

Animal Research Review Panel

Guideline 18

Revised November 2023

Guidelines for the Care and Management of Rabbits in Scientific Institutions

Contents

Definitions.....	3
1 General	4
1.1 Introduction	4
1.2 Responsibilities	5
1.3 General Care of Animals in Holding, Production, Facilities, and Housing.....	6
1.4 Aspects of Rabbit Behaviour Relevant to Housing.....	7
2 Housing.....	9
3 Pen Design and Environment	12
3.1 Materials for Pens	12
3.2 Enclosure floor area and height.....	13
3.3 Enclosure Bedding and Flooring	13
3.4 Nesting Materials.....	15
3.5 Cleaning of Enclosures	15
3.6 Enclosure Shelters.....	16
4 Rabbit Care and Management	18
4.1 Management of Rabbits in Groups.....	18
4.2 Regrouping / Establishing Groups	19
4.3 Catching / Handling of Rabbits in Pens and Cages.....	20
4.4 Enrichment.....	21
4.5 Identification.....	23
4.6 Food and Water	24
4.7 Monitoring and Health of Rabbits	26
4.8 Specific Health Requirements of Rabbits	27
4.9 Breeding of Rabbits	28
5 Special Housing - Single and Double Housing of Rabbits in Cages	31

Guidelines for the Care and Management of Rabbit in Scientific Institutions

Guideline 18, 2023

5.1	The advantages of housing animals singly in cages include:	31
5.2	The disadvantages of housing animals singly in cages include:.....	31
5.3	Floor Area of Single and Double Housing of Rabbits in Cages.....	32
6	Environmental Variables.....	33
6.1	General.....	33
6.2	Light	33
6.3	Temperature	33
6.4	Humidity	34
6.5	Air Quality	34
6.6	Sound and Vibrations.....	34
6.7	Monitoring of Environmental Variables.....	35
7	Records	37
7.1	Pen / Cage Labels	37
7.2	Breeding, Health, and Other Records.....	37
	Recommendation Summary	39
	Recommended Reading and Resources	43
	References	44
	Acknowledgments	47
	Disclaimer	47

Definitions

Guideline

<i>Best Practice</i>	<p>A practice, procedure, method, or process that has been proven to be most effective in supporting and safeguarding animal wellbeing and that:</p> <ul style="list-style-type: none">• Takes into consideration the relevant aspects of species-specific biology, physiology, and behaviour;• Is based on the best available scientific evidence (or in the absence of scientific evidence, accepted good practice) which includes the potential adverse impact of conditions and procedures on their wellbeing of the animals;• Includes strategies to minimise adverse impacts.
<i>Good Practice</i>	<p>A practice, procedure, method, or process that is effective in supporting and safeguarding animal wellbeing and should be used unless there is strong justification for deviation.</p>
<i>Must</i>	<p>Use to indicate an obligatory part of the Code.</p>
<i>Required</i>	<p>Used to indicate a requirement for animal care, management, and welfare.</p>
<i>Scientific Purposes</i>	<p>All activities conducted with the aim of acquiring, developing, or demonstrating knowledge or techniques in all areas of science, including teaching, field trials, environmental studies, research (including the creation and breeding of a new animal line), diagnosis, product testing, and the production of biological products.</p>
<i>Should</i>	<p>Used to indicate a strongly recommended component of the Code. In some instances, a recommended component of the Code is an example of how it is anticipated that a person will meet the obligatory requirements of the Code.</p>
<i>Background</i>	<p>Science-based background information and evidence for animal housing and care.</p>
<i>Code</i>	<p>Code for the Care and Use of Animals for Scientific Purposes (2013) 8th Edition.</p>
<i>Recommendation</i>	<p>Practices that are recommended in addition to ‘<i>Standard</i>’ practices to meet best practices.</p>
<i>Standard</i>	<p>Practices that meet minimum Code requirements and/or standard good industry practices.</p>

Housing

<i>Pen</i>	<p>Housing for rabbits that allows for freedom of movement by rabbits and allows for the provision of a variety of environmental enrichment strategies.</p>
<i>Cage</i>	<p>Fully enclosed container for housing rabbits which, because of its size, restricts freedom of movement by rabbits and limits the provision of environmental enrichment strategies. Cages are usually constructed from metal or plastic, with solid or mesh sides.</p>

1 General

1.1 Introduction

Principles

- These ARRPs guidelines are intended for use by people involved in the housing and care of rabbits in scientific institutions. The guidelines are not intended to be a complete manual on rabbit care and management but rather to provide some key guiding principles on standards, good practices and best practices in rabbit care and management.
- The NHMRC 2013 (8th edition) *Australian Code for the Care and Use of Animals for Scientific Purposes*¹ (the Code) governing principles (1.1 ii & iii) clearly outlines that respect for animals must underpin all decisions and actions by supporting animal wellbeing and minimising harm, pain, and distress.
- The NHMRC 2018 *Best Practice Methodology in the Use of Animals for Scientific Purposes*² describes the requirements for best practices in research and teaching with animals, to prevent unnecessary negative impacts or use of animals, enable robust research outcomes, and maintain social license for working with animals.
- Scientific evidence strongly supports the ability for vertebrate animals to experience positive, neutral, and negative states of welfare (affective states)³. The literature also continues to demonstrate that inadequate care and negative states of welfare in animals can negatively impact research results and reduce reproducibility^{4,5}. Best practices in animal welfare are therefore paramount and foundational for regulatory requirements, ethical obligations, social license to operate, and high-quality research. The Code supports these principles (1.8-1.10).
- The guidelines will be revised from time to time to take account of advances in the understanding of rabbit physiology, animal behaviour, technological advances, and changes in community attitudes and expectations about the welfare of animals. As per the NHRMC 2018 *Best Practice Methodology in the Use of Animals for Scientific Purposes*², best practices should be used to maximise outcomes for animal welfare and scientific purposes. Strong justification and consideration are required to deviate from these practices.
- The guidelines are based on best and good practices regarding the care and management of rabbits taken from NHRMC codes, scientific literature, and veterinary experts.
- Recommended (best) and standard (good or Code) practices are outlined within this guideline where applicable.
- Where there is minimal literature, guidelines have been extrapolated based on behaviour of rabbits in the wild or similar species maintained in captivity. The information included is current at the time of writing. Those involved in the care and use of animals for scientific purposes are expected to maintain current best animal care and management practices.
- It is expected institutional animal care and management plans are reviewed at least annually. As standards improve and new literature arises, this information should be incorporated and implemented into animal care and management plans.

- The information in this document addresses some of the key housing requirements of the Code (3.2.13-3.2.16). The requirements of the Code include that animals held for scientific purposes should have their species-specific behavioural and physical needs met, whilst at the same time ensuring that the animals can adequately be monitored, protected from disease, and considering the requirements of animals in all scientific purposes.
- To further support the requirements of the Code, a program of veterinary care (2.1.5iv & 2.5.14), training and competency (1.29), adverse event management (2.1.5, 3.1.1 & 3.1.24), an emergency animal care plan (2.1.5), standard operating procedures or similar (2.2.33-36), complaints process (5.4-5.12), and animal welfare policies (2.1.2, & 2.1.5iv), should be developed in conjunction with appropriately trained veterinary and similarly qualified animal welfare experts (2.5.14). The AEC should be consulted and must approve standard operating procedures (2.2.5v & 2.2.33-36).
- All monitoring, recording and care activities should be undertaken in a manner that demonstrates and ensures compliance with approved animal ethics committee projects and regulatory requirements. Monitoring records with animal or room checklists and relevant emergency contacts should be easily accessible to ensure continuity of animal care to animal carers, researchers, AEC members or auditors.
- Prompt detection and management of any animal welfare, care, management, or similarly related issues are required.
- While these guidelines focus on the welfare of rabbits, the provision of good practices in housing, husbandry, conditions, and care that provide for the environmental, physiological, physical, behavioural, and mental animal welfare requirements of animals is foundational to robust quality scientific outcomes⁴.

1.2 Responsibilities

- As per the Code, respect for animals must underpin all decisions and actions involving the care and use of animals for scientific purposes (1.1).
- Institutions, researchers, teachers, animal care staff and facility managers must ensure all involved in the care and use of animals understand their responsibilities and Code requirements as well as have the necessary skills, competency, knowledge and access to education and resources for best practices. This should include biosecurity, housing, husbandry, care, monitoring, managing adverse impacts on animal welfare, managing adverse events with necropsies and minimising harm, pain, and distress (2.1 – 2.5.17iii).
- Veterinarian care and advice must be available with oversight provided by a qualified competent veterinarian for the program of veterinary care (health, husbandry general care, preventative care, emergency care and biosecurity), quality management and project design (2.1.5iv & 2.5.14).
- Further information can be found in sections for institutions (2.1 & 2.2), animal ethics committees (2.3), investigators (teachers and researchers 2.4), and animal carers as well as animal facility managers (2.5).

1.3 General Care of Animals in Holding, Production, Facilities, and Housing

- Under sections 3.1 and 3.2, animal accommodation should be designed and managed to meet species-specific conditions and requirements, suitable for the species, and achieve high standards of animal care. Variations to these requirements must receive prior AEC approval. Animals should also have additional appropriate monitoring and veterinary oversight during these periods of time.
- Animals must be checked daily with clean, fresh drinking water available at all times.
- Pens, cages, enclosures, and containers must be constructed and maintained to a high standard to ensure animal wellbeing and comfort. The following factors should be considered:
- Species-specific behavioural requirements, including the availability and design of space to enable free movement and activity, sleeping, privacy, contact with others of the same species, and environmental enrichment⁶;
 - provision of single housing for animals when appropriate for the species and if necessary for the purpose of the project (for example, during recovery from surgery or collection of samples);
 - species-specific environmental requirements, such as lighting, temperature, air quality, appropriate day/night cycles and protection from excessive noise and vibrations;
 - the need to provide ready access to food and water;
 - the need to maintain cleanliness;
 - protection from pests, predation and disease;
 - requirements of the project;
 - the need to observe the animals readily; and
 - facilities must be appropriately staffed, designed, equipped, constructed, managed, and maintained to achieve high standards of animal care and suitable for the animals and activities undertaken.
- Facilities, pens, enclosures, cages, and containers must:
 - be constructed of safe, durable materials;
 - be kept clean, tidy and free of noxious odours;
 - be maintained in good repair;
 - be secure and escape-proof;
 - protect animals from adverse environmental conditions and other mitigable adverse risks;
 - not cause injury to animals;
 - be large enough for the species and the number of animals held; and
 - be compatible with good animal welfare requirements or any other special requirements of the species.

- The population density of animals within cages, pens, enclosures or containers and the placement of these in rooms must be such that acceptable social and environmental conditions for the species can be maintained.
- Where it is necessary to individually house animals of a species normally kept in a social group or environmental conditions, the conditions must be managed to minimise the impact of social isolation or any environmental deviations. Animals must be housed in these circumstances for the minimum time necessary.
- Bedding and litter are required to be provided if appropriate to the species and should be comfortable, absorbent, safe, non-toxic, sterilisable if needed, and suitable for scientific or educational aims. Pregnant animals that nest must be provided with appropriate nesting materials and any other species-specific housing requirements.
- The Animal Ethics Committee, relevant investigators or teachers and an appropriately qualified veterinarian are to be informed in advance of planned changes to these conditions since these may affect the welfare of animals and the results of the scientific and teaching activities.
- Any project or activity that precludes or deviates from good animal care, management and housing conditions must have special ethical consideration by the AEC, be specifically AEC approved (3.1.6 & 3.2.13) and is required to be reviewed by an appropriately qualified veterinarian. This includes single housing for social animals (3.1.12). Additional mitigation and monitoring strategies should be applied. Animals that demonstrate signs of welfare compromise should be removed from study and/or housing (3.1.19ii & 3.2.12).

1.4 Aspects of Rabbit Behaviour Relevant to Housing

Background

- All rabbits derive from the European rabbit (*Oryctolagus cuniculus*). The behaviour of laboratory rabbits is similar to that of wild rabbits⁷⁻¹⁰.
- Wild rabbits are prey species that are naturally gregarious and live in breeding groups. Within each group there is a linear dominance hierarchy for each sex. Social rank within each group is established by physical fighting or confrontations (e.g., chasing) between individuals^{8,9,11}.
- Studies have shown that, given the opportunity, laboratory rabbits prefer to be together, spending about 79% of their time in each other's company¹²⁻¹⁵. Amicable behaviours when together include lying near each other, grooming each other and nuzzling¹⁰. Social interaction is therefore important for rabbits¹².
- Rabbits practice coprophagy to maintain gastrointestinal and general health. Soft, nitrogen rich faeces derived from the caecum are re-ingested almost immediately after being passed, usually at night¹⁶.
- The natural active behaviours of rabbits include foraging, hopping, running, chasing, playing, grooming, sitting up with ears erect, rearing, leaping, and digging^{9,12,17}. Periods of rest lasting several hours alternate with periods of activity. Juveniles will engage in leaping, running, and chasing during play and will climb onto or jump over low or high obstacles in their enclosure.

- The provision of hay *ad libitum* in the diet has been shown to substantially reduce negative behaviours and health issues in rabbits^{18,19}.

Standard

- 1.4.1 To meet Code and animal welfare requirements (i.e., to provide accommodation that meets the species-specific needs of rabbits), housing should be provided which allows rabbits the opportunity for social interaction, the opportunity to carry out normal behaviours such as hopping and rearing upwards (freedom of movement) and the opportunity to rest and withdraw from each other.
- 1.4.2 The Code recognises there may be circumstances where the requirements of experimental procedures may preclude meeting some species-specific needs under special AEC consideration and approval. Housing in these situations should still meet the physiological and psychological needs of rabbits as closely as possible.
- 1.4.3 The provision of ad lib hay is widely recognised as required to maintain and prevent health issues in rabbits¹⁸.

2 Housing

Background

- Group housing in floor pens is preferred as they facilitate the use of a deep litter type bedding system with a greater floor space which is often more suitable and recommended for animal welfare requirements.
- When rabbits are housed in cages or small enclosures, they should have regular frequent access to floor playpens to mitigate some of the issues associated with animals housed in cages or small enclosures^{20,21}. When scientific work precludes the keeping of rabbits in floor pens or utilising playpens the impacts on animal welfare must be considered and appropriately mitigated.
- Advantages of housing rabbits in groups in pens include:
 - Housing in pens provides increased space which allows rabbits freedom of movement to carry out normal activities such as hopping, stretching out, sitting up with ears erect, rearing, and leaping. Physical and psychological well-being is assisted by the opportunity to exercise and explore a complex environment^{12,22}.
 - Rabbits are social animals that benefit from the company of others²³. Housing rabbits in groups in pens allows for social interaction and behaviours such as grooming penmates, lying together and playing^{12,24,25}. The behavioural repertoire of group housed rabbits is more varied compared to that of singly housed rabbits²⁶.
 - Pens provide a greater opportunity than cages for the environment to be enriched and made more behaviourally stimulating (for example by the addition of ledges for climbing on and areas for retreating into)^{24,26}.
 - Costs of setting up pens and maintaining rabbits in pens may be less than for buying cages and maintaining rabbits in cages. Cost savings may be made in the areas of bedding, cleaning agents, maintenance, energy, and labour²⁴.
 - Health advantages include that sore hocks (pododermatitis) and gastrointestinal hair balls (trichobezoars) are rare in penned animals^{9,10,12}. The incidence of respiratory diseases such as Pasteurellosis (“snuffles”) may also be reduced, possibly because of better ventilation than solid walled cages. Thinning of the bones of the femur and spine because of inactivity may be seen in caged rabbits. This can result in a loss of ability to move normally, fractures, spinal distortions, and discomfort from trapping nerves in the spine^{24,27}. There is no evidence of such thinning of the bones, with its attendant complications, occurring in rabbits in pens.
- Disadvantages of housing rabbits in groups in pens include:
 - As with any group housing, fighting, and bullying may occur, especially in mature entire males^{10,24,28}. The grouping of rabbits may become unstable – there may be difficulties in reintroducing a rabbit that has been removed for even a short time. Fighting and aggressive behaviours may result in severe injuries and stress responses in subordinate animals.
 - Rabbits may be more difficult to catch in pens, however this can be mitigated with adaptation of procedures, appropriate use of the enclosure and training.
 - The volume of bedding disposal may be increased.

- Vertical space may be reduced.
- Some types of experimental work may require cages.

Standard

- 2.1 Good biosecurity, quarantine and animal care principles are required for the housing of animals. Facilities should have areas for quarantine, management of treatment of sick animals and provision of additional enclosures for emergency purposes and/or during cleaning²⁹.
- 2.2 Regular sanitation using water and aqueous cleaning agents and disinfectants should be used and will be required for all types of housing arrangements.
- 2.3 Housing arrangements should use of floor pens. Other options under special circumstances can include the use of floor pens or metal, or plastic cages mounted on shelves or in fixed or mobile racks.
- 2.4 Rabbits require housing in stable group floor pens and should be housed accordingly.
- 2.5 Pens should be run as an all-in and all-out basis with full decontamination between groups.
- 2.6 Where this is not possible, incoming animals should be quarantined, introduced in pairs along with additional enrichment and monitored closely to ensure prompt management of any issues.
- 2.7 Rabbits that cannot be housed in groups (e.g., intact males or for experimental reasons) should be housed in pens with olfactory, visual and, if possible, physical contact with adjacent rabbits.
- 2.8 Rabbits should only be housed in cages with strong justification, special approval and ethical consideration from the Animal Ethics Committee based on compelling evidence. In such cases, cages should be enriched by methods as described in this document (such as pair housing in double cages and availability of playpens). Lack of space or facilities for pens must not be considered sufficient justification for the use of such cages.
- 2.9 Rabbits should not be housed singly in conventional (unenriched) cages except in exceptional circumstances and with strong justification, special approval and ethical consideration from the Animal Ethics Committee based on compelling evidence. Lack of space or facilities for pens should not be considered sufficient justification for the use of conventional cages.
- 2.10 A high level of stockpersonship in caring for and monitoring rabbits is required. Animal carers, investigators and teachers should be proficient in recognising all aspects of rabbit behaviour to ensure welfare, health and social interaction can effectively be monitored³⁰.
 1. Security barriers and appropriate alarms must be in place to prevent unauthorised entry and or escape of animals.
 - 2.
 3. Appropriate firefighting and fit for purpose fire alarm systems and out of hour alerts must be in place.
 4. Appropriate fit for purpose alarm systems and out of hours alerts must be in place for heating, cooling, and ventilation.

Recommendation

- i. Slower introductions are recommended when introducing or re-introducing rabbits into their groups or pairs.

3 Pen Design and Environment

3.1 Materials for Pens

Background

- A variety of materials may be used, depending on the design of the pen. For example, the pen may occupy a whole room or be adapted from plastic bins made for other purposes or from pens for larger animals^{9,26}. Materials for pen walls may be solid (for example plastic) or be open weave (for example wire mesh) and opaque or transparent/translucent. Opaque solid walls between pens have the advantage of providing additional areas for shelter/privacy, but the disadvantages, as with all solid walls, of restricting air flow and of restricting vision of surroundings.

Standard

- 3.1.1 Enclosures should accommodate the animals' animal welfare requirements including requirements for shelter and retreat from view, particularly in breeding colonies³¹.
- 3.1.2 The front of any enclosure should allow a view of other rabbits in adjacent pens and people approaching to reduce fear responses.
- 3.1.3 A solid floor with a suitable high quality bedding substrate should be used.
- 3.1.4 The floor space for rabbits should incorporate open spaces interspersed with shelter to allow animals to retreat and hide. Temporary covers such as piles of hay, straw, or wood wool as well as permanent shelters such as plastic or timbers and sections of PVC or similar pipe can be used. Hay and other natural products may require additional treatment or precautions where animals must maintain a specific pathogen free status or are immune compromised.
- 3.1.5 The materials from which an enclosure is constructed should incorporate sufficient floor space for the number of animals, should be able to be cleaned and serviced safely and efficiently. Materials for the construction of enclosures are to be strong and water-resistant.
- 3.1.6 Materials used in the housing of animals must be non-toxic, easy to clean or dispose of, and where used, made from non-aromatic wood (e.g., aspen not pine). Sawdust should not be used.
- 3.1.7 Stainless steel can be used but galvanized steel and other metals should be avoided.
- 3.1.8 Rabbits should only be housed in rooms containing other herbivores. It is inappropriate for rabbits to be housed within sight, scent, or audible range of predators.
- 3.1.9 If predators are housed within the same facility, personnel must ensure that clothing & footwear are changed, and hands thoroughly cleansed, before moving between predator and prey species, to avoid undue stress.

Recommendations

- ii. Workflows should be arranged so that prey species are managed before predator species.
- iii. Rabbits should only be housed in single species rooms.

3.2 Enclosure floor area and height

Background

- The provision of sufficient floor space is essential to the well-being of the animals.
- The minimum space provided should allow each rabbit to carry out its normal behaviour, including a wide range of locomotory behaviours, such as hopping, leaping, playing, exploring, and stretching out.
- Normal behaviours of rabbits also include rearing up on their hind legs and sitting up erect with their ears pricked¹². Rabbits commonly sit on top of objects and the minimum height provided should allow for this behaviour. The minimum height provided should allow rabbits to carry out these behaviours. Rabbits can jump very high and may use objects within a pen as “launching pads” to jump out of pens.
- Overcrowding rabbits can cause stress, physiological and immunological changes, decrease reproduction and increase abnormal behaviours such as hair chewing or overgrooming^{32,33}.
- Inappropriate housing can impact animal welfare and experimental outcomes^{5,34}.

Standard

- 3.2.1 The minimum space provided should allow rabbits to complete at least 3 hops in one direction³⁵.
- 3.2.2 Height of enclosures should be 1.5m uncovered and 1.25m covered as well as allow entry of staff.
- 3.2.3 Floor areas that should be used are outlined below. They should ensure a clear area of 2.5m² with a minimum length in one direction of 2.5m:
- 3.2.4 Breeding pair with unweaned litter – 3m² with each additional breeding female with unweaned litter +1m² with a maximum recommended ratio of 1:5 (M:F)
- 3.2.5 Non-breeding rabbit single 2.5m²
- 3.2.6 Non-breeding rabbit pair 3m² with each additional rabbit 0.8m²
- 3.2.7 In addition to meeting minimum space requirements for movement, space should be provided to allow the provision of structural complexity and environmental enrichment in pens. For example, additional space should be provided to accommodate objects such as boxes and pipes, which provide rabbits with retreat/hiding areas.

Recommendation

- iv. Enclosure shapes should maximise effective use of floor space.

3.3 Enclosure Bedding and Flooring

Background

- Bedding ensures a clean, dry, comfortable lying area. In addition, it is desirable for it to be cheap, readily available, and easy to use and dispose of.

- Rabbits can be litter box trained. Several and sufficient litter boxes will be required to ensure they are used by all rabbits and to prevent resource guarding. Litter boxes can be filled with various substrates such as paper-based pellets or similar rabbit safe materials.
- Wire mesh flooring is inappropriate and can cause injuries such as pressure neuropathy, increased risk of hair loss, foot pad ulcers and dermatitis, decreased breeding activity and slower weight gain.
- Animals used in experiments involving the disruption of innervation to the distal limb require special care^{36,37}. These animals can struggle with their mobility and are at a high risk of developing injuries to the lower limbs and feet.

Standard

- 3.3.1 Bedding should be dust free, free of microbial or parasitic contamination, non-toxic, ammonia binding, non-traumatic and moisture absorbent³⁸. Bedding should be treated, when possible, to remove entrants of disease (e.g., autoclaved).
- 3.3.2 Suitable substrate for bedding in rabbit enclosures includes hay, straw, shredded paper, pelleted paper, and wood shavings and non-aromatic wood shavings (e.g., no pine)³⁹.
- 3.3.3 A depth of at least 5cm should be used for straw and hay and is ideal for all bedding. A depth of at least 3 cm is to be used for shredded paper with a base of paper or newspaper at the bottom. Other substrates are also to have a minimum depth of 3cm.
- 3.3.4 Hay and straw should be of high quality to avoid grass awns and other undesirable elements.
- 3.3.5 Sawdust should not be used as a primary bedding.
- 3.3.6 Where appropriate a layer of higher absorbency of bedding of 3cm can be overlaid with a top layer of straw and hay. This can offer good absorbency and the ability for animals to nibble and manipulate substrate.
- 3.3.7 Floors in rabbit enclosures should be solid to assist normal toenail wear and obviate the need to trim toenails.
- 3.3.8 Enclosures with wire mesh floors should not be used for the housing of rabbits.
- 3.3.9 Where the use of mesh flooring is specifically approved by an AEC based on compelling scientific evidence, the mesh used must provide adequate footing for the animals. Perforated plastic or perforated stainless steel floors should be used. All types of mesh or perforated floors must have a solid area for resting that can accommodate all animals in the enclosure.
- 3.3.10 Additional support in the enclosures housing animals with distal limb issues or mobility issues should be used. Items such as rubber matting with deep litter can be used. Additional monitoring should be required for these animals.

Recommendation

- v. Hay and straw should be used as they have the added benefit of being a substrate animals can safely ingest and nibble.
- vi. Rabbits are encouraged to be litter box trained and there should be multiple litter trays available within an enclosure.

3.4 Nesting Materials

Background

- The provision of appropriate nesting materials is an important requirement for rabbits, especially for female breeding rabbits that will construct and build nests for their young.

Standard

- 3.4.1 All animals should be offered additional substrate and nesting materials to offer opportunities for enrichment and expressions of natural behaviours.
- 3.4.2 Female breeding rabbits must have a comfortable substrate and a secure shelter or retreat where they can give birth to encourage natural nesting and reproductive behaviours.

3.5 Cleaning of Enclosures

Background

- Rabbits in pens will typically have a toilet area. They will urinate and defaecate in one corner or area, although faecal pellets may be scattered with the movement of rabbits in the pen.
- To avoid the need to remove the rabbits from their pen and thus reduce the disturbance to the animals, floor pens may be temporarily divided at cleaning time, with the animals herded into one side, behind a removable partition, while the other side is cleaned.
- A balance needs is required between human perception of the need for cleanliness and the level of disturbance to rabbits. Smell is very important to rabbit social interactions related to sex, age, reproductive status, individual identity, hierarchy, and mother/young relationships.

Standard

- 3.5.1 Daily spot cleaning and of the toilet area and/or litter tray should be done in between complete weekly bedding changes. Full bedding changes must be done every two weeks unless an AEC and veterinary exemption is in place due to extenuating circumstances.
- 3.5.2 In the rare circumstances where cage trays are utilised for slatted, mesh or perforated floors, they must be cleaned and emptied daily.
- 3.5.3 Enclosures should be washed and disinfected with an odourless disinfectant at least every month.
- 3.5.4 Enclosures must be fully cleaned with an odourless disinfectant every time a room is cleared, and new stock is brought in. All substrates and objects should be removed, cleaned with a bacterial/virucidal disinfectant e.g., quaternary ammonium compound (F10, Virkon) allowed to soak before wiping clean, then thoroughly dried prior to replacing bedding and any objects.
- 3.5.5 More frequent cleaning may be required as needed to ensure appropriate cleanliness.
- 3.5.6 Humans typically smell ammonia at 8-10ppm which indicates levels of ammonia are too high for animals.

3.5.7 Concentrations of ammonia must not exceed 10ppm.

Recommendation

- vii. Concentrations of ammonia should be less than 1-2ppm.

3.6 Enclosure Shelters

Background

- The degree rabbits will utilise the space provided to them depends on the provision of shelters and retreats to which they can retire to rest or when a threat is perceived. Extensive open space in an enclosure will generally be avoided by the animals if there is no shelter close-by. In the absence of shelter, the animals tend to utilise the space on the periphery of the enclosure, resting and sleeping close together next to the walls. When adequate shelter is provided, use of the space develops over time until it is fully utilised⁴⁰.
- Permanent shelters can be made from a variety of materials. Shelters can be made from:
 - Pieces of straight, angled, Y section or T section of sufficient diameter PVC or similar water pipe with smooth edges. Plastic pipe has the advantage that it can be readily cleaned and disinfected²⁶.
 - Pieces of larger diameter pipe cut lengthways yield two semicircular sections that can be inverted to create tunnel shelters.
 - Clean, recycled plastic drums cut down if necessary and with a suitable hole cut in the side.
 - Clean, recycled cardboard with at least 2 suitable holes cut in the sides.
 - Purpose built boxes made of plastic, exterior grade plywood or timber.
 - Some establishments use boxes fitted with a floor, a top opening lid and two sliding doors across the access hole in the side, which allows the staff to capture animals quickly and easily when necessary and facilitates the handling of individuals for examination or treatment⁴¹.
 - Temporary shelter can also be provided with biscuits of hay heaped in the enclosure. Rabbits will play and tunnel through the hay and gradually eat the leafy material and trampling the stalks. The continuous provision of hay also prevents behaviour problems such as hair damage due to barbering and assists normal tooth wear.

Standard

- 3.6.1 All pens and cages should have shelters and hiding places for rabbits. Lack of space or facilities must not be considered sufficient justification for the absence of shelters.
- 3.6.2 Permanent shelters must have at least 2 holes for exit/entry and where appropriate multiple holes drilled along the top to promote ventilation and prevent smothering.
- 3.6.3 Shelters must be replaced and/or cleaned as they become soiled or damaged and when enclosures are cleaned and disinfected between groups of rabbits.

- 3.6.4 Wood must not be treated with an insecticide or fungicide and have an impervious, non-toxic finish that can be cleaned effectively.
- 3.6.5 Hay should be regularly replenished to maintain its value as a feed supplement and shelter. Mouldy or dirty hay must not be used⁴².
- 3.6.6 Animals should be regularly monitored for ocular discharge, blepharospasm and other ocular abnormalities that may indicate a hay or straw poke injury to the eye.
- 3.6.7 Sufficient shelter should be provided to avoid resource guarding or other similar issues.

4 Rabbit Care and Management

4.1 Management of Rabbits in Groups

Background

- The success of group housing rests largely on the skill and enthusiasm of the animal carers.
- It is very important to keep the composition of a group stable.
- Although rabbits are social animals, some breeds and individuals are more aggressive than others. However, a stable group of rabbits cannot be guaranteed by selecting less aggressive breeds. The occurrence of aggression, and the severity and outcome of such encounters, can be difficult to predict.
- It is best to establish groups of rabbits when they are young (around the time of weaning), and at least before they reach puberty (which may begin as early as 2.5 months of age). Ideally littermates should be used, although separate litters of similar age can be grouped. Large weight or age differences can result in aggression.
- Mature entire sexed male rabbits fight which can result in severe injuries¹⁰. After about 3 – 4 months of age it is unsafe for entire sexed male rabbits to be housed together as the outbreak of severe aggressive encounters is difficult to predict and may occur without warning¹⁶.
- If animals are desexed they can be carefully housed together but it is still advised to keep siblings together if possible. Injectable chemical (e.g., suprelorin) and surgical desexing are both available options for rabbits.
- Some individuals may be highly aggressive. In such cases it may be necessary to remove the dominant or subordinate rabbit temporarily or permanently and re-house with another compatible rabbit²⁴.
- It is important that all rabbits are provided with sufficient space and objects to assist them to escape and hide from aggressors. Objects such as boxes, pipes, ledges, and vertical barriers provide means for hiding and escape.
- To ensure that individuals can be adequately monitored for signs of ill health or bullying, group sizes should not exceed 8 rabbits with the exception of kits/juveniles with does/dam. Limiting group numbers also avoids high stocking densities and overcrowding⁴³.

Standard

- 4.1.1 Carers must be able to monitor and assess rabbit behaviour and implement management strategies accordingly.
- 4.1.2 Males can be housed in groups until they reach 3 months of age⁴⁴.
- 4.1.3 Entire mature sexed animals should not be mixed (apart from breeding groups).
- 4.1.4 If desexing is to be performed, it should be performed as early as possible and ideally before 10 weeks of age.

- 4.1.5 Sufficient objects and shelters should be provided to eliminate competition for any items or resources within enclosures, to enable rabbits to escape from aggressors and offer sufficient spaces to hide.
- 4.1.6 No more than 8 rabbits should be housed together as numbers larger can create difficulties in developing and maintaining a stable hierarchical system. Groups should be between 4-6 rabbits.

4.2 Regrouping / Establishing Groups

Background

- Bonds exist between rabbits to provide security and health-promoting effects. The severing of these bonds by the isolation of individuals has measurable physiological effects, with potentially deleterious outcomes for the welfare of rabbits. The maintenance of a familiar environment and provision of visual, olfactory, and auditory contact with familiar cohorts reduces the stress associated with individual housing and reintroduction to the group. These effects may also confound experimental outcomes if not considered during the experimental planning.
- In situations where a rabbit must be removed from its social group for individual treatment, the housing of a familiar companion animal with the treated animal will help reduce the effects of stress caused by separation. Techniques like placing scented bedding or objects from pen mates into enclosures can also be useful.
- It is possible to regroup rabbits, but this requires particular care and intensive monitoring. It is important that rabbits are placed in a fresh neutral area to avoid home territory for any animals. Additional measures include:
 - Providing hiding places and breaking up clear areas so that rabbits can escape from each other;
 - Placing wire partitions between pens to allow familiarisation between rabbits before they are mixed which may take a prolonged period over several days to weeks;
 - Scattering faecal pellets and urine-soaked litter from each rabbit in the new pen;
 - Scattering food in the new pen to encourage foraging;
 - Having the usual carer handle rabbits together in small groups in a different pen before mixing;
 - Consider “faux transporting” the rabbits together for short period of time in a transport container before transferring to a new pen. This can sometimes help facilitate bonding.
- Moving rabbits from cage housing to pens can present specific problems. Rabbits housed in cages for 6 months or more are prone to fighting (due to lack of social experience) and bone fractures due to osteoporosis²⁴. Methods to assist group housing such animals in pens include slowly increasing daily periods of exercise individually and then in small groups. Then housing the animals in the group pen during the day and individually in cages at night and finally fully housing in the group pen.

Standard

- 4.2.1 If a protocol is approved by the AEC requires individual housing, provision must be made for visual, auditory, and olfactory contact with other rabbits.
- 4.2.2 Where individual rabbits need to temporarily be separated from a group, they should be housed so that visual contact between the individual and the group can be maintained. This helps to ensure that they will be readily recognised and accepted as familiar members of the group when returned.
- 4.2.3 Carers must be vigilant and should increase monitoring to identify signs of fighting or incompatibility. Groups may become unstable and may require the removal of individuals.
- 4.2.4 Rabbits should not be raised or housed in isolation. If required under special ethical consideration and approval with strong justification and compelling scientific evidence then additional monitoring, care, and independent veterinary oversight must be required.

Recommendation

- viii. If a single animal will remain for a period of time after cohorts have been removed from a treatment group, then wherever possible a compatible companion should be provided. This could be an already desexed adult male or female guinea pig. Chemical desexing is an option for companions which are excess to colony requirements is also a potential option. Surgical desexing of animals for the purposes of companionship should not be undertaken.
- ix. Animals should be removed in pairs and returned in pairs to the larger group whenever possible.

4.3 Catching / Handling of Rabbits in Pens and Cages

Background

- Rabbits are highly sensitive to human activity and sounds in the animal room. It is very important to approach the animals and perform husbandry tasks with due empathy to avoid startling them.
- A quiet approach should be taken. Rabbits will usually retreat to a darkened hiding place from where they may be picked up. The careful and appropriate use of purpose-built shelters to catch rabbits can be utilised.
- Rabbits show a reduction in fearfulness to handlers after repeated positive approach and handling⁴⁵. The use of good handling and approach programs may help reduce general emotional, physical and physiological reactivity⁴⁶ (not just fear of humans) and strengthen the human-animal bond. Positive reinforcement, training and treats are important components of these programs.
- Pens may provide room to escape and catching rabbits in pens may be difficult when the appropriate strategies have not been implemented. Anticipation of catching and procedures can play a major role in a rabbit's behaviour.
- Inappropriate handling of rabbits can risk fractures of the legs and spine when struggling to escape.

Standard

- 4.3.1 Rabbits should be handled regularly from a young age to facilitate training and acclimatisation.
- 4.3.2 Rabbits should be given training and acclimatisation (operant conditioning) to facilitate ease of animal care and experimental procedures.
- 4.3.3 Animal carers should also spend time with the rabbits, and employ training techniques, treats and other methods which will facilitate catching. Rabbits should be positively and routinely handled from a young age to facilitate catching and handling.
- 4.3.4 Steps should be taken to reduce the stress of procedures and to catch and handle rabbits without conducting other procedures⁹.
- 4.3.5 Handlers should be experienced and confident approaching and lifting rabbits and hold them in the species-specific way to reduce stress-related injuries. Rabbits must be handled with care with their hindlegs supported, an arm under the body and the head under the handlers opposite elbow or arm. Pregnant females require additional care and support during handling.

Recommendations

- x. Rabbits should be trained to accept procedures (e.g., oral administration of an antibiotic solution) with minimal or no restraint when given positive reinforcement (e.g., drug delivered in a sugar-coated syringe after a period of training by administering a sugar solution)⁴⁷.

4.4 Enrichment

Background

- The aims of environmental enrichment are not simply to prevent distress or negative experiences⁴⁸, but to offer the potential for positive experiences and to achieve optimum outcomes of experimental work through the application of accepted good animal welfare practices in animal husbandry and care.
- The implementation of strategies to provide environmental enrichment for rabbits should be regarded as a fundamental requirement for rabbit care and management.
- Environmental enrichment strategies will extend over all facets of rabbit housing from pen design to food provision, opportunities for social contact and the provision of objects for manipulation.
- There is a wealth of information on enrichment for animals available through various lab animal networks, literature, and websites which should be utilised. The recommendations listed below are only a small list in addition to other recommendations throughout the document which contribute to enrichment of a rabbit's environment.
- Enrichment gives animals a creative outlet for physical activity and mental exercise, as well as choice and control over how they spend their time. Enrichment should stimulate all 5 senses and have motor, sensory, cognitive, and social stimulation components.

- The recommendations listed below are only a small list in addition to other recommendations throughout the document which contribute to enrichment of a rabbit's environment:
 - Social interaction: Housing rabbits in compatible social groups
 - Chewing / gnawing: small blocks of softwood, seagrass mats, palm tree woven ball, apple/pear branches, hay, and straw¹⁸. Animals that are routinely provided with softwood sticks usually do not attempt to gnaw fittings such as food hoppers in their enclosure¹⁷.
 - Locomotion (including jumping, exploring, and playing): Hay biscuits or a hay rack positioned just above the floor; open space interspersed with shelters and multiple levels that encourage rabbits to use the available floor space.
- Resting / hiding: Shelters in the form of PVC or similar pipes, timber, plastic or metal boxes, clean plastic drums or cardboard boxes with holes cut in the sides, and bedding materials¹².
- Providing rabbits with enrichment via penmates¹⁴ or proximity to penmates, and items to manipulate triggers species-typical behaviours, reduces stereotypical behaviours, results in increased activity, and improves animal welfare and experimental outcomes⁴⁹.
- Rabbits like to sit on elevated areas such as ledges and nest boxes.
- It is important for rabbits to be able to hide and to get away from each other.
- Rabbits like to play, manipulate, and chew hay, straw, and various objects.
- Safety and risk assessments are important components of housing and environmental enrichment⁵⁰.

Standard

- 4.4.1 In accordance with the requirement of the Code, accommodation (housing), physical and social environmental conditions to meet should species-specific requirements (3.2.13).
- 4.4.2 All animals are to be provided with enrichment as a standard requirement for animal welfare and care. AEC specific approval with veterinary oversight for any exemption of any enrichment should be under careful consideration and strongly scientifically justified (3.2.13). Exemptions may also be needed when animals are unwell and under veterinary advice and care.
- 4.4.3 The suitability of items for enrichment must be critically assessed to ensure that the strategies improve and are not detrimental to animal welfare.
- 4.4.4 Rabbits should be provided with non-toxic rabbit-safe objects to manipulate and gnaw such as wooden sticks, cardboard boxes, seagrass or hay-based matting, non-toxic branches (e.g., fruit trees like apple, pear, plum) with leaves and small cardboard boxes.
- 4.4.5 If kept in cages, rabbits should be taken out of cages on a regular basis for handling/petting and exercise in a play pen⁵¹. Lack of space or facilities for playpens should not be considered sufficient justification.
- 4.4.6 Some materials, such as some plastics, treated wood, galvanized, or painted materials, may be dangerous because of their toxicity when chewed and must not be used.

Recommendation

- xi. Rabbits should have elevated areas placed 20-30cm from the floor and managed appropriately to prevent rabbits from jumping out of enclosures.
- xii. A rotating enrichment program and plan should be implemented, regularly updated, and reviewed annually.
- xiii. A variety of food should be provided. Food may be spread out in the bedding to encourage foraging behaviour.
- xiv. To reduce negative impacts to physical and physiological health including the relief of boredom, all rabbits should have access to larger, complex floor pens to assist in providing the opportunity for exercise, enrichment, and better health.

4.5 Identification

Background

- Identification and recording of animals are required for good regulatory, management and experimental practices. Methods of identification vary and can include but are not limited to:
- Coat colour and pattern with photos are useful for the identification of individuals in some breeds of rabbits.'
- Dyes including non-toxic animal safe permanent wool dyes, agricultural sheep sprays/crayons may be used. These need to be reapplied at intervals, as the dye fades or the rabbit moults.
- Xylene free permanent markers may be used on ears and fur. Generally, these need to be refreshed every 3 weeks²⁴. The use of these markers on the inside of the ears is effective and different colours can be used for coding.
- Fur clipping may be used but needs to be carried out frequently.
- Microchips and ear tattoos may be used for permanent identification⁵². Note there is transitory pain associated with applying these forms of identification. Microchips can be inserted from 6 weeks of age.

Standard

- 4.5.1 Rabbits should be individually identifiable and be the least invasive method of identification should be used that is compatible with the project (2.4.18iv).
- 4.5.2 Methods of identification should be non-invasive, cause the least amount of harm, distress, and pain to animals (3.3.6) and not likely to catch or tear out.
- 4.5.3 Anaesthesia (local or general) and/or sedation along with analgesia must be used in applying tattoos and microchips and only by specially trained staff.
- 4.5.4 Numbered ear tags should not be used as they can tear the pinna, causing pain, infection, inflammation, and keloid/scar formation. Collars should not be used due to the risks of catching on enclosures.
- 4.5.5 Ear notching and toe clipping must not be used.

- 4.5.6 A permanent record of the individual tag numbers must be kept and available either in the enclosures or in the same location as the animals for ease of identification, compliance, and auditing purposes.

4.6 Food and Water

Background

- Appropriate nutrition and water are critical for regulatory, animal welfare and experimental outcomes.
- Periodic detailed analysis of the diet by a competent laboratory may avoid long-term deficiencies that can affect research results along with consultation with a rabbit veterinary specialist and/or nutritionist.
- A nutritionally adequate diet is required for good rabbit welfare and is primarily composed of long-stem hay and grasses appropriate for the life stage^{18,19}.
- High fibre feed such as hay helps prevent myriad of disease including but not limited to dentition, dental cavity, behaviour, gastrointestinal tract, obesity and trichobezoars (hairballs).
- A diet with around 18 – 25% crude fibre is required⁵³.
- There are two main types of hay: grass hay and legume hay. Typically grass hays (e.g., meadow, Timothy, oaten) have lower energy, protein and calcium content and are suitable for all rabbits. Legume hays like lucerne have higher protein and calcium content and can be fed to growing animals and breeding females for short periods. Prolonged feeding of legume hays will predispose to the development of urinary calculi and should not be fed to non-breeding adults.
- Dried pelleted diets can be standardised with little variation. However, these diets are also monotonous and compromise the dental, nutritional and behavioural welfare of rabbits if fed in excess to the below recommendations.

Standard

- 4.6.1 Animals must receive and access to a nutritionally complete, appropriate, uncontaminated, quantity, and composition of diet that maintains normal growth, normal weights, and meets the requirements of pregnancy, lactation, or other conditions (3.2.24)
- 4.6.2 Clean, fresh drinking water must be available at all times in a way suitable for the species and checked daily (3.3.25).
- 4.6.3 Long-stem forage (e.g., hay) should form the primary component of the diet and should be available daily.
- 4.6.4 Special AEC consideration and approval is required to feed diets deficient in daily long-stem forage.
- 4.6.5 If a restricted diet is required to be fed, it must be only by specific exemption and approvals from the AEC with veterinary oversight. Investigators and AECs should be aware this will compromise physical and psychological welfare as well as increase the risk of disease which can negatively impact experimental results. Feed should be

provided in the late afternoon (which has been shown to reduce the frequency of abnormal behaviours in caged rabbits)⁵⁴.

4.6.6 Storage and any other conditions must be taken into account (e.g., autoclaving) when preparing and delivering diets for animals.

4.6.7 More than one source of food and water should be provided to reduce the possibility of aggressive competition.

Recommendations

xv. Separation of water supplies from food hoppers is recommended as there is tendency for rabbits to dribble water into the food which causes caking and wastage of pelleted rations and other feed.

Water

xvi. Systems to supply²⁹ water may be used. If automatic watering systems or water bottles are used, care should be taken to avoid leakage and overflows. Open water systems (such as chicken water hoppers) should be raised up to prevent water being contaminated with bedding and faeces.

xvii. Water supplies require daily checking, should be replenished daily and must be easily accessible. Water dishes tend to become soiled with food and faeces and through rabbits resting in them. Water bottles sipper tubes can become clogged with masticated food if they are placed too close to food bowls. Sipper tubes should be situated sufficiently far above the level of the substrate to ensure that wicking and loss of water into the substrate does not occur²¹.

xviii. Stainless steel tubes are less prone to damage by chewing than brass tubes. Sippers and water bottles may be preferred over open bowls of water. If an automatic watering system is used the animals should be able to access the drinker by sticking their muzzle out of the enclosure. The incorporation of a drip channel to convey spilled water away from the enclosure is essential to avoid problems of wet substrate caused when valves leak, or rabbits play with them.

Food

xix. Sudden changes to the diet can affect normal gut flora and should be avoided.

xx. Scattering food reduces boredom by encouraging rabbits to forage. This reduces the amount of time available for fighting and helps to prevent obesity²⁴.

xxi. Hay should always be provided as something to manipulate, play with, eat, and should be provided in excess of feed requirements.

xxii. Periodic nutritional analysis of the diet should be undertaken to ensure quality as composition varies between types and batches of hay and/or forage.

xxiii. Hay should be supplemented with items such as fruit (e.g., apple, pear, strawberry tops) and low calcium vegetables (e.g., leafy green herbs (basil, coriander, mint)), Asian greens (e.g., pak choy, bok choy, choy sum), cos or butter lettuce. Limited amounts of higher calcium leafy greens (e.g., kale, spinach, silverbeet) can also be given.

xxiv. Fruit and vegetables should be washed and/or sanitised to reduce the risk of introduction of disease.

- xxv. Fresh food should mostly be composed of low calcium vegetables.
- xxvi. Fruit should be given sparingly.
- xxvii. Excessive feeding of any single fresh item should be avoided, as diarrhoea and other gastrointestinal upsets can occur.
- xxviii. Pelleted diets should not be fed at more than the amount of 10g/kg/day and only as an adjunct to hay and vegetables. Pellets must be fed within the prescribed use-by date and stored correctly to avoid the decomposition of vitamins and/or minerals. More than one formulation may be fed to reduce boredom.

4.7 Monitoring and Health of Rabbits

Background

- Good biosecurity, animal health monitoring and animal assessment management plans are paramount to good animal welfare and robust research outcomes^{55,56}. A high standard of animal care is crucial for the success of housing rabbits. Observations and familiarity by the animal care staff are required and the foremost important part of a health monitoring program.
- The infectious disease spread in rabbits housed in groups in pens does not appear to be greater than for animals housed singly in cages, provided high standards of care and monitoring are maintained. Possible routes for disease spread include direct contact and shared food and water containers^{10,12,57}. Unless people exercise extreme care going between singly caged rabbits with the ventilation carefully controlled and directed, the spread of infection can occur equally in single housed or group penned systems.
- Rabbits are prey species and may hide signs of illness. Therefore, any cause for any concern requires a health check and if abnormalities are found a veterinary assessment. Animals may need to be removed from a group. In cages normal behaviours may be difficult to assess (because it is difficult or impossible for rabbits to carry out these behaviours) and changes in grooming, food and water intake may be the only early indicator of illness.

Standard

- 4.7.1 Facilities must have appropriate animal management plans, a program of veterinary care, relevant SOPs and training plans developed with oversight and/or in conjunction with an appropriately qualified veterinarian.
Rabbits must be monitored both for health and social interactions within the group.
- 4.7.2 Animal carers must be aware of the normal behaviour of rabbits and of the individuals within a group and observe for deviations from normal.
- 4.7.3 Familiarity of the animal carer with the normal appearance and behaviour of healthy rabbits is essential and any deviation should be investigated promptly.
- 4.7.4 Rabbits must be monitored by observation at least daily for any signs of abnormality, illness, pain, or distress and to ensure adequacy of environmental conditions, food, and water supplies.

- 4.7.5 Weekly health checks of growing rabbits must be performed until rabbits reach maturity in addition to daily observation. Adults should be health checked every 2 weeks but must be checked at a minimum every month.
- 4.7.6 In addition to regular health checks, facilities should include a weekly review of health and husbandry records, routine husbandry, diagnoses, treatments and fertility, fecundity, morbidity and mortality in breeding, experimental and other animal colonies.
- 4.7.7 Any signs of abnormalities should be reported with increased monitoring and referral for health checks and/or veterinary care.
- 4.7.8 Animals that die unexpectedly should be submitted for post-mortem examination and diagnosis.
- 4.7.9 Rabbits introduced into group housing should be quarantined, and free of *Pasteurella multocida*, ear mites and coccidia.
- 4.7.10 Routine surveillance and specific-pathogen free testing should be regularly undertaken with a laboratory animal specific pathology laboratory utilised.
- 4.7.11 Health monitoring data and results of surveillance testing for specific diseases should routinely be made available to the researchers responsible for the rabbits and to the AEC.

Recommendation

- xxix. Rabbit behaviour can be more difficult to interpret, and subjective judgements may not always be reliable. A combination of objective and subjective indicators of health and welfare should be regularly monitored.
- xxx. Health checks for individuals should include body condition score and weight; observation of any lumps or bumps or discharges or drooling; review of the eyes, ears, skin, teeth/malocclusion, jaw, perianal region, genitals, and feet; assessment of demeanour, behaviour, activity, respiratory rate, and locomotion; review of eating, drinking, urination, faeces, and caecotrophs; and observation of general appearance and shape.
- xxxi. Health checks for entire and breeding rabbits should include specific observations of the mammary glands, external reproductive organs, and genitals.
- xxxii. Extra care and observation should be undertaken for subordinate rabbits to check for signs of bullying (which may result in fight wounds or denial of access to food or water).
- xxxiii. All sick rabbits should be examined and diagnosed by a veterinarian.

4.8 Specific Health Requirements of Rabbits

Background

Calicivirus/Rabbit Haemorrhagic Disease Virus (RHD)

Calicivirus/RHD causes signs ranging from transient apathy to death with widespread haemorrhage^{26,58}. It is transmitted by direct contact between rabbits, or by transportation of the virus by clothing, other objects, people and animals^{26,58}. Insects such as flies and mosquitoes also act as vectors for the disease⁵⁹.

Myxomatosis

Myxomatosis is caused by a myxoma (pox) virus and results in characteristic signs including swelling and closure of the eyelids and a thick mucopurulent eye discharge and subcutaneous swelling especially around the face and ears. A progressive loss of condition usually results in death in 11 – 18 days^{26,58}. It is spread by direct contact or insects (fleas and mosquitoes).

Vaccination strategies

Vaccination for both myxomatosis and calicivirus is available for rabbits. Calicivirus vaccines/(RHD) is available from 10 weeks of age. Newer versions of the vaccine are traditionally given annually to rabbits but may be given more frequently during times of outbreaks. Myxomatosis vaccines are available overseas but are not available in Australia. Prevention of direct contact from fleas and mosquitoes is the only available option.

4.9 Breeding of Rabbits

Background

- Domesticated rabbits can have seasonal breeding cycles and can produce multiple litters throughout the year. Litter sizes range from 1 to 4. Most rabbits can be bred from 6 months onwards for small sized breeds and 7 months onwards for medium sized breeds^{24,60}. Males will mate with females immediately after they have given birth.
- Problems that occur in breeding systems which house rabbits in cages can include very limited freedom of movement, stereotypies, restlessness, disturbed sexual behaviour, disturbed nursing, and cannibalism. The use of appropriately designed floor pens and managed breeding colonies can reduce the incidence of these problems.
- Nest quality can affect the survival of young, especially in the first two weeks of life. Does have been found to build better nests if provided with soft nesting materials of natural fibre (such as wool, cashmere or camel hair). Such materials promote a better microclimate (temperature and humidity) within the nest and may be more comfortable for young rabbits⁶¹. Fibre content of the diet of the doe also has a strong influence on nest quality, with inadequate long-stem fibre having a detrimental effect⁶².
- Normal behaviour of female rabbits is to visit their nestlings once a day for nursing, open the nest entrance each time, and close it again afterwards. Nesting boxes should promote these natural behaviours and emulate these requirements.
- The handling of young rabbits helps to reduce fearfulness towards humans and general emotional reactivity, as well as increasing “open field” activity and exploratory behaviour^{28,63,64}. Handling in the first week of life and at a time associated with nursing may be especially effective in reducing fearfulness towards humans. The effect of this handling appears to be long-lasting.

Standard

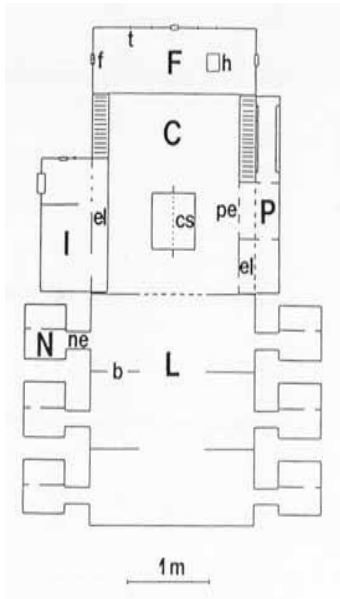
- 4.9.1 Breeding rabbits should be screened for reproductive diseases such as syphilis and have an examination of the genitals for scabbing/swelling prior to entering a breeding colony.

- 4.9.2 Genitals and the mammary glands of breeding rabbits should be monitored regularly in addition to routine health checks.
- 4.9.3 Females should be bred a maximum of 3 litters per year.
- 4.9.4 Females and males should be rested for at least one reproductive cycle before being bred again.
- 4.9.5 Rabbits should not be bred from prior to 6 months of age for small breed and 7 months of age for medium to large breeds.
- 4.9.6 Breeding groups should be between 2 - 5 females, one male and their offspring until weaning if sufficient space is available and there are no other behavioural issues in group floor pens^{24,60}.
- 4.9.7 Females should be provided with straw or other suitable materials such as hay or shredded paper to utilise in their nesting place.
- 4.9.8 Females should be able to withdraw from their young by retreating to a separate compartment or raised area⁶⁰, and/or by closing the nest after nursing.

Recommendation

- xxxiv. Females should be bred a maximum number of 2 times a year.
- xxxv. For breeding rabbits in pens the following are recommended for inclusion in the pen design:
 - xxxvi. A central area where rabbits can rest
 - xxxvii. A feeding area with several sources of food and water
 - xxxviii. A nesting area with separate nesting boxes for each female to nest alone with tunnel-like entrances (which substitute for breeding burrows dug in the earth and allow closing of the nest by the female)
 - xxxix. Straw bedding and barriers between each nest to obscure the view of adjacent nests (and thus limit aggressive behaviour)
- xl. Nest boxes should be about 38cmx25cmx20cm high
- xli. A pup area with small entrance passages accessible to rabbits up until about weaning age (about 18- 39 days)
- xlii. An isolation area (which is needed to separate the male from time to time and for sick females) which allows sight and olfactory contact with rabbits in the main pen⁶⁰. (see Figure 1)
- xliii. Handling of kits should be for short periods of time (<5 min) to reduce risk of rejection of kits by the doe. Care must be taken to ensure minimal scent transfer from staff, the surrounding area, or other animals.

xliv.



C	central area	b	blind
F	feeding area	cs	central structure
I	Isolation cage	el	raised resting space
L	bedded nesting area	f	pellet feeder
N	nesting box	h	hay rack
P	pup area	ne	tunnel-like nest entrance
		pe	entrance to pup area
		t	drinker

Figure 1 Example Rabbit housing system for breeding groups

(Reproduced with kind permission from: Stauffacher (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare 1*: Figure 1 page 114; Publisher: UFAW, The Old School, Brewhouse Hill, Wheathampstead, Herts AL4 8AN, UK)

5 Special Housing - Single and Double Housing of Rabbits in Cages

Background

When scientific work precludes the keeping of animals in appropriate environments, such as using floor pens and playpens, or single housing of animals, both the researcher and AEC should be aware of the negative impacts on animal welfare and experimental outcomes^{9,20}.

5.1 The advantages of housing animals singly in cages include:

- Food and water intake can be controlled and monitored²⁴.
- Faeces and urine excretion can be quantified and monitored²⁴.

5.2 The disadvantages of housing animals singly in cages include:

- Potential space restrictions in cages mean that rabbits cannot carry out normal activities such as hopping, lying stretched out, sitting up with ears erect, rearing and leaping^{9,12,16}.
- The behavioural repertoire of singly caged animals is severely restricted, largely as a result of enrichment, spatial and social deprivation²⁶.
- Singly housed rabbits in cages carry out a variety of stereotypic behaviours such as bar gnawing, hopping back and forth, excessive grooming, fur eating, playing with the water nipple, pawing in the corners, head swaying and vertical sliding of the nose between the bars. Additional behaviours that have been observed include sitting in a hunched position for long periods and sitting with the head lowered in a corner. Rabbits also exhibit “restlessness” in cages – a high frequency of changing from one activity to another. It is likely that such behaviours are the result of frustration, anxiety, and boredom related to a barren, confined environment^{13,17,26,27,44,54,60,65–67}. These behaviours are rarely if ever seen in rabbits housed in groups in pens^{13,54,67}.
- Singly caged rabbits tend to overreact to relatively small changes in the environment. Such changes are likely to be a source of stress to the rabbits and they may become nervous and take fright or become aggressive. Such behaviour may relate to a chronic lack of stimulation and/or to the fact that they have no way of escaping and hiding^{27,68,69}. Health problems which are relatively common in caged rabbits and rare or unseen in penned rabbits include trichobezoars (hairballs) and gastrointestinal ulcers, pododermatitis (sore hocks), obesity, depression and osteoporosis which may lead to a loss of capacity for normal locomotion, bone fractures and spinal distortion.
- Cages are expensive to buy and costly and time consuming to clean.
- Singly housed rabbits in cages may be psychologically, physically, behaviourally, and physiologically abnormal. The use of such animals in research will have an influence on experimental results.

Standard

- 5.2.1 The impacts on animal welfare and experimental outcomes of single housing of social animals must receive special ethical consideration by the AEC and requires special approval (3.2.13).
- 5.2.2 Where the use of single or double housing cages is approved by an AEC, the stress associated with separating rabbits from their social group into individual cages and/or removal from floor pens should be minimised under the experimental protocol by housing them in a room that permits visual, olfactory, and auditory contact with familiar cohorts (3.2.23).
- 5.2.3 Mitigation strategies (e.g., mirrors⁷⁰) should be in place to manage the negative animal welfare and experimental impacts.

Recommendation

- xliv. Enclosure shapes should maximise effective use of floor space and consider additional levels to provide more space and enrichment.
- xlvi. All single, double, cage, or restricted housing should have oversight by an appropriately qualified independent veterinarian.

5.3 Floor Area of Single and Double Housing of Rabbits in Cages

Standard

- 5.3.1 Cages must allow rabbits to stretch fully in all directions in the cage (length, width, and diagonal) at a minimum of 1m x 1m.
- 5.3.2 Caged rabbits should be given daily playpen/exercise pen or at least a minimum of 3 times a week unless specially approved by the AEC.
- 5.3.3 Caged rabbits should be group housed or housed in compatible pairs.
- 5.3.4 The floor space provided for pair housed rabbits in cages should be greater than that provided for single caged rabbits and at least 1.8m x 1.0m with a minimum clear direction of 1.8m.
- 5.3.5 The minimum height should be a minimum of 75cm to enable normal rearing behaviour of rabbits and sitting with ears upright to allow investigation of sights and sounds.

Recommendation

- xlvii. Additional space is recommended and should be used to allow for the provision of the expression of natural behaviours and for additional environmental enrichment.
- xlviii. For pair or groups housing of rabbits, this will usually require the use of double cages. Cages may, for example, be joined by a PVC pipe which also acts as a hiding/resting area.

6 Environmental Variables

6.1 General

Background

- A variety of environmental factors, including light, temperature, humidity, air quality and sound may impact on the behavioural responses and health of rabbits. The design, construction and management of rabbit pens and cages will largely determine how these factors will impact on the animals⁷¹⁻⁷³.

6.2 Light

Background

- In the wild, rabbits are often nocturnal, and forage mainly at dusk and dawn. Laboratory rabbits can become diurnal due to the external noises and scheduled feeding during the day.

Standard

- 6.2.1 When working with albino rabbits, maintain a lower light level except when bright light is required for working in the room^{24,26}.
- 6.2.2 All animals must have a minimum of 8 hours of dark.

Recommendation

- xlix. Although individual animals may respond differently, the provision of a 12:12 light-dark cycle is recommended for housed rabbits.
- l. A light level of a maximum of 60 lux is recommended for albino animals.
- li. It is recommended to create an artificial dawn and dusk period²⁶.

6.3 Temperature

Background

- Air temperature in the pen or cage is influenced not only by the design of the enclosure but also by air distribution, ventilation rate, the position of the enclosure within the air flow pattern and its proximity to other enclosures⁷¹.
- Low temperatures are better tolerated by rabbits than high heat and draughts. Temperatures of above 25°C can cause heat stress which may result in infertility and mortality. Higher humidity exacerbates the effects of heat.

Standard

- 6.3.1 Temperature for rabbit housing should be kept between 18°C - 22°C.
- 6.3.2 Pregnant, neonates, sick and geriatric rabbits will be more sensitive to temperature changes and/or other adjustment should be reviewed and considered.

6.4 Humidity

Standard

6.4.1 A maximum relative humidity for rabbit housing is 70% and a minimum of 35%²⁶.

Recommendation

lii. A relative humidity for rabbit housing of between 45 – 65% is recommended.

6.5 Air Quality

Background

- The effective ventilation of rabbit enclosures is a critical consideration in the management of environmental factors. The adequacy of air exchange in the rabbits' immediate environment of the pen or cage will affect temperature, humidity, and air quality. The placement of air inlets and outlets in a room and the rate of air exchange will affect the pattern and efficiency of air distribution⁷¹.
- The number of air changes per hour that are needed will in part be determined by the cleaning routine and stocking density of rabbits²⁶. Air changes and an efficient air flow are required to keep ammonia levels within the rabbits' immediate environment of the pen or cage at an acceptable level.
- Odours in the environment may influence the health and behaviour of rabbits.

Standard

6.5.1 Air exchange rates should be between 10 to 20 changes per hour and is dependent on the stocking density and ambient temperature.

6.5.2 Concentrations of ammonia must not exceed 10ppm. Humans begin to smell ammonia at 8-10ppm which means if an ammonia smell can be detected by staff it is too high.

Recommendation

liii. Concentrations of ammonia should ideally be lower than 1-2ppm.

6.6 Sound and Vibrations

Background

- Rabbits are sensitive to high sound frequencies (ultrasound) and vibrations which cannot be detected by humans.
- The effects of vibration and noise on animal welfare and experimental outcomes can be profound and may not be easy to detect by human senses⁷⁴⁻⁷⁸.
- Excessive sounds of vibrations can cause reproductive disorders, increase rates of cannibalism in kits, induce physiological and behavioural changes, and can result in death.

- Ultrasound and vibrations can be produced by common laboratory equipment such as temperature regulating devices, electronic equipment such as computer monitors, video recording equipment and telephones, cage cleaning equipment and vacuum hoses as well as by running water and squeaky door hinges, chairs or trolley wheels or distant construction. Such sources should be eliminated by routine maintenance wherever possible and offending equipment should be shielded or its use should be avoided in the animal house⁷². The use of vibration mats may reduce vibrations.
- Artificial background noise such as a radio, piped music, a white noise generator, or white noise arising coincidentally from the operation of an air conditioning system, may be of some use in masking sudden noises that occur in an animal house. Classical and similar sounds of radio music and white noise sources may be of benefit because they do not normally include the very high frequencies that are within the auditory range of laboratory animal species.

Standard

- 6.6.1 Human conversation is normally around 65db. Noise should be kept to under 70db. Vibrations should be kept to less than 0.25g (gravity).
- 6.6.2 If there are concerns regarding sounds and vibrations in the facility, then meters should be sourced to determine sound and vibrations levels with appropriate steps to mitigate any potential issues.
- 6.6.3 Sounds or vibrations in excess to normal volumes or frequencies should be mitigated.

Recommendation

- liv. A background sound level of 50db has been suggested to avoid disturbance to animals or personnel.

6.7 Monitoring of Environmental Variables

Background

- At the pen or cage level, temperature, humidity, and air quality are all affected by the system controlling the supply to each room.
- Environmental variables of the rabbits' living area require regular monitoring.

Standard

- 6.7.1 Air exchange, temperature, humidity, light, and noise should be maintained within limits compatible with rabbit wellbeing and good health, monitored and recorded.
- 6.7.2 Temperature and humidity should be checked daily.
- 6.7.3 Animal rooms should have temperature and humidity read-outs in a position where staff can easily see them.
- 6.7.4 Sensors must be fitted to monitor and report malfunctions in ventilation, temperature, and humidity control on a 24-hour basis, with automatic alarm activation and alerting of appropriate staff.

- 6.7.5 Regardless if a centralised computer system is regulating general environmental conditions, it is still essential to check these variables daily in the room.
- 6.7.6 Automatic monitoring and control systems should be regularly calibrated and validated at room level.

Recommendations

- lv. Diurnal variations should be checked where appropriate.
- lvi. Sensors for reporting and monitoring light/dark cycles should be fitted with automatic alarm activation and alerting of appropriate staff.

7 Records

7.1 Pen / Cage Labels

Background

- Identification and appropriately sufficient record-keeping and labelling of pens, enclosures and animals is required for good regulatory, animal welfare, and experimental outcomes.

Standard

- 7.1.1 Animals must be identifiable either individually or in groups (2.4.16iv).
- 7.1.2 Health records for each animal should be kept (2.4.18vii & 2.4.32) detailing dates of monitoring, procedures, and any adverse events such as injuries, fighting.
- 7.1.3 Pens and cages should have labels attached that provide the following information (2.4.32):
 - Rabbit identification
 - Name, location and contact numbers of the principle/chief investigator and (if applicable) other investigators using the rabbits
 - Name, location and contact numbers of staff associated with the housing and care of the rabbits
 - Name and approval number of AEC approved protocol
 - Age (date of birth) of rabbits
 - Date of entry of rabbits into the pen or cage
 - Any other relevant or important information (e.g., treatments)

7.2 Breeding, Health, and Other Records

Background

- Appropriately sufficient record-keeping of breeding records of animals is required for good regulatory, animal welfare, and experimental outcomes.
- Good record keeping is an essential adjunct to good observation. Accurately recorded production data can indicate early changes in the health status of an animal colony that might otherwise pass undetected.
- Standard operating procedures, animal management and emergency/contingency plans are essential for quality control, clarity, training, consistency, safety, and demonstrating appropriate compliance with AEC approved applications and other relevant regulatory requirements.
- All together these documents form the basis for good animal welfare, care, research, and compliance outcomes.

Standard

- 7.2.1 To assist in monitoring the management of animal breeding colonies, regular reports must be provided to the Animal Ethics Committee, for review, on the fertility, fecundity, morbidity, and mortality of all animal breeding colonies (2.5.12). The frequency of such reports should be at least 6 monthly and more often if deemed necessary by the Animal Ethics Committee. (See ARRP Guideline: Supervision of Animal Supply by Animal Ethics Committees).
- 7.2.2 Adequate records to allow effective management of the breeding stock and management of colonies including the detection of the origin and spread of disease (2.5.11, 2.5.13 & 2.5.15x). Records should include:
- the source, care, allocation, movement between locations, use and fate of all animals;
 - details of any diseases;
 - the fertility, fecundity, morbidity, and mortality in breeding colonies; and
 - the health status, genetic constitution, and physical environment of the animals
- 7.2.3 These reports should be reviewed and analysed in consultation with an appropriately qualified veterinarian. Any issues identified should be promptly investigated, diagnosed, and addressed, with reporting back to the AEC.

Recommendation

- lvii. Breeding and health records should be regularly reviewed, ideally at least quarterly, in consultation with veterinary, animal care staff, and researchers input.
- lviii. Based on this review strategic analysis and planning should be undertaken and implemented with information regularly relayed to the AEC.
- lix. All records and documentation (e.g., training, management plans, SOPs) should be refreshed at least every 3 years.
- lx. Facilities should consider the use of digital records to facilitate trend analysis and review.

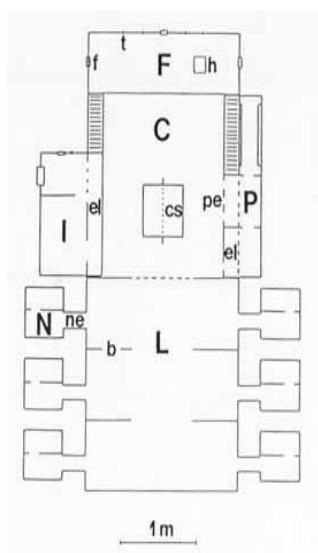
Recommendation Summary

- i. Slower introductions are recommended when introducing or re-introducing rabbits into their groups or pairs.
- ii. Workflows should be arranged so that prey species are managed before predator species.
- iii. Rabbits should only be housed in single species rooms.
- iv. Enclosure shapes should maximise effective use of floor space.
- v. Hay and straw should be used as they have the added benefit of being a substrate animals can safely ingest and nibble.
- vi. Rabbits are encouraged to be litter box trained and there should be multiple litter trays available within an enclosure.
- vii. Concentrations of ammonia should be less than 1-2ppm.
- viii. If a single animal will remain for a period of time after cohorts have been removed from a treatment group, then wherever possible a compatible companion should be provided. This could be an already desexed adult male or female guinea pig. Chemical desexing is an option for companions which are excess to colony requirements is also a potential option. Surgical desexing of animals for the purposes of companionship should not be undertaken.
- ix. Animals should be removed in pairs and returned in pairs to the larger group whenever possible.
- x. Rabbits should be trained to accept procedures (e.g., oral administration of an antibiotic solution) with minimal or no restraint when given positive reinforcement (e.g., drug delivered in a sugar-coated syringe after a period of training by administering a sugar solution)⁴⁷.
- xi. Rabbits should have elevated areas placed 20-30cm from the floor and managed appropriately to prevent rabbits from jumping out of enclosures.
- xii. A rotating enrichment program and plan should be implemented, regularly updated, and reviewed annually.
- xiii. A variety of food should be provided. Food may be spread out in the bedding to encourage foraging behaviour.
- xiv. To reduce negative impacts to physical and physiological health including the relief of boredom, all rabbits should have access to larger, complex floor pens to assist in providing the opportunity for exercise, enrichment, and better health.
- xv. Separation of water supplies from food hoppers is recommended as there is tendency for rabbits to dribble water into the food which causes caking and wastage of pelleted rations and other feed.
- xvi. Systems to supply²⁹ water may be used. If automatic watering systems or water bottles are used, care should be taken to avoid leakage and overflows. Open water systems (such as chicken water hoppers) should be raised up to prevent water being contaminated with bedding and faeces.

- xvii. Water supplies require daily checking, should be replenished daily and must be easily accessible. Water dishes tend to become soiled with food and faeces and through rabbits resting in them. Water bottles sipper tubes can become clogged with masticated food if they are placed too close to food bowls. Sipper tubes should be situated sufficiently far above the level of the substrate to ensure that wicking and loss of water into the substrate does not occur²¹.
- xviii. Stainless steel tubes are less prone to damage by chewing than brass tubes. Sippers and water bottles may be preferred over open bowls of water. If an automatic watering system is used the animals should be able to access the drinker by sticking their muzzle out of the enclosure. The incorporation of a drip channel to convey spilled water away from the enclosure is essential to avoid problems of wet substrate caused when valves leak, or rabbits play with them.
- xix. Sudden changes to the diet can affect normal gut flora and should be avoided.
- xx. Scattering food reduces boredom by encouraging rabbits to forage. This reduces the amount of time available for fighting and helps to prevent obesity²⁴.
- xxi. Hay should always be provided as something to manipulate, play with, eat, and should be provided in excess of feed requirements.
- xxii. Periodic nutritional analysis of the diet should be undertaken to ensure quality as composition varies between types and batches of hay and/or forage.
- xxiii. Hay should be supplemented with items such as fruit (e.g., apple, pear, strawberry tops) and low calcium vegetables (e.g., leafy green herbs (basil, coriander, mint)), Asian greens (e.g., pak choy, bok choy, choy sum), cos or butter lettuce. Limited amounts of higher calcium leafy greens (e.g., kale, spinach, silverbeet) can also be given.
- xxiv. Fruit and vegetables should be washed and/or sanitised to reduce the risk of introduction of disease.
- xxv. Fresh food should mostly be composed of low calcium vegetables.
- xxvi. Fruit should be given sparingly.
- xxvii. Excessive feeding of any single fresh item should be avoided, as diarrhoea and other gastrointestinal upsets can occur.
- xxviii. Pelleted diets should not be fed at more than the amount of 10g/kg/day and only as an adjunct to hay and vegetables. Pellets must be fed within the prescribed use-by date and stored correctly to avoid the decomposition of vitamins and/or minerals. More than one formulation may be fed to reduce boredom.
- xxix. Rabbit behaviour can be more difficult to interpret, and subjective judgements may not always be reliable. A combination of objective and subjective indicators of health and welfare should be regularly monitored.
- xxx. Health checks for individuals should include body condition score and weight; observation of any lumps or bumps or discharges or drooling; review of the eyes, ears, skin, teeth/malocclusion, jaw, perianal region, genitals, and feet; assessment of demeanour, behaviour, activity, respiratory rate, and locomotion; review of eating, drinking, urination, faeces, and caecotrophs; and observation of general appearance and shape.

- xxx. Health checks for entire and breeding rabbits should include specific observations of the mammary glands, external reproductive organs, and genitals.
- xxxii. Extra care and observation should be undertaken for subordinate rabbits to check for signs of bullying (which may result in fight wounds or denial of access to food or water).
- xxxiii. All sick rabbits should be examined and diagnosed by a veterinarian.
- xxxiv. Females should be bred a maximum number of 2 times a year.
- xxxv. For breeding rabbits in pens the following are recommended for inclusion in the pen design:
- xxxvi. A central area where rabbits can rest
- xxxvii. A feeding area with several sources of food and water
- xxxviii. A nesting area with separate nesting boxes for each female to nest alone with tunnel-like entrances (which substitute for breeding burrows dug in the earth and allow closing of the nest by the female)
- xxxix. Straw bedding and barriers between each nest to obscure the view of adjacent nests (and thus limit aggressive behaviour)
- xl. Nest boxes should be about 38cmx25cmx20cm high
- xli. A pup area with small entrance passages accessible to rabbits up until about weaning age (about 18- 39 days)
- xlii. An isolation area (which is needed to separate the male from time to time and for sick females) which allows sight and olfactory contact with rabbits in the main pen⁶⁰. (see Figure 1)
- xliii. Handling of kits should be for short periods of time (<5 min) to reduce risk of rejection of kits by the doe. Care must be taken to ensure minimal scent transfer from staff, the surrounding area, or other animals.

xliv.



C	central area	b	blind
F	feeding area	cs	central structure
I	Isolation cage	el	raised resting space
L	bedded nesting area	f	pellet feeder
N	nesting box	h	hay rack
P	pup area	ne	tunnel-like nest entrance
		pe	entrance to pup area
		t	drinker

Figure 1 Example Rabbit housing system for breeding groups

(Reproduced with kind permission from: Stauffacher (1992) Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal Welfare 1*: Figure 1 page 114; Publisher: UFAW, The Old School, Brewhouse Hill, Wheathampstead, Herts AL4 8AN, UK)

- xlvi. Enclosure shapes should maximise effective use of floor space and consider additional levels to provide more space and enrichment.
- xlvi. All single, double, cage, or restricted housing should have oversight by an appropriately qualified independent veterinarian.
- xlvi. Additional space is recommended and should be used to allow for the provision of the expression of natural behaviours and for additional environmental enrichment.
- xlvi. For pair or groups housing of rabbits, this will usually require the use of double cages. Cages may, for example, be joined by a PVC pipe which also acts as a hiding/resting area.
- xlvi. Although individual animals may respond differently, the provision of a 12:12 light-dark cycle is recommended for housed rabbits.
 - l. A light level of a maximum of 60 lux is recommended for albino animals.
 - li. It is recommended to create an artificial dawn and dusk period²⁶.
 - lii. A relative humidity for rabbit housing of between 45 – 65% is recommended.
 - liii. Concentrations of ammonia should ideally be lower than 1-2ppm.
 - liv. A background sound level of 50db has been suggested to avoid disturbance to animals or personnel.
 - lv. Diurnal variations should be checked where appropriate.
 - lvi. Sensors for reporting and monitoring light/dark cycles should be fitted with automatic alarm activation and alerting of appropriate staff.
 - lvii. Breeding and health records should be regularly reviewed, ideally at least quarterly, in consultation with veterinary, animal care staff, and researchers input.
 - lviii. Based on this review strategic analysis and planning should be undertaken and implemented with information regularly relayed to the AEC.
 - lix. All records and documentation (e.g., training, management plans, SOPs) should be refreshed at least every 3 years.
 - lx. Facilities should consider the use of digital records to facilitate trend analysis and review.

Recommended Reading and Resources

Department of Primary Industries New South Wales, “Animal Research Review Panel Guideline 16.” https://www.dpi.nsw.gov.au/_data/assets/pdf_file/0003/1320267/ARRP-GI-16-AEC-supervision-of-obtaining,_ding,-keeping-and-supplying-animals-updated-Sept-2022-AR-Reg-2021-refs-only.pdf

Liss, Cathy, Kenneth Litwak, Viktor Reinhardt, and Dave Tilford. *Comfortable Quarters for Laboratory Animals*. Animal Welfare Institute Washington, DC, 2015. https://awionline.org/sites/default/files/publication/digital_download/AWI-ComfortableQuarters-2015.pdf

Meredith, Anna, and Brigitte Lord. *BSAVA Manual of Rabbit Medicine*. British Small Animal Veterinary Association, 2014

Meredith, Anna, and Sharon Redrobe. *BSAVA Manual of Exotic Pets*. British Small Animal Veterinary Association, 2002.

Morton DB, Jennings M, Batchelor GR et al (1993b) Refinements in rabbit husbandry: second report of the BVA/AFW / FRAME / RSPCA / UFAW joint working group on refinement. *Laboratory Animals* 27: 301 – 329 (www.lal.org.uk/labam.htm)

NA3RSC, “Rabbit Housing and Handling.” <https://www.na3rsc.org/rabbit/>

NC3Rs, “Housing and Husbandry: Rabbit.” <https://nc3rs.org.uk/3rs-resources/housing-and-husbandry-rabbit#:~:text=Rabbits%20should%20be%20housed%20in,olfactory%20contact%20with%20other%20rabbits.>

RSPCA UK and UFAW, “Refining Rabbit Care.” <https://www.rspca.org.uk/webContent/staticImages/Downloads/RefiningRabbitCare.pdf>

Stevens et al., “Report of the 2020 RSPCA/UFAW Rodent and Rabbit Welfare Meeting.” <https://science.rspca.org.uk/documents/1494935/9042554/2020+RSPCAUFAW+Rodent+and+Rabbit+Welfare+Group+meeting.pdf/b6f9e9ee-3f49-7f46-ea2e-6087c7767ecc?t=1621942480160>

Underwood, Wendy, and Raymond Anthony. “AVMA Guidelines for the Euthanasia of Animals: 2020 Edition.” Retrieved on March 2013, no. 30 (2020): 2020–21. <https://www.avma.org/sites/default/files/2020-02/Guidelines-on-Euthanasia-2020.pdf>

University of Michigan and Thurston, S., “Rabbit Categories of Enrichment.” <https://animalcare.umich.edu/sites/default/files/resource-download/acu-um-real-rabbit.categories.enrichment.pdf>

References

1. National Health and Medical Research Council. Australian code for the care and use of animals for scientific purposes, 8th Edition. Published online 2013.
2. National Health and Medical Research Council. Best practice methodology in the use of animals for scientific purposes. Published online Updated 2018.
3. Mellor DJ, Beausoleil NJ, Littlewood KE, et al. The 2020 Five Domains Model: Including Human–Animal Interactions in Assessments of Animal Welfare. *Animals*. 2020;10(10). doi:10.3390/ani10101870
4. Mellor DJ. Affective States and the Assessment of Laboratory-Induced Animal Welfare Impacts. In: ; 2012. <https://api.semanticscholar.org/CorpusID:38800174>
5. Loss CM, Melleu FF, Domingues K, Lino-de-Oliveira C, Viola GG. Combining animal welfare with experimental rigor to improve reproducibility in behavioral neuroscience. *Frontiers in Behavioral Neuroscience*. 2021;15:763428.
6. National Research Council. Environment, housing, and management. In: *Guide for the Care and Use of Laboratory Animals*. 8th Edition. National Academies Press (US); 2011.
7. Bell D. The behaviour of rabbits: implications for their laboratory management. In: *Standards in Laboratory Animal Management*. UFAW; 1984:151-162.
8. Lehmann M. Social behaviour in young domestic rabbits under semi-natural conditions. *Applied Animal Behaviour Science*. 1991;32(2-3):269-292.
9. Love JA. Group housing: Meeting the physical and social needs of the laboratory rabbit. *Laboratory animal science*. 1994;44(1):5-11.
10. Love J, Hammond K. Group Housing in Rabbits. *Lab Animal*. 1991;20(8):37-43.
11. Mykytowycz R, Fullagar P. Effect of social environment on reproduction in the rabbit, *Oryctolagus cuniculus* (L.). *Journal of reproduction and fertility Supplement*. 1973;19:503-522.
12. Morton D. Enrichment techniques for rodents and rabbits. Published online 1994.
13. Gunn D. The behaviour of single-caged and group-housed laboratory rabbits. In: Royal Society of Medicine Press; 1994:80-84.
14. Huls W, Brooks D, Bean-Knudsen D. Response of adult New Zealand white rabbits to enrichment objects and paired housing. *Laboratory Animal Science*. 1991;41(6):609-612.
15. DL B. Cage enrichment for female New Zealand White rabbits. *Lab Animal*. 1993;22(5):30-38.
16. Kalagassy EB, Carbone LG, Houpt KA. Effect of castration on rabbits housed in littermate pairs. *Journal of Applied Animal Welfare Science*. 1999;2(2):111-121.
17. Berthelsen H, Hansen L. The effect of hay on the behaviour of caged rabbits (*Oryctolagus cuniculus*). *Animal Welfare*. 1999;8(2):149-157.
18. Bradley T. Rabbit care and husbandry. *Veterinary Clinics: Exotic Animal Practice*. 2004;7(2):299-313.
19. Birolo M, Trocino A, Zuffellato A, Pirrone F, Bordignon F, Xiccatto G. Use of Gnawing Hay Blocks: Effects on Productive Performance, Behavior and Reactivity of Growing Rabbits Kept in Parks with Different Sex-Group Compositions. *Animals*. 2022;12(9):1212.
20. Cait J, Cait A, Scott RW, Winder CB, Mason GJ. Conventional laboratory housing increases morbidity and mortality in research rodents: results of a meta-analysis. *BMC Biology*. 2022;20(1):15. doi:10.1186/s12915-021-01184-0
21. Batchelor GR, Giddins G. Bodyweight changes in laboratory rabbits subjected to transport and different housing conditions. *Animal Technology (United Kingdom)*. Published online 1995.
22. Davys J. floor pen for laboratory animals--a mixed blessing? *Animal technology: journal of the Institute of Animal Technicians*. Published online 1994.
23. Crowell-Davis S. Rabbit Behavior. *Veterinary Clinics of North America: Exotic Animal Practice*. 2021;24(1):53-62. doi:10.1016/j.cvex.2020.09.002
24. Morton DB, Jennings M, Batchelor G, et al. Refinements in rabbit husbandry: Second report of the BVA/WF/FRAME/RSPCA/UFAW joint working group on refinement. *Laboratory Animals*. 1993;27(4):301-329.
25. GR B. Group housing on floor pens and environmental enrichment in sandy lop rabbits. *Animal Technology*. 1991;42:109-120.

26. Batchelor G. The laboratory rabbit. *The UFAW Handbook on the Care and Management of Laboratory Animals, 7th edition Poole T ed, Blackwell Science, Oxford*. Published online 1999:395-408.
27. Lehmann M. Interference of a restricted environment—as found in battery cages—with normal behaviour of young fattening rabbits. *Agriculture: Rabbit production systems including welfare (ed Teresa Auxilia Instituto sperimentale per la Zootecnia), Luxemburg, Commission of the European Communities*. Published online 1987:257-268.
28. Denenberg VH, Wyly MV, Burns JK, Zarrow M. Behavioral effects of handling rabbits in infancy. *Physiology & Behavior*. 1973;10(6):1001-1004.
29. Hubrecht RC, Kirkwood J. *The UFAW Handbook on the Care and Management of Laboratory and Other Research Animals*. John Wiley & Sons; 2010.
30. Turner PV. Chapter 12 - Rodent and Rabbit Welfare in the Research Environment. In: Bayne K, Turner PV, eds. *Laboratory Animal Welfare*. Academic Press; 2014:171-196. doi:10.1016/B978-0-12-385103-1.00012-9
31. Stevens C, Hawkins P, Smulders T, et al. Report of the 2020 RSPCA/UFAW rodent and rabbit welfare meeting. *Anim Technol Welfare*. 2021;20:21-33.
32. Verga M, Luzi F, Carenci C. Effects of husbandry and management systems on physiology and behaviour of farmed and laboratory rabbits. *Hormones and Behavior*. 2007;52(1):122-129.
33. Turner R, Held S, Hirst J, Billingham G, Wootton R. An immunological assessment of group-housed rabbits. *Laboratory Animals*. 1997;31(4):362-372.
34. Kleven GA. Behavioral biology of guinea pigs. In: *Behavioral Biology of Laboratory Animals*. CRC Press; 2021:131-146.
35. Rabbit Welfare Association & Fund. Rabbit Welfare Association and Fund. Accessed January 7, 2023. <https://rabbitwelfare.co.uk/>
36. Fullerton PM, Gilliat R. Pressure neuropathy in the hind foot of the guinea-pig. *Journal of Neurology, Neurosurgery, and Psychiatry*. 1967;30(1):18.
37. Shimp T, Gilliat RW, Kennett R, Allen P. Susceptibility to pressure neuropathy distal to a constricting ligature in the guinea-pig. *Journal of Neurology, Neurosurgery & Psychiatry*. 1987;50(12):1625-1632.
38. Potgieter F, Wilke P. Laboratory animal bedding and nesting materials for rodents and lagomorphs: the South African situation. *Journal of the South African Veterinary Association*. 1993;64(4):144-148.
39. RJ T. Preferred substrates for penned laboratory rabbits. *Animal Technology*. 1992;43:185-192.
40. Young RJ. *Environmental Enrichment for Captive Animals*. John Wiley & Sons; 2013.
41. Boers K, Gray G, Love J, et al. Comfortable quarters for rabbits in research institutions. *Comfortable quarters for laboratory animals*. 2002;9.
42. Meredith A, Redrobe S. *BSAVA Manual of Exotic Pets*. British Small Animal Veterinary Association; 2002.
43. Mikó A, Matics Z, Gerencsér Z, et al. Performance and welfare of rabbit does in various caging systems. *Animal*. 2014;8(7):1146-1152.
44. SS R. Group housing for male New Zealand White rabbits. *Lab Animal*. 1997;26(4):36-37.
45. Kersten A, Meijsser F, Metz J. Effects of early handling on later open-field behaviour in rabbits. *Applied Animal Behaviour Science*. 1989;24(2):157-167.
46. Knudtzon J. Plasma levels of glucagon, insulin, glucose and free fatty acids in rabbits during laboratory handling procedures. *Zeitschrift fur Versuchstierkunde*. 1984;26(3):123-133.
47. JM M. A non-stressful alternative to gastric gavage for oral administration of antibiotics in rabbits. *Lab animal*. 1993;22(2):47-49.
48. Hansen L, Berthelsen H. The effect of environmental enrichment on the behaviour of caged rabbits (*Oryctolagus cuniculus*). *Applied Animal Behaviour Science*. 2000;68(2):163-178.
49. SDE H. Effect of environmental enrichment on the behaviour of group-housed New Zealand White and Dutch X Californian laboratory rabbits. In: Royal Society of Medicine Press; 1994:358-360.
50. Shomer NH, Peikert S, Terwilliger G. Enrichment-toy trauma in a New Zealand White rabbit. *Journal of the American Association for Laboratory Animal Science*. 2001;40(1):31-32.
51. Knutsson M. Exercise pens as an environmental enrichment for laboratory rabbits. Published online 2011.
52. van Zutphen LF, Baumans V, Beynen AC, Restani P. Principles of laboratory animal science. Published online 1996.

53. Patton N, Manning P, Ringler D, Newcomer C. Colony Husbandry in the Biology of the Laboratory Rabbit. Published online 1994.
54. Krohn T, Ritskes-Hoitinga J, Svendsen P. The effects of feeding and housing on the behaviour of the laboratory rabbit. *Laboratory animals*. 1999;33(2):101-107.
55. FELASA Working Group on Revision of Guidelines for Health Monitoring of Rodents and Rabbits, Mähler M, Berard M, et al. FELASA recommendations for the health monitoring of mouse, rat, hamster, guinea pig and rabbit colonies in breeding and experimental units. *Laboratory animals*. 2014;48(3):178-192.
56. Nicklas W, Baneux P, Boot R, et al. Recommendations for the health monitoring of rodent and rabbit colonies in breeding and experimental units. *Laboratory animals*. 2002;36(1):20-42.
57. Whary M, Peper R, Borkowski G, Lawrence W, Ferguson F. The effects of group housing on the research use of the laboratory rabbit. *Laboratory Animals*. 1993;27(4):330-341.
58. Meredith A, Lord B. *BSAVA Manual of Rabbit Medicine*. British Small Animal Veterinary Association; 2014.
59. Asgari S, Hardy JR, Sinclair RG, Cooke BD. Field evidence for mechanical transmission of rabbit haemorrhagic disease virus (RHDV) by flies (Diptera:Calliphoridae) among wild rabbits in Australia. *Virus Res*. 1998;54(2):123-132. doi:10.1016/s0168-1702(98)00017-3
60. Stauffacher M. Group housing and enrichment cages for breeding, fattening and laboratory rabbits. *Animal welfare*. 1992;1(2):105-125.
61. Verga M, Nelli A, Leone P, Carezzi C. Behaviour and performances of rabbit does and young rabbits. *Rabbit Production Systems Including Welfare CEC Publ, Luxembourg*. Published online 1987:241-243.
62. MM K, LJ M, KA C. Influence of dietary fiber on maternal behaviour in rabbits. Published online 1993.
63. Bilkó Á, Altbäcker V. Regular handling early in the nursing period eliminates fear responses toward human beings in wild and domestic rabbits. *Developmental Psychobiology: The Journal of the International Society for Developmental Psychobiology*. 2000;36(1):78-87.
64. Jezierski T, Konecka A. Handling and rearing results in young rabbits. *Applied Animal Behaviour Science*. 1996;46(3-4):243-250.
65. Gunn D, Morton DB. Inventory of the behaviour of New Zealand White rabbits in laboratory cages. *Applied Animal Behaviour Science*. 1995;45(3-4):277-292.
66. Lidfors L. Behavioural effects of environmental enrichment for individually caged rabbits. *Applied Animal Behaviour Science*. 1997;52(1-2):157-169.
67. Podberscek A, Blackshaw J, Beattie A. The behaviour of group penned and individually caged laboratory rabbits. *Applied Animal Behaviour Science*. 1991;28(4):353-363.
68. McBride E, Wickens S. rabbit--an exotic pet with behaviour problems. In: Potters Bar, Herts, Great Britain: Universities Federation for Animal ...; 1997.
69. Wemelsfelder F. Animal boredom: a model of chronic suffering in captive animals and its consequences for environmental enrichment. *Humane innovations and alternatives (USA)*. Published online 1994.
70. Mastellone V, Bovera F, Musco N, et al. Mirrors improve rabbit natural behavior in a free-range breeding system. *Animals*. 2019;9(8):533.
71. Rose M. Laboratory animal behaviour management. In: ; 1996.
72. Clough G. The animal house: design, equipment and environmental control. *The UFAW handbook on the care and management of laboratory animals*. Published online 1987.
73. Hall LES, Robinson S, Finch J, Buchanan-Smith HM. The influence of facility and home pen design on the welfare of the laboratory-housed dog. *Journal of pharmacological and toxicological methods*. 2017;83:21-29.
74. Bailey K, Stephens D, Delaney C. Observations on the effects of vibration and noise on plasma ACTH and zinc levels, pregnancy and respiration rate in the guineapig. *Laboratory animals*. 1986;20(2):101-108.
75. Turner JG. Noise and vibration in the vivarium: recommendations for developing a measurement plan. *Journal of the American Association for Laboratory Animal Science*. 2020;59(6):665-672.
76. Nayfield K, Besch E. Comparative responses of rabbits and rats to elevated noise. *Laboratory Animal Science*. 1981;31(4):386-390.
77. Anthony A, Ackerman E, Lloyd JA. Noise stress in laboratory rodents. I. Behavioral and endocrine response of mice, rats, and guinea pigs. *The Journal of the Acoustical Society of America*. 1959;31(11):1430-1437.

78. Anthony A, Harclerode JE. Noise stress in laboratory rodents. II. Effects of chronic noise exposures on sexual performance and reproductive function of guinea pigs. *The Journal of the Acoustical Society of America*. 1959;31(11):1437-1440.

The initial draft of this document was researched and prepared by:

Dr. Shari Cohen, Veterinary Animal Welfare Consultant and Fellow of Animal Welfare, Ethics and Law on behalf of the New South Wales Department of Primary Industries PO Box 100 BEECROFT NSW 2119
email: sharicohen.vet@gmail.com

Acknowledgments

We acknowledge the original assistance and support in the initial version of this document of Dr Lynette Chave, Senior Veterinary Officer, Animal Welfare Branch NSW DPI, and comments provided, during the development of this document, by A/Professor Margaret Rose, Professor Lesley Rogers, Mr Mark Lawrie, Ms Susie Velte, Dr Peter Johnson, Mr Greg Alpen, Mrs Anne Alpen, Mr Stephen Boys, Dr Sandra Eady, Professor David Morton, the University of Newcastle AEC, the Canadian Council on Animal Care, Dr Malcolm France, the Central Sydney Area Health Service AEC and Dr Birgit Drescher are gratefully acknowledged.

We acknowledge the ongoing and additional assistance and support for the current version of this document of Dr. Michelle Sutherland (Avian and Exotic Pet Specialist, Australia), Dr Lynette Chave (Leader Animal Research, NSW DPI Australia), Compliance and Licensing Unit NSW DPI, Animal Welfare Unit NSW DPI, and members of the NSW Animal Research Review Panel (Australia), have contributed significantly to the guidelines and are gratefully acknowledged.

Disclaimer

Printed copies of the document are regarded as uncontrolled. Please check [ARRP policies, guidelines & factsheets | Department of Primary Industries \(nsw.gov.au\)](#) to ensure use of the latest version.

© State of New South Wales through Regional NSW [Department of Primary Industries] 2023. The information contained in this publication is based on knowledge and understanding at the time of writing (December 2023). However, because of advances in knowledge, users are reminded of the need to ensure that the information upon which they rely is up to date and to check the currency of the information with the appropriate officer of the Department of Regional NSW or the user's independent adviser.