above are Ancestral Remains which have been modified after removal from their original context or those that have been mummified but continue to degrade. Storage conditions for these are:

- **Fluid-preserved organs and tissue**

Storage requirements are variable depending on the nature of the preserving fluid, however the variations relate to managing hazards from off-gassing of those solutions. The environmental requirements are similar to those in the General Storage Area but the remains should be held in a chemical storage cabinet vented to the outside with trays to contain possible spills (see the Section 3.6.2 Conservation Treatment/Isolation Room).

- **Objects which incorporate human remains, including sorcery objects**

If only the remains are of concern and if all the components can be safely held in closed cabinets in the general storage environment then the objects should be held there. If there are other materials in the object that are actively degrading and considered a threat to the remains under general storage conditions (e.g. corroding metal or unstable, non-human biological components), or if it is considered important to provide the best possible storage for all of the components, some of which have very specific requirements, an appropriate environment could be created by placing each set of remains in a moisture-proof container with desiccants or soluble salts conditioned to the appropriate RH (Thompson 1990, pp. 107–114). These remains should be included on the Vulnerable Remains Check Program list. It would be best to hold all the remains that require checking in the same area in the General Storage Area unless this is culturally inappropriate.

If there are likely to be a large number of this type of remains then it would be more efficient to hold them in a large, sealed cabinet, and condition the environment in the cabinet interior as a whole. A scaled-up version of an electrical enclosure cabinet would be suitable but this would need to be custom made to include a sealed drawer in the bottom to hold desiccant or soluble salts and an hygrometer visible from the outside of the container to show the internal RH. More than one such cabinet would be required if more than one specialised environment is specified. This would make managing the environment for all these remains relatively straightforward.

- **Artificially articulated skeletal remains**

If the metal used in the articulation is actively corroding (possibly due to more than one metal being used in the frame), cannot be stabilised and has become fixed to the remains, then it may be necessary to ensure that the RH is kept low (c.40%) to ensure that swelling due to corrosion will not cause the skeletal elements to crack or break off (Bachmann 1992, p. 132). This would be an unusual situation and would always be a compromise between what is best for preserving the bone and what is necessary to arrest the corrosion. Usually

a stable storage environment would prevent metal corrosion. Because only a small number of remains are likely to be involved, their requirements could be met by placing each set of remains in a moisture-proof container with a desiccant or soluble salt solution. These remains should be included on the Vulnerable Remains Check Program list.

However, if there is a large number of remains of this sort, an alternative would be to design a large, sealed cabinet similar to the one described above to house these remains.

- **Chemically treated remains**

Some Ancestral Remains may have been given pest treatments which are now considered to constitute a hazard to those handling them, e.g. arsenic powders, or may have been examined in a way that leaves a chemical residue, e.g. the use of mercury to find the volume of internal spaces. Usually these can be managed by housing the remains in standard boxes with clear labels identifying the hazard. Once this is done they can be kept in the General Storage Area. If necessary the box should be lined with a barrier film and sealed to prevent dust or fumes from escaping.

It is essential that the nature of any hazard be recorded on the database so that anyone making planning decisions about access has the necessary safety information.

3.3 THE STORAGE ROOM

The Conservation requirements for the storage area in a National Resting Place are for undisturbed, dark storage which meets the environmental, access and safety needs of the remains while allowing staff to access them occasionally for short or long periods. It must also take into account the need to incorporate as much passive technology into the design as possible to ensure long-term economic and energy sustainability. 'By appropriate planning, choice of materials, and especially the management of ventilation one can achieve free heating in cool climates and even free cooling in over heated climates' (AICCM 2014, p. 25).

The information given here applies only to a facility sited in a dry, cool-temperate climate such as Canberra's and is based on the technology and understandings available at the time of writing.

It is assumed that there will be at least 2 storage spaces – the General Storage Area for skeletal and mummified remains, hair, biological samples, grave goods and casts; and a separate area in which the fluid-preserved specimens are held in specially ventilated cabinets (see Section 3.2). Personal experience at the NMA Keeping Place suggests there are only likely to be a very small number of this latter type of remains and their storage will be considered separately from the General Storage Area.

The General Storage Area is essentially a purpose-built, dark store with the need for access limited to the deposition of incoming Ancestral Remains and the scheduled programs for cleaning, pest checking and checking remains with special requirements. Such a room lends itself to a completely passive design (see Figure 1) and requires the following features:

- The Store should be sited in the centre of the building with no walls in common with the exterior of the building in order to reduce unwanted solar gain in hot weather or heat loss during cold periods. This arrangement will also reduce access for pests.
- It should sit directly onto the concrete slab-on-ground foundation. This will provide the thermal mass required to store and release heat and thus dampen temperature fluctuations within the Store. It will also reduce the risk of vibration. In a climate like Canberra's it is

advisable to insulate the underneath and sides of a slab-on-ground foundation (Reardon et al. 2013: Typical Applications section). If it is necessary to site the Storage Room on an upper level of the building there are a number of options for creating a thermal mass in the floor. All of these would require insulation under whatever material is used to create the floor. A thermal performance assessor should be consulted about specific requirements once the site for a National Resting Place is determined and before the design is finalised. However, if the room is to be in an upper level of the building it is essential that every effort be made to ensure that vibration is structurally dampened.

- The dimensions of the room, particularly the height, need to be discussed with a thermal performance assessor to ensure that the thermal mass is sufficient to passively maintain the required temperature range for the volume of air in the room.
- The walls and ceiling should be insulated to the highest standards.
- The walls and ceiling should be lined with a layer of hygroscopic material to give stability to the RH.
- The materials in the walls and ceiling should have the highest available fire rating.
- The materials in the walls should be smooth and continuous to facilitate cleaning and to avoid providing slots and gaps where insects can breed or mould develop.
- The floor should be polished concrete with no additional floor covering to ensure maximum benefit from the thermal mass it provides and also to make cleaning and pest management as efficient as possible.
- There should be no windows.
- There should be 2 standard doors, one at either end of the room, to ensure there is an exit in the case of emergency. These doors should be tight fitting/sealed to prevent unintended air movement into and out of the Store leading to fluctuations in RH. Access through these doors into the Storage should be security controlled, but exit from the Store should be unrestricted.
- There should be no adjacent wet areas and no wet pipes running through the floors, walls or ceiling.
- If there is an occasional need for lifting or access equipment, there should be an insulated, access controlled, tight-fitting, sliding door with dimensions sufficient to allow that equipment to be moved into and out of the room. Equipment should not be kept in the Store and should never be recharged there due to the generation of ozone during recharging.
- All electrical fittings should be spark protected.
- Fans are required to keep the air in the room moving to minimise the development of still microclimates where pests can breed and mould can develop undisturbed.
- Because the Store would be virtually sealed, the air will become stale over time. To provide a safe working environment for staff, there should be a monitoring system which identifies when the RH and temperature of the environment outside the building falls within the parameters set for the environment in the Store (see Section 3.2). When these conditions are met, it should be possible to activate an exhaust fan vented to the outside of the building at one end of the room and a filtered air intake for external air intake at the other end to replace the air in the Store. It is desirable that this system be able to be manually

controlled to avoid the cost of unnecessary air changes during periods when staff are not likely to be accessing the room for more than a few minutes.

- General coverage lighting is required to facilitate cleaning and pest checks, and sectional lighting may also be desirable, depending on the layout of the room.
- Power points at floor level are required to power cleaning equipment. How many will depend on the layout of the room.
- The room should have good wi-fi coverage to facilitate the tracking and location of Ancestral Remains and the use of laptops. This would need to be governed by strict privacy controls to ensure no information about an Ancestral Remain is made public.
- Digital environmental monitoring equipment should be hard wired into the Store. This should provide an ongoing recording of conditions in the room and be capable of providing back-to-base alerts when environmental conditions go outside the set parameters.
- Fire extinguishers should be strategically located around the walls.
- There should be no automated fire suppression system⁷ installed in the Store because its design makes it unlikely that a fire could begin there. However, there should be a VESDA (Very Early Smoke Detection Apparatus) system installed with back-to-base reporting to ensure that, in the unlikely event of fire, swift action can be taken.

3.4 STORAGE SYSTEMS

3.4.1 Types

The main options for storage systems in the Storage Room are:

- compactus
- open shelving units
- closed cabinets with drawers.

Each of these has advantages and disadvantages, however, they would all be considered appropriate in the context of Conservation 'best practice' for storage. A combination of all 3 types is likely to provide the best method of housing Ancestral Remains safely and efficiently.

A compactus is the most efficient use of space, and modern designs have good vibration dampening. This type of system can be used for all Ancestral Remains in standard boxes. The moving units of shelves in a compactus allow good access for cleaning and they can be locked to give an extra level of security. The disadvantages can be that a unit, once installed, is difficult to reconfigure to house deeper- or taller-than-standard boxes. Also, in a low access, dark Store they are likely to remain in the same position for long periods. This can result in poor air movement with the consequent risk of insects taking up residence or mould developing. A program of regular repositioning and inspections can effectively manage this risk.

⁷ A nitrogen enhanced environment was considered as a fire prevention measure but was rejected because: it limits access for more than a short period of time unless the room is flushed with fresh air and the nitrogen replaced after access; it is inadvisable for pregnant women and anyone with a respiratory condition to enter the room; it would be an additional ongoing cost to maintain the system which could be avoided by adopting a more passive approach.

Open shelving units with adjustable shelf height provide good access with no vibration and are suitable for all boxed remains. They are ideal for housing non-standard-sized boxes such as those required for articulated skeletons because units with deeper shelves can be relatively easily substituted for standard units. Fixed open shelving allows good air movement and, if the lowest shelves are at least 15 cm above the floor, provide good access for cleaning. The disadvantage is that they take up considerably more space than a compactus to provide the same amount of storage.

Closed cabinets fitted with drawers are the most suitable option for unboxed Ancestral Remains and any objects incorporating Ancestral Remains that need to be segregated, such as sorcery objects. Well-designed, soft-close drawers will minimise vibration. Closed cabinets enable remains to be held in a dust-free environment and are the best option for the remains of individuals who are represented by only a small number of post-cranial skeletal elements. Their disadvantage is in being less accessible than a compactus or open shelving and, like open shelving units, taking up more space.

A sub-category of closed cabinets are sealed cabinets that can hold an environment specially designed for the types of Ancestral Remains they are to house. For example, mummified remains which are unstable require a low RH to ensure degradation is not activated. This type of cabinet would need to be custom-made and incorporate a sealed storage chamber of the required size and a sealed drawer in the base with a grate connecting it to the storage chamber. It should also have a hygrometer on the outside of the cabinet to allow monitoring of the internal RH without opening the chamber. This is a variation on the design used for climate-controlled showcases (Thompson 1990, pp. 106–15).

Depending on the nature of the remains being stored (see Section 3.1), all of these types of storage system could be used in the Storage Room.

3.4.2 *Materials*

There are numerous publications on suitable materials for storage systems. One of the most comprehensive is by Jean Tétreault from the Canadian Conservation Institute (see Tétreault 2009) which provides detailed criteria for the selection of Conservation 'best practice' materials.

While there are ways in which wood can be treated to make it suitable for shelving, metal 'is the most effective shelving to use from the point of view of strength and durability and also from the conservation point of view' (Museums and Galleries of NSW n.d.). Compactus, open shelving units and cabinets should be made from powder-coated metal to prevent corrosion.

Sealed cabinets must be made from powder-coated metal with a platinum-cured silicone, neoprene, polyethylene gasket (Tétreault n.d., p. 9) to ensure that the cabinet remains unaffected by the environment it is intended to hold. Rubber should not be used.⁸

Storage requirements for fluid-preserved specimens will be treated separately (see Section 3.6.2 Conservation Treatment/Isolation Room).

3.4.3 *Storage boxes*

Most Ancestral Remains can be stored in one of 2 sizes of standard boxes. These boxes are pre-cut from archival board and assembled as required. They have a slot-in-groove method of

⁸ The selection of gasket material should be revisited at the time the cabinets are being selected because advances in the performance of plastics is likely to continue into the future.

construction and have no metal components. For this reason, dimensions for the boxes before assembly and after assembly will be given to ensure sufficient space in both the Storage Room and in the packing materials storage space in the Receipt Space.

Some individuals, depending on their stature and the number of their bones present, may require 2 or more boxes (see Section 3.1, Footnote 1). These boxes must be able to be stored together and linked by their database records.

- **Cranial storage boxes**

These are designed to hold skulls and crania. If desired they can be used to store the post-cranial remains of an individual if those remains are small or for commingled bones. In its flat state the base of the box measures 63 x 93 cm and the lid measures 32 x 54 cm. When folded to make a box with a lid the dimensions are 29(l) x 20(w) x 19(h) cm.

- **Post-cranial storage boxes**

These boxes are designed to hold post-cranial remains, and their length is set by the likely maximum length of unarticulated, adult, long bones, and their width by the maximum width of an adult pelvis. In its flat state the base of the box measures 102 x 110 cm and the lid measures 39 x 88 cm. When folded to make a box with a lid the dimensions are 64(l) x 28(w) x 21(h) cm.

Custom-made boxes

While the vast majority of Ancestral Remains can be held in standard-sized boxes there are exceptions such as those which have been mummified or which are artificially articulated. Burial packages may also require a custom-made box. The dimensions of such boxes are dependent on the individual remains. Based on experience at the NMA, very few of these boxes are likely to be required and, although they could be made in-house, the amount of equipment, expertise and materials required to make them to the standard of the other storage boxes is not justified when they can be ordered in small quantities from the supplier of the standard boxes.

3.5 THE LOADING BAY

The Loading Bay, or in this case the Unloading Bay, will be the point of entry for Ancestral Remains into a National Resting Place. This area will be situated between the road outside the building and the Receipt Space. If this facility is to serve as the general Loading Bay for the entire building then there would need to be additional access-controlled doors connecting to the other areas it serves. Deliveries, other than Ancestral Remains or equipment/materials required for the care of Ancestral Remains, must not enter other areas of the building through the Receipt Space.

The Loading Bay will not require environmental controls because Ancestral Remains will still be in their travel crates while they move from the delivery truck into the Receipt Space.

The Loading Bay will need to have:

- an insulated, access-controlled, folding or sliding door of sufficient height to allow the entry of a delivery truck
- sufficient space in the dock to allow a delivery truck to come fully inside and have the door close behind it. This will provide both protection from the elements during unloading and privacy. The dimensions of the largest truck used by International Art Services, the company used to bring Ancestral Remains into Australia, is 1224(l) x 250(w) x 428(h) cm with a tail lift 265(l) x 250(w) cm (Button 2020)

- a 6-m space beyond the extended tail lift to allow the free movement of any equipment required for unloading (Button 2020). Space will also be required to store the unopened, incoming crates until they can be moved into the Receipt Space. Ideally this move to the Receipt Space should happen immediately, but sometimes this may not be possible with a large consignment. If the crates have to remain in the Loading Bay for more than a week during periods of temperature extremes, such as mid-summer and mid-winter, it would be desirable to hire an insulated shipping container. This can either sit inside or immediately outside the Loading Bay. The environmental conditions inside the Loading Bay and outside it are unlikely to be significantly different particularly if it serves the entire facility and is in constant use (see Figure 1). The footprint of a standard shipping container would be 2.43(w) x 6.06(l) x 2.59(w) m. If the container is to be held inside the Loading Bay there would need to be space allowed on the short side where the doors are situated for both doors to be opened to at least 90° and for equipment to move the crates in and out⁹
- facilities for parking and charging large, battery-operated equipment, e.g. fork or scissor lifts
- an access controlled, insulated, tight fitting, sliding door leading from the Loading Bay into the Receipt Space. This should be large enough to allow crates to be moved in from the Loading Bay using moving equipment
- a standard, access-controlled door from the Loading Bay into the Receipt Space
- a floor lift, if there is a discrepancy between the floor level in the Loading Bay and the access door to the Receipt Space.

3.6 THE ANCESTRAL REMAINS RECEIPT SPACE

Once the initial arrival of Ancestral Remains to a new facility has taken place it is likely that this area may only be used periodically as new remains come in and need to be prepared for entry into the Storage Room. Office areas may be in continual use for ongoing research, and research facilities may be elsewhere in the building or even off-site.

How this area is used at other times is not a Conservation concern unless it reduces security or introduces anything which could be a threat to the remains in the Storage Room. For example, nothing should be brought into the area that has not been checked for pests, and nothing should be kept there which could attract pests, such as starch-based packing beads. Whether or not the area is in constant use, there must be a program of regular cleaning and pest checks, particularly in the materials storage areas of the Receipt Space.

The Receipt Space may contain one or more rooms and acts as a link between the Loading Bay and the Storage Room. The Receipt Space should have entrances and exits to the outside or to other spaces in the building, as well as to the Loading Bay, to ensure the safety of staff in the case of an emergency, but it should not be a general passageway and access should be strictly controlled.

The structural design for this area should incorporate the following features:

- Walls, floor and ceiling should be insulated.
- Walls should have a smooth continuous surface to facilitate cleaning.

⁹ The aesthetics of the Loading Bay are not a Conservation concern, but it may be considered more culturally appropriate to have the Unloading Bay enclosed so that ceremonies for incoming Ancestral Remains can be carried out by a Community at their point of arrival.

- Floors should have a continuous surface such as welded Tarkett to facilitate cleaning. A cushioned material is desirable for the comfort of staff standing for long periods. Alternatively, high-density, foam matting could be used around the benches/tables.
- Windows can be part of the design if desired, although privacy would be an issue with windows to the outside. Skylights with an air lock between the ceiling and the roof would be a suitable option to allow natural light.
- An access-controlled, tight-fitting, insulated, standard door and an access-controlled, tight-fitting, insulated, sliding door should be fitted between the Loading Bay and the Receipt Space.
- An access-controlled, tight-fitting, standard door and an access-controlled, tight-fitting, sliding door should be fitted between the Receipt Space and the Storage Room.
- There should be a level floor running from the Loading Bay into the Receipt Space via the sliding door. If this is not possible, a floor lift or other suitable lifting apparatus should be installed in the Loading Bay.
- Door frames should be unobstructed at the base or have faceted footings to allow smooth movement of tables and trolleys.
- The Receipt Space will require heating, cooling and air changes for the comfort of staff. The amount of environmental adjustment could be minimised by adopting a solar passive approach to the design. The environmental conditions required for staff comfort would fit within the parameters for the Storage Room (see Section 3.2) so the anticipated, infrequent movements between the Receipt Space and Storage Room are unlikely to cause problematic environmental changes in the Store.
- There should be an alarm system to alert staff when the door to the Loading Bay and the door to the Receipt Space are open at the same time. Depending on the time of year the flow of external air into the Receipt Space could add significantly to cost of maintaining the internal environmental parameters.
- A wet area should be provided with toilet(s) and hands-free handbasin(s), eyewash station and paper towel dispenser. A washing machine and dryer for laundering personal protective garments could also be included in this space. The wet area should not be sited against any wall which is common to the Storage Room. This is where the first-aid box should be placed.
- Good general coverage lighting and emergency lighting in case of power failures is especially important if there are no windows or skylights letting in natural light.
- Electrical power points spaced around the walls and either in the floor or suspended from the ceiling allow the use of specialised lights, such as UV lamps, during examination of Ancestral Remains.
- A separate room within the Receipt Space should be created to house a Conservation Treatment Area and to provide a space where other activities which require isolation can be carried out. It should have a tight-fitting door with independent environmental controls and ventilation. None of the air from this room should be circulated in the rest of the Receipt Space or the Storage Room. Electrical fittings in this room should be shielded and it should have water available for a fume hood and an eyewash station.

- The Receipt Space should have either a fire suppression system or walls, floor and ceiling with a high fire rating and a VESDA detection system with back-to-base monitoring like the Storage Room.

3.6.1 *Facilities required in the Ancestral Remains Receipt Space*

The Receipt Space should include all the facilities necessary to prepare Ancestral Remains for safe, long-term storage and to manage the running of the Receipt Space and the Storage Room. These facilities include:

- a space where incoming crates containing Ancestral Remains can be held while they await processing
- benches/tables with stainless steel or marble tops where Ancestral Remains can be checked and, if necessary, laid out for assessment. These benches/tables should have adjustable height¹⁰
- benches/tables with stainless steel or marble tops where Ancestral Remains can be rehoused in Conservation-standard materials for long-term storage. These benches/tables should have adjustable height and could be the same as those used for checking if appropriate cleaning takes place
- an area or room with office workstations where Ancestral Remains can be checked against their accompanying documentation and entered into the central database. Computer terminals, the reference library, general filing cabinets, a charging station for phones and scanners and printers, including label printers should be included here
- a storage area, possibly a separate, access-controlled room, for hard copy documentation associated with the Ancestral Remains. These records should be kept in fire-proof, lockable filing cabinets and plan cabinets (some remains are accompanied by X-rays which do not fit into standard filing cabinets) and the environmental conditions in the Receipt Space would be suitable for their long-term care
- deep, powder-coated metal shelving for storing Conservation packing materials such as boxes, tissue, zip-lock bags, plastic tubs, cotton tape, etc. These could be held in a room of their own if desired (see Section 3.4 for dimensions of standard boxes), along with materials such as flags used during repatriation ceremonies
- an area where trolleys, pallet jacks and any other manually powered equipment used with the Ancestral Remains can be parked. Specialised lights and magnifiers on stands could also be held here when not in use
- facilities for photographing Ancestral Remains. The NMA does not photograph Ancestral Remains unless requested by Communities, but if a National Resting Place wishes to do so then these facilities would need to be included in the Receipt Space
- a cupboard where tools and cleaning equipment can be kept. This should be provided with power points/recharging station to enable battery-operated tools such as drills and hand-held vacuum cleaners to be recharged

¹⁰ Recently all Ancestral Remains returned to the NMA Keeping Place have been individuated. However, there have been cases in the past where remains have had to be re-associated almost from scratch. In instances where, on examination, the remains proved to have been poorly individuated, the assistance of an expert was required to clarify the situation.

- a cupboard for personal protective clothing
- fire extinguishers mounted on the walls
- an area for a container to hold contaminated waste waiting for collection. This container should be on wheels
- a freezer large enough to hold an articulated and/or mummified individual. This could be used for pest treatments or, in the case of a water emergency, to freeze and hold tissue remains or documents until they can be transferred to an external facility for drying out
- a disaster-response bin.

3.6.2 *Conservation Treatment/Isolation Room*

This room should be physically and environmentally separated from the rest of the Receipt Space. As such it can serve both for Conservation treatments, including those that require Ancestral Remains to be isolated for short periods, and as the area where the sealed cabinet(s) containing fluid-preserved remains are held long-term. These cabinets should stand on a drip tray which can accommodate the volume of fluid in the cabinet in case of spills or breakages.¹¹

The room should have the following design features:

- walls and door that close the area off from the rest of the Receipt Space
- walls with a smooth continuous surface to facilitate cleaning
- floors with a continuous surface such as welded Tarkett to facilitate cleaning. A cushioned material is desirable for the comfort of staff standing for long periods, or high-density, foam matting could be used around the benches/tables
- entry that is access controlled for entry only. Exiting should not be controlled
- shielded electrical fittings
- a window in the wall facing into the rest of the Receipt Space to allow a single staff member working in there to be seen by other staff to ensure their safety
- independent air-conditioning and ventilation. The air from the room should be vented to the outside, and no air from here should be circulated in the rest of the Receipt Space or Storage Room
- a floor drain to deal with spills.

The room should contain:

- a fume hood of a size able to hold an articulated or mummified individual
- a cabinet for UV treatment of mould. The fume hood could double for this purpose if it was fitted with a stand to hold the UV light and a black-out blind which could be drawn during treatments

¹¹ Rehousing fluid-preserved specimens requires both unusual technical skill and specialised equipment. It is assumed here that this type of treatment will not be carried out in-house. If this is not the case, then a wet-area workshop, including a water deioniser, and a perspex welding facility would need to be established along with a chemical store for new chemicals and storage space for used solution awaiting disposal.

- a stainless steel or marble topped bench/table with height adjustment
- space for one or more sealable cabinets to house Ancestral Remains held in either known or unknown fluid preservatives
- a cabinet to store protective equipment including a vacuum cleaner with a HEPA (High-Efficiency Particulate Air) filter
- a cabinet to store packaging material required to prepare Ancestral Remains for pest treatment in the freezer
- a vented chemical storage cabinet.

3.6.3 *Sterile Area*

The specifications for a Sterile Area to be used for the extraction of DNA are outside the scope of this report. Information on what is required could be provided by the Genomics Centre, the ANU, the CSIRO or the Federal Police. Given that DNA analysis is a rapidly developing field of study, the best approach at this point would be to consult those working in the field to identify what the structural requirements are for an extraction lab and incorporate these into the plans for a Sterile Area. To take advantage of the most up-to-date technological developments available, the fit-out should be left until a National Resting Place is built.

4. ONGOING CARE

If a National Resting Place is designed to hold the required environment in its Storage Room by passive means, then little ongoing mechanical maintenance is likely to be required. The exceptions are the need for maintenance of the fans for air circulation and the air intake system. As previously stated, this air intake system should be designed to be activated manually when the external conditions match those set for the Storage Room. This would ensure that air changes only take place when staff are planning to spend more than 30 minutes working in the room.

With this arrangement, there is little likelihood that Ancestral Remains will be put at risk due to funding cuts or power restrictions

Once Ancestral Remains enter the Storage Room their requirements for ongoing care are largely those of housekeeping. It is essential for their long-term wellbeing that the following programs be developed and scheduled for implementation:

- Integrated Pest Management (IPM) Program
- Vulnerable Remains Check Program
- Three-Monthly Cleaning Program
- Occupational Health and Safety Policy specifically for working with human remains (e.g. Pickering 2019).

The Conservation requirements given in this paper ensure that these programs and procedures are able to be carried out. However, their implementation is a management concern rather than a design issue.

5. BIBLIOGRAPY

American Institute for Conservation of Historic & Artistic Works (AIC) 2019, *Environmental Guidelines Wiki* ([www.conservation-wiki.com/wiki/Environmental Guidelines](http://www.conservation-wiki.com/wiki/Environmental_Guidelines)).

Australia Institute for the Conservation of Cultural Materials (AICCM) 2014, *Passive Climate Control for Cultural Institutions*, no. 7, https://aiccm.org.au/wp-content/uploads/2020/04/environ_2.pdf

Bachmann, Konstanze (ed.) 1992, *Conservation Concerns*, Smithsonian Institution Press, Washington.

British Museum 2013, *British Museum Policy: Human Remains in the Collection*, British Museum, London.

Button, Ingrid 2020, personal communication from the ACT State Manager of International Art Services (IAS).

Department for Culture, Media and Sport 2003, *Care of Historic Human Remains*, DCMS, London.

Deutscher Museumsbund 2013, *Recommendations for the Care of Human Remains in Museums and Collections*, Deutscher Museumsbund, Berlin.

Getty Conservation Institute 2018, *Conservation Perspectives: The GCI Newsletter: Collection Environments*, GCI, Los Angeles.

Grattan, David & Michalski, Stephan 2017, *Environmental Guidelines for Museums*, Government of Canada, <https://canada.ca/en/conservation-institute/services/preventive-conservation/environmental-guidelines-museums.html>

Jones, Mark 2008, 'Museums and climate change', https://www.nationalmuseums.org.uk/media/documents/what_we_do_documents/mark_jones_museums_climate_change_nov08.pdf

Kozlowski, Roman 2018, 'Collection environments and evidence-based decision making', in *Conservation Perspectives: The GCI Newsletter – Collection Environments*, The Getty Conservation Institute, Los Angeles.

Museums and Galleries of NSW n.d., 'Fact sheet: Collection storage – shelving', <https://mgnsw.org.au/sector/resources/online-resources/storage/collection-storage-shelving/>

National Museum Directors' Council (NMDC) 2014, 'NMDC guiding principles for reducing museum's carbon footprint', https://www.nationalmuseums.org.uk/media/documents/what_we_do_documents/guiding_principles_reducing_carbon_footprint.pdf

Natural History Museum 2014, *Human Remains Policy*, Natural History Museum, London.

O'Connor, TP 1987, 'On the structure chemistry and decay of bone, antler and ivory', in *Archaeological Bone Antler and Ivory: Occasional Papers Number 5*, United Kingdom Institute for Conservation (UKIC), London.

Pagliarino, Amanda 2019, 'Environmental guidelines: An Australian perspective', *AICCM Bulletin*, Australian Institute for the Conservation of Cultural Materials, <https://aiccm.org.au/conservation/environmental-guidelines/>

Pickering, Michael 2019, 'Working with human remains', internal document, National Museum of Australia, Canberra.

Reardon, Chris et al. 2013, 'Thermal mass', *Your Home*, Australian Government, <https://www.yourhome.gov.au/passive-design/thermal-mass>

Serota, Nicholas 2008, 'Museum environmental conditions in an era of energy constraint', paper presented to the Bizot Group Meeting, May 2008, [https://www.nationalmuseums.org.uk/media/documents/what we do documents/serota bizot paper_may08.pdf](https://www.nationalmuseums.org.uk/media/documents/what_we_do_documents/serota_bizot_paper_may08.pdf)

Singley, Katherine 1988, *The Conservation of Archaeological Artifacts from Freshwater Environments*, Lake Michigan Maritime Museum, South Haven, Michigan.

Tétreault, Jean n.d., *AICCM Workshop: Guidelines for Selecting Display and Storage Products*, AICCM, Canberra.

Tétreault, Jean 2009, *Products Used in Preventive Conservation – Technical Bulletin 32*, Canadian Conservation Institute, Ottawa, <https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/technical-bulletins/products-used-preventive-conservation.html>

Thompson, Garry 1990, *The Museum Environment*, 2nd ed., Butterworth-Heinemann, London.

APPENDIX 1 – Types of Ancestral Remains in the NMA Store by percentage of total holdings

These are arranged by the number of individuals they represent. An individual could be represented by anything from a full skeleton to a single bone. The percentages are indicative only and have been rounded up.

Post-cranial remains, not articulated (large)	46%
Post-cranial remains, not articulated (small)	20%
Casts	15.5%
Skull, cranium and calvarium	15%
Hair samples	2%
Skeleton, not articulated (complete or nearly complete)	1%
Skull, cranium, calvarium, mandible and some unarticulated post-cranial remains	1%
Mummified remains (head, individual limbs)	0.2%
DNA samples (related to individuals)	0.2%
Fluid preserved remains	0.2%
Skeleton, artificially articulated (complete or nearly complete)	0.1%
Mummified remains (complete or nearly complete)	0.1% (all are infants)
Commingled remains (small)	0.1%
Commingled remains (large)	0.1%
Unidentified skeletal elements	0.04%
Post-cranial remains, artificially articulated	0.04%
Objects incorporating Ancestral Remains	0.04%
Sorcery objects incorporating Ancestral Remains	0.04%
Burial packages	0%
Blood samples	0%
Histology slides	0%