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1. Introduction

1.1 Purpose and Scope
There are many biological hazards (biohazards) that can be encountered in University teaching and research laboratories. Laboratories where biologicals are used and stored must have the appropriate training, approvals, practices and equipment in place to manage the associated risks. This manual provides information on relevant legislative requirements and safe work practices when working with or being exposed to biological materials. The guidelines within this manual have been developed to complement other biosafety and WHS management information from:

- Australian Standards AS/NZS2243.3 series (SAI Global available through the library)
- The Office of the Gene Technology Regulator (OGTR)
- Australian Department of Agriculture and Water Resources (DAWR)
- Security Sensitive Biological Agents Regulatory Scheme
- The World Health Organisation
- SafeWork NSW

This manual covers basic biological safety requirements and it is expected that individual Faculties and Departments will develop and implement local safety instructions that are designed to meet their specific requirements but remain compatible with these guidelines. This manual should be used in conjunction with the Macquarie University General Laboratory Safety Guidelines and The Macquarie University Code for the Responsible Conduct of Research.

1.2 Policy
The University Biosafety and Biosecurity Policy is the enabling policy for this guide. Key provisions of the Policy state that Macquarie University will:

- Maintain an appropriately constituted Institutional Biosafety Committee (IBC) who is provided with the resources required for institutional monitoring.
- Ensure, through the IBC, that all research, teaching and services at the University involving biohazardous materials, genetically modified organisms (GMOs), security sensitive biological agents (SSBAs) and agents requiring quarantine containment are conducted in accordance with the relevant legislation, regulations, guidelines and codes.
- Ensure dealings with GMOs, the use of microorganisms classified as risk group 2 and above, animals potentially containing zoonotic microorganisms classified as risk group 2 and above, SSBAs or agents requiring containment or approval under the Quarantine Act 1908, are not commenced without the prior approval of the IBC.
- Ensure it maintains certification of OGTR and quarantine approved facilities.
- Enable the IBC to conduct monitoring inspections, at least annually, of the University’s laboratories to ensure compliance with the relevant Acts, Regulations, guidelines and codes.
- Conduct an institutional biosafety workshop at least annually for personnel involved in the acquisition, handling, storage, removal or disposal of biological materials on University premises to ensure that such personnel are aware of potential risks.
Macquarie University expects its staff, HDR candidates, students, researchers, contractors and visitors to adhere to this manual and to the University’s Biosafety and Biosecurity Policy to maintain a safe and healthy environment by minimising the risks from biological work procedures. To reach this standard, work with biological material will be guided by current Acts, Regulations, Codes of Practice, Australian Standards and University policy and procedures. See Appendix 1 for a detailed list of biosafety legislation.

Macquarie University requires that:

- Biological materials are obtained, transported, stored and disposed of in an ethical and responsible manner.
- Biological materials are handled in a way that will not put at risk the health and safety of any individual.
- University staff and students comply with training requirements.
- University staff and students are provided with sufficient information, instruction, and supervision to handle microorganisms, biohazardous materials and GMOs safely.

### 1.3 Objectives

The objectives of this manual are to ensure that:

- All staff, students, researchers, and visitors are aware of the biological hazards, legislative requirements, Australian Standards and University policy and procedures associated with working with microorganisms and biohazardous material.
- Staff, students and researchers are aware of their responsibilities in regard to biological safety at Macquarie University.
- All staff, students, researchers, and visitors receive appropriate training and information that enables them to recognise potential hazards associated with their work.
- All research and teaching involving GMOs, SSBAs, risk group 2 and above microorganisms, clinical and diagnostic samples, animal and human tissues, blood or body fluids, and materials requiring quarantine containment is assessed by the IBC. The use of humans, animals and their tissue, blood or body fluids in research and teaching receives approval from the appropriate (Human or Animal) Ethics Committees prior to commencement of work.
- All research and teaching involving non-pathogenic microorganisms or other biological material or agent unlikely to cause human or animal disease or harm the environment are risk assessed by the Chief Investigator or Unit Convenor prior to the commencement of work.
- Biohazardous operations involving microorganisms or diagnostic samples are performed in the appropriate manner and physical containment facility according to their risk groups.
- Risk management procedures are in place in the event of biological spills.
- Appropriate waste disposal systems are in place for biological materials.
2. Management Structure and Responsibility

2.1 Deputy Vice Chancellor (Research)
The Deputy Vice Chancellor (Research) is responsible to the Vice Chancellor for the Macquarie University IBC and that committee’s implementation of requirements as specified by the OGTR and other regulatory bodies.

2.2 Institutional Biosafety Committee
Under OGTR legislation, all work involving GMO’s must be reviewed by IBC. The Macquarie University IBC is responsible for:

- Reviewing research and teaching applications which involve the use of and dealings with risk group 2 and above microorganisms, animals potentially containing risk group 2 and above zoonotic microorganisms, GMOs, quarantine materials and SSBAs.
- Ensuring that the use of GMOs within the university is conducted in compliance with the Gene Technology Act 2000 and the Gene Technology Regulations 2001.

2.3 University Biosafety Officer
The University Biosafety Officer is authorised to advise and report on biosafety and quarantine matters. The Biosafety Officer assists the IBC in ensuring compliance of OGTR and Quarantine approved facilities.

2.4 Deans and Heads of Department
Deans and Heads of Department are responsible for ensuring that all employees and students receive appropriate information and training necessary for them to work and conduct their research safely and in accordance with this manual. They are to ensure that Technical and Facility Managers have resources to develop and implement procedures necessary to ensure that biosafety guidelines are met.

2.5 Laboratory and Facility Managers
Laboratory and Facility Managers are responsible for monitoring laboratory access and authorisation. They are to ensure that staff and students teaching, working or conducting research in their laboratories have undergone the appropriate laboratory safety induction prior to commencing. Managers of certified facilities (OGTR and quarantine) are to maintain all laboratory documentation required for their certification.

2.6 Chief Investigators
Chief Investigators (including Principal Investigators, Academic Supervisors, Research Supervisors and Unit Conveners) are responsible for the health and safety of the undergraduate and postgraduate students they supervise in addition to volunteers and staff employed under them. They are to ensure that their students and staff have received the appropriate laboratory safety induction and training to enable them to undertake their work safely and that associated risk assessments have been completed.
2.7 Staff, Students and Volunteers
Staff, students and volunteers working with biological hazards must ensure that they follow safety guidelines set out by Macquarie University and their respective Facility Manager and Chief Investigators. They are to ensure that their actions do not put themselves, or any other individual at risk.

3. Health Management

3.1 Immunisation
People working with infectious organisms, blood or bodily fluids or in animal holding facilities should routinely review their need for immunisation against preventable disease. Additionally, people who are immunosuppressed, immunocompromised or involved in any of the following activities should consider their need for immunisation:

- Field work
- Working with waste or contaminated water or soil
- Working with animals or insects
- First aid administration

It is mandatory for Chief Investigators to undertake a thorough risk management assessment to identify risks specific to any human pathogen brought into a facility and to which they or other research members may be exposed.

For a comprehensive guide to immunisations please visit:

- The Australian Immunisation Handbook 10th edition
- World Health Organisation website
- The Australian Federal Government Smart Traveller
- NSW Health occupational immunisation requirements

Tetanus, Hepatitis A, Hepatitis B and Q Fever are notifiable diseases in all states and territories in Australia. In NSW if an employee contracts Q fever it must be reported to WorkCover.

3.1.1 Tetanus
Tetanus is a disease caused by a toxin produced by *Clostridium tetani*. Any tetanus-prone wound can become contaminated with *C. tetani*. Tetanus-prone wounds are those other than clean, minor cuts and include:

- Wounds where disinfection has been delayed by more than 4 hours
- Compound fractures
- Bites
- Deep penetrating wounds
- Wounds containing contamination or foreign bodies (wood, dust, soil, manure)

Those at risk of tetanus include:

- Anyone at risk of scratches, bites and cuts from animals or their cages
- Anyone handling *C. tetani* or its toxin
• Outdoor workers

3.1.2 Hepatitis
Hepatitis A is one of several different hepatitis viruses that can cause infections and damage to the liver. Hepatitis A is caused by the hepatitis A virus and it is highly contagious and can be particularly dangerous for people with pre-existing liver problems. The virus is spread by the faecal oral route and can survive on hands, in food and in water for prolonged periods of time.

Hepatitis B is a potentially life-threatening disease caused by the hepatitis B virus. The Hepatitis B virus is spread through contact with blood and other bodily secretions. Immunisation is an effective way of protecting against hepatitis A and B viruses. Currently for Hepatitis C there is no immunisation or completely effective treatment.

Those at risk of hepatitis infections include anyone who:
• Handles a hepatitis virus
• Is exposed to human faecal material, blood, liver tissue and bile and other bodily secretions
• Works with non-human primates
• First aiders

3.1.3 Q fever
Q fever is amongst the most serious infective hazards and is a WorkCover-reportable illness in NSW. Q fever is a zoonotic infectious disease caused by the bacterium *Coxiella burnetii*, which can be harboured in numerous domesticated and wild animals. *C. burnetii* is highly infectious and is transmitted to humans via aerosols from contaminated body fluids of infected animals.

People considered at risk of exposure are those working with or handling:
• *Coxiella burnetii* as part of their work
• Animals potentially infected, especially pregnant animals, including native animals (e.g. kangaroos), companion animals (cats and dogs) and stock animals (pigs, sheep, cattle)
• Unfixed tissues, including carcasses from potentially infected animals
• Unfixed human samples (blood or tissue) that could be from individuals with Q fever

3.2 Precautions for Pregnant Women
Minimising laboratory risks for pregnant women is especially important due to the sensitivity of the foetus to specific biological agents. All lab workers should know the hazards associated with the materials with which they work and it is important to recognise that an individual’s susceptibility to those hazards may change due to factors such as pregnancy. In all cases, a pregnant woman should discuss her laboratory environment with her medical care professional and provide specific information about potential exposures.

3.3 Personal Hygiene
To prevent the spread of laboratory contaminants, it is important to use good microbiological techniques, wear the provided personal protective equipment (PPE) and ensure that hands are washed after completing a procedure, and before leaving the laboratory. See Appendix 3 for the recommended antiseptics for hand washing and Appendix 4 for good hand washing technique.
4. Research Approval and Risk Management

4.1 The Institutional Biosafety Committee (IBC)

The Macquarie University IBC help to minimise the risks associated with working with biological materials by asking Chief Investigators to complete an online Biosafety Application with an inbuilt risk assessment. Biosafety Applications are maintained by the IBC and are subject to routine monitoring to ensure the specified risk management strategies are being followed. The IBC also confirms that particular laboratories meet a physical containment level under OGTR, quarantine and AS/NZS 2243.3 specifications. The IBC is charged with monitoring all GMO, recombinant and synthetic biology projects and reports annually to the OGTR.

At Macquarie University, Biosafety Applications are required for all research, teaching or services that involve the use of biological materials. Biosafety Applications are submitted online and are reviewed by the IBC via an expedited review process between February 1st – November 30th.

*Please be advised that the IBC will be out of session from December 1st to January 31st.*

A Biosafety Application form for work involving the use of risk group 1 microorganisms (including animals with the potential to carry risk group 1 zoonoses) or other biological material or agent that is unlikely to cause human or animal disease or harm the environment is still required, however it is treated as a notification.

Biosafety Applications are approved for a period of five years, and for GMO projects approval is under the provision of annual reporting. All Biosafety Applications are subject to IBC audit and inspection.

4.2 Biosafety Management and Support

Work involving any of the below categories must not commence until IBC approval has been granted and the Macquarie University introductory biosafety course has been completed:

- Microorganisms classified as risk group 2 and above
- GMOs
- SSBAs
- Agents requiring containment under the Biosecurity Act 2015
- Animals with the potential to carry zoonotic agents classified as risk group 2 and above
- Human and animal clinical and diagnostic samples

A Biosafety Application form for work involving the use of risk group 1 microorganisms (including animals with the potential to carry risk group 1 zoonoses) or other biological material or agent that is unlikely to cause human or animal disease or harm the environment is still required, however it is treated as a notification.

Applications must be submitted via the Biosafety Management System using your OneID and password. All applications must be approved by the Chief Investigator prior to an IBC submission.
Biosafety Applications are approved for a period of five years, and for GMO projects approval is under the provision of annual reporting. All biosafety applications are subject to IBC audit and inspection.

The use of humans, animals and their tissue, blood or body fluids in research and teaching may require additional approval from the appropriate Human or Animal Ethics Committees prior to commencement of work.

For more information and supporting resources relating to submitting applications, safety documentation, the review process, and managing approved projects please refer to the Biosafety Management support page located on the University Wiki.

For clarification of GMO Dealings visit the OGTR website or the Macquarie University GMO Classification tables.

The Macquarie University introductory biosafety course is available online using iLearn. Please click on the following link and self-enrol using your OneID:

Macquarie University introductory biosafety course

4.3 Risk management

4.3.1 Hierarchy of control
A risk assessment section has been built into the Biosafety Application. The information requested on the risk assessment section is necessary to give the IBC and Chief Investigator enough information to decide if the work can be carried out safely and, in a laboratory, equipped to meet biosafety needs.

The risk assessment section follows a globally accepted risk management process known as the hierarchy of control. The hierarchy of control creates a systematic approach to manage biological risks safely by providing a structure to select the most effective control measures to eliminate or reduce the risk of hazards associated with a particular research project. The hierarchy of control has six levels of control, the most effective measure is at the top, the least effective at the bottom. As best practice it is recommended to try to incorporate the use of high end controls such as elimination, substitution, isolation and engineering controls as opposed to the use of low end controls such as administrative and the use of personal protective equipment. The hierarchy of control is included in all Risk Assessment Forms to provide a systematic approach for managing the risk associated with biological research hazards.

The hierarchy of control involves the following six steps;

1. **Elimination** – remove the cause of danger completely (e.g. inactivate infectious source).
2. **Substitution** – controls the hazard by replacing it with a less risky way to achieve the same outcome (e.g. use of a less pathogenic organism).
3. **Engineering /bioengineering controls** – Isolate the hazard from people and the environment by using physical or biological safety features to plant or equipment (e.g. Physical containment facility, Class II biosafety cabinet vaccines).
4. **Administration** – use of administrative controls to lessen the risk (e.g. signage, risk assessments and safe work procedures, training).

5. **Personal Protective Equipment (PPE)** – provides a personal barrier between the user and the infectious/toxic substance (e.g. gloves, eye protection, lab coat).

*Note:* The use of PPE to reduce the risk of an hazard should always be the last resort.

For more detailed information please refer to Appendix 5: The hierarchy of risk control.

### 4.3.2 Responsibility of the Chief Investigator

The Chief Investigator must ensure:

- Research and technical personnel have read risk assessments before work starts.
- Hard copies of risk assessments are available in the laboratory for reference.
- Research and technical personnel have received sufficient training and/or supervision to allow them to work and handle biological agents and materials in a safe manner.
- Faulty equipment is reported and removed from service where a danger exists.
- Safe Working Procedures are followed.
- Safety rules are followed.
- Emergency equipment is serviced.
- The physical containment level is appropriate for the risk group.
- Incidents, accidents and near miss occurrences are reported to the health and safety unit.
- Regular compliance checks and safety tours are carried out and any findings are documented.
- That they familiarise themselves with the AS/NZ 2243.3 standard.

### 4.3.3 Responsibility of Research and Technical Personnel

Research and technical personnel include, but is not limited to staff, students, animal care staff, research assistants and volunteers. Research personnel must ensure that they:

- Read the relevant risk assessment and relevant guidance material.
- Follow all relevant Safe Work Procedures and guidelines.
- Report any faulty equipment.
- Attend required training.
- Speak to a supervisor or laboratory manager about any safety concerns.
- Comply with the relevant safety rules and guidelines.

### 4.3.4 Register of Biological Hazards

The register of biological hazards lists all biologically hazardous materials and microorganisms used and stored in teaching and research laboratories. Hard copies of risk assessments are to be maintained in these laboratories and made available to personnel who conduct work in those laboratories. The register must be updated annually and should also indicate whether any SSBAs are being held.
4.3.5 Inductions
Any person entering a facility must comply with the local processes for induction. The level and
detail of the safety induction should depend upon the risk and legislative requirements associated
with procedures/work carried out and the materials and equipment stored within the lab. Induction
records must be kept and maintained. Access and authorization requirements will be determined on
the risk associated with the procedures/work carried out and the materials stored within the
laboratory.

4.3.6 Training
In order to reduce the inherent risks associated with biohazards, training, hazard awareness,
knowledge of the biological agent, good habits, caution, attentiveness and concern for the health of
coworkers are prerequisites for all individuals.

The University Research Office runs a Biosafety Workshop which outlines the legislative framework
for research using biological agents, potential risks associated with biological research, the
application process for such research and provides guidance on how to complete a risk assessment.
This workshop is mandatory for individuals intending to work with GMOs, biohazardous materials or
working in any of the Universities Physical Containment facilities. It is expected that individuals
refresh the Biosafety Workshop every three years. The IBC maintains all biosafety training records.
For further information please contact your supervisor, laboratory manager or the University
Biosafety Officer. In addition, the University has a Health and Safety unit for advice and guidance
ohs@mq.edu.au.

Quarantine training is mandatory for individuals working with quarantine materials or those working
within any of the University’s Quarantine Approved Premises (QAP). For further details contact the
QAP Facility Manager or the Biosafety Officer. The University IBC requires a copy of the certificates
once training has been successfully completed.

4.3.7 Laboratory Access and Authorisation
It is a condition of entry that all persons understand the general laboratory safety rules and accept
their responsibility under WHS Legislation to adhere to the safety rules at all times. Individual
Departments should implement local laboratory safety instructions that are designed to meet their
specific requirements. It is a requirement that inductions are performed for all University
laboratories. Induction records are to be maintained by the laboratory Manager. Access to general
laboratories is under the authorisation of the Laboratory Manager or Laboratory Supervisor. Access
and authorisation to physical containment facilities is under the direction from the Facility Manager
and may be dependent on completion of the Biosafety Workshop. Refer to the respective Facility
Manager for further information on access to their laboratories.

4.3.8 Personal Protective Equipment
Personal protective equipment (PPE) is specialised clothing or equipment worn by laboratory
personnel for protection against exposure to aerosols, splashes and accidental inoculation. PPE must
be worn while working in the laboratory and must not be taken home or worn outside the
laboratory. PPE equipment is selected to suit the type of work being performed and the potential
risk of exposure. Consult AS/NZS 2243.1:2005 for detailed information regarding the different types
of PPE. All PPE is to be removed and hands decontaminated prior to leaving the laboratory or
containment facility. Appendix 6 details a step by step process for safely removing PPE.
At a minimum, enclosed footwear is mandatory for all University research and teaching laboratories. Within research laboratories a properly fastened laboratory coat that protects the arms and body must be worn at all times unless lesser requirements can be justified by a risk assessment. Laboratories will supply safety glasses, goggles, face shields and gloves which meet Australian standards and appropriate to the type of work being performed.

4.3.9 Working After Hours
The University defines its business hours as Monday – Friday 7:00 am to 10:00 pm and weekends 8:00 am – 6:00 pm. After hours work is defined as the period outside of these business hours and Public Holidays. All individuals occupying a building after hours are required to advise the Security Information Centre (ext: 7112) of their presence in the building and an estimate of their length of stay.

4.3.10 Safety Documentation
Safe Work Instructions (SWIs) and Standard Operating Procedures (SOPs) outline the safe way to undertake a task and may be developed for techniques, processes and equipment to minimise any risk to individuals when working with biohazardous materials. Safety documentation is being developed and implemented across the University. Visit the university wiki websites below for current approved documents and templates:

Biosafety Management support page
Macquarie University Health and Safety

It is advised that individual research and teaching facilities have a procedure manual which highlights any specific requirements, standard processes and hazards associated with the work space. All staff and students are advised to familiarise themselves with it and consult the relevant Manager with any questions.

5. Standard Precautions
Human error, poor laboratory techniques and misuse of equipment cause the majority of laboratory injuries and laboratory acquired infections. The World Health Organization (WHO) has compiled a chapter of technical methods that are designed to avoid or minimise the most commonly reported problems of this nature. For further detailed information see the WHO Laboratory Biosafety Manual, Chapter 12

The National Health and Medical Research Council (NHMRC) have recommended adoption of the term ‘Standard Precautions’ as the basic risk minimisation strategy for handling potentially infectious material. Standard precautions are recommended for the care and treatment of all patients in the clinical environment and in the handling of:

- Microbiological agents
- Blood (including dry blood)
- Body fluids, secretions, excretions (excluding sweat)
- Non-intact skin
- Mucous membranes
Standard precautions are work practices required for the basic level of infection control and they include the use of:

- Good microbiological practices (aseptic techniques)
- Good hygiene practices (particularly washing and drying hands before and after patient and sample contact and when leaving the laboratory)
- Use of PPE (including the wearing of gloves, lab coats, gowns, plastic aprons, masks, eye protection)
- Waterproof coverings over any skin breaks
- Appropriate procedures for the handling and disposal of contaminated wastes
- Appropriate procedures for the handling and disposal of sharps

When used in combination with physical containment work practices described in AS/NZS2243.3:2010, this meets the requirements of implementing standard precautions. Specific AS/NZS 2243.3:2010 sections relating to physical containment work practices are listed below:

- Section 5.2.3 and 5.3.6 of a PC1 and PC2 Laboratory Containment Facility
- Section 6.4.3 and 6.5.5 of a PC1 and PC2 Animal Containment Facility
- Section 7.2.4 and 7.3.5 of a PC1 and PC2 Plant Containment Facility
- Section 8.2.4 and 8.3.5 of a PC1 and PC2 Invertebrate Containment Facility

Further infection control guidelines can also be found on the Department of Health website.

6. Microorganisms and Biohazardous Materials

6.1 Introduction

The laboratory contains many potential biological hazards. These include working with microorganisms (bacteria, fungi, viruses and parasites), genetically modified organisms, humans, animals, and their associated tissues and biohazardous substances such as prions, human blood, blood products, body fluids and raw and treated sewerage. The basic approach to working with microorganisms is to regard them as potential pathogens and to handle them with standard microbiological techniques. Such techniques help minimize the risk to laboratory staff, the environment and to maintain purity of strains of isolates. All work with microorganisms and biohazardous materials must be carried out according to the requirements detailed in the AS/NZS 2243.3:2010 Safety in Laboratories, Part 3: Microbiological safety and containment. Compliance with the relevant sections of AS/NZS 2243.3 is considered a minimum requirement for anyone handling microorganisms.

Microorganisms vary widely in their infectivity. This is partly due to differences in the portal of entry (skin, ingestion or via the respiratory tract), the physiology of the microorganism, the infectious dose and the ability of the microorganism to overcome intrinsic immune and other host defences.

Laboratory acquired infections may arise through:

- Inhalation through the production of aerosols from processes such as centrifugation, pipetting, opening cultures or flaming contaminated loops.
- Ingestion from accidental splashing into the mouth or contaminated hands.
• Sharps injuries via needle pricks, cuts with contaminated glass, and bites and scratches from animals.
• Transfer through open wounds or across mucosal membranes (eyes, mouth and nose).

6.2 Risk groups
The Australian Standard AS/NZS 2243.3:2010 classifies infectious microorganisms into risk groups. AS/NZS 2243.3:2010 lists risk groups by microorganism type (eg: viruses, bacteria, parasites, fungi) and further divides the lists into human/animal, plant and invertebrate infectious microorganisms. Safe work practices and physical containment levels for each group are detailed within the AS/NZS 2243.3:2010 standard. A list of risk group 2, 3 and 4 organisms can be found in Appendix 7.

6.2.1 Risk group classification for human and animal infectious microorganisms
Risk group classification for humans and animals is based on the agent’s pathogenicity, mode of transmission, host range, the availability of preventative measures and the availability of effective treatment.

Risk group 1 (low individual and community risk) – a microorganism that is unlikely to cause human or animal disease.

Risk group 2 (moderate individual risk, limited community risk) – a microorganism that is unlikely to be a significant risk to laboratory workers, the community, livestock, or the environment; laboratory exposures may cause infection, but effective treatment and preventative measures are available, and the risk of spread is limited.

Risk group 3 (high individual risk, limited to moderate community risk) – a microorganism that usually causes serious human or animal disease and may present a significant risk to laboratory workers. It could present a limited to moderate risk if spread in the community or the environment, but there are usually effective preventative measures or treatment available.

Risk group 4 (high individual and community risk) – a microorganism that usually produces life threatening human or animal disease, represents a significant risk to laboratory workers and may be readily transmissible from one individual to another. Effective treatment and preventative measures are not usually available.

6.2.2 Risk group classification for plant infectious microorganisms
The risk grouping of plant infectious microorganisms is primarily concerned with containment of plant pathogens to avoid risk to the environment. Factors considered in relation to the risk from plant infectious microorganisms are the ecological or economic impact; the agents presence in Australia or New Zealand; ease of spread; and the agents host range.

Plant risk group 1 – a microorganism that is unlikely to be a risk to plants, industry, a community or region and is already present and widely distributed.

Plant risk group 2 – a microorganism that is a low to moderate risk to plants, industry, a community or region and is present but not widely distributed.
**Pant risk group 3** – a microorganism that is a significant risk to plants, industry, a community or region and is exotic but with limited ability to spread without the assistance of a vector.

**Plant risk group 4** – a microorganism that is a highly significant risk to plants, industry, a community or region and is exotic and readily spread naturally without the assistance of a vector.

### 6.2.3 Risk group classification for invertebrates carrying infectious microorganisms

The risks posed by invertebrates are based on the microorganism that they may be harbouring. Factors considered in relation to their risk are based on: risk to laboratory workers, host range, economical/ecological impact, geographical distribution and ability to disperse. Some examples include viruses in mosquitos, Borrelia in soft ticks and trypanosomes in Triatmid bugs.

**Invertebrate risk group 1** – microorganisms that are carried by invertebrates where the microorganisms are unlikely to be a risk to humans or to the environment and are already present and widely distributed.

**Invertebrate risk group 2** – microorganisms that are carried by invertebrates where the microorganisms are a low to moderate risk to humans or to the environment and are present but not widely distributed. They have a limited ability to disperse because of low persistence of the microorganism outside the host. They are carried by invertebrates that are unlikely to be able to disperse or can be readily controlled.

**Invertebrate risk group 3** – microorganisms that are carried by invertebrates where the microorganisms are a significant risk to humans or to the environment and are exotic and have the ability to disperse with or without the aid of a vector. They are carried by invertebrates that are able to disperse.

**Invertebrate risk group 4** – microorganisms that are carried by invertebrates where the microorganisms are a highly significant risk to humans or to the environment and are exotic and readily able to disperse with or without the aid of a vector. The microorganisms may be carried by invertebrates that are difficult to detect visually.

### 6.3 Physical Containment

Containment of microorganisms involves a combination of buildings, engineering, equipment, worker practices and training to handle microorganisms safely. Physical containment is the term used to describe procedures and structures designed to reduce or prevent the release of viable organisms into the outside environment. The physical containment level used relates to the risk group classification of the microorganism, i.e. Physical Containment Level 2 for risk group 2. In some circumstances the physical containment level required for a particular microorganism may depend on the work being performed (e.g. Human Immunodeficiency Virus which is classified as both a risk group 2 and 3 microorganism). There are four classifications of Physical Containment Facilities and are identified by the ‘PC’ prefix followed by numbers 1 – 4. Not all laboratories operating within the University are certified containment facilities. Certain types of GMO and quarantine related dealings are required to be conducted in a certified facility.

**PC1 Facilities** – A PC 1 laboratory or facility is suitable for work with microorganisms where the hazard levels are low, and where standard laboratory practice can adequately protect laboratory or
facility personnel. This level of laboratory is usually suitable for undergraduate teaching laboratories. Specimens that have been inactivated or fixed may be handled in PC 1 facilities.

**PC2 Facilities** – A PC2 Laboratory or Facility is required for all work with microorganisms or material likely to contain microorganisms that are classified as risk group 2. If working with specimens containing microorganisms transmissible by the respiratory route or if the work produces a significant risk to humans or the environment from the production of infectious aerosols, a biological safety cabinet must be used.

PC3 Facilities – A PC3 laboratory or facility is required for all work with microorganisms or material likely to contain microorganisms that are classified as risk group 3. A PC3 laboratory or facility provides additional building features and services to minimize the risk of infection to individuals, the community, and the environment.

PC4 Facilities – This is the highest Physical Containment level and due to the highly hazardous nature of this work, rigorous requirements must be adhered to in these facilities. This level of laboratory or facility is required for work with microorganisms classified as risk group 4 microorganisms and other dangerous agents.

### 7. Work with Genetically Modified Organisms (GMOs)

#### 7.1 Introduction

Work involving genetic manipulation or the use of genetically modified organisms (GMOs) is regulated by the Gene Technology Act 2000 and the Gene Technology Regulations 2001 through the national Office of the Gene Technology Regulator (OGTR). The legislative mandate of the OGTR is to “prevent harm to human health and safety and the environment by regulating use of GMOs in Australia”.

A GMO is defined as:

- An organism that has been modified by gene technology, or
- An organism that has inherited particular traits from an organism (the initial organism), being traits that occurred in the initial organism because of gene technology, or
- Anything declared by the regulations to be a genetically modified organism, or that belongs to a class of entities declared by the regulations to be genetically modified organisms

Dealings with, in relation to a GMO, means the following:

- Conduct experiments with the GMO
- Make, develop, produce or manufacture the GMO
- Breed the GMO
- Propagate the GMO
- Use the GMO in the course of manufacture of an entity that is not the GMO
- Grow, raise or culture the GMO
- Import, transport or dispose of a GMO
The Macquarie University IBC is accredited by the OGTR to provide on-site monitoring of all teaching and research proposals of work involving the use of GMOs, and to act on behalf of the OGTR and the University to ensure that the Act, Regulations and guidelines are followed. All work with GMOs must:

- Have written approval from the IBC before commencement
- If the GMO is a vertebrate animal or cephalopod, then an animal ethics application is also required
- Comply with the Gene technology Act 2000, Gene technology Regulations 2001 and OGTR guidelines

### 7.2 Types of Dealings

There are a number of different classes of GMO dealings. The type of authorisation required for each class is based on the level of risk that the dealings may pose to people and the environment. These classes of dealings and the respective authorisation processes are described below.

#### 7.2.1 Exempt Dealings

Exempt Dealings are described in Schedule 2 of the Regulations and are a GMO category assessed as posing very low risk. The only legislative requirement for exempt dealings is that they must not involve an intentional release of a GMO into the environment. The OGTR does not require annual reporting of Exempt Dealings.

Exempt Dealings do not require a specified level of containment. If Exempt Dealings occur in uncertified facilities, those facilities must comply with the AS/NZS 2243.3:2010, Part 3: Microbiological Safety and Containment. The regulator has produced *Guidance Notes for the Containment of Exempt Dealings*, to provide guidance to persons conducting Exempt Dealings. Prior to commencement, approval from the IBC is required.

#### 7.2.2 Notifiable Low Risk Dealings

Notifiable Low Risk Dealings (NLRDs) are described in Schedule 3 of the Regulations and are a GMO category assessed as posing low risk to people and the environment provided the risk is properly managed. As a requirement of the Regulations, NLRDS must not be intentionally released and must be reported to the OGTR. NLRDS must be approved by the IBC and it is a condition of approval that the chief investigators complete an Annual Progress Report. NLRDS must be conducted by appropriately trained persons and must be transported, stored and disposed of in accordance with OGTR guidelines. NLRDs must be conducted within an OGTR certified facility. Macquarie University has certified PC1 and PC2 Facilities.

#### 7.2.3 Dealings Not Involving Intentional Release

Dealings Not Involving Intentional Release (DNIR) are described in Schedule 3 of the regulations and must be licensed by the regulator. DNIRs are subject to case by case assessments by the OGTR and a license will only be granted once the OGTR is satisfied that any risks posed by the dealings are able to be managed so as to protect the health and safety of people and the environment. Some examples of DNIR dealings are: clinical trials involving GMOs, genetic modifications that may increase the pathogenicity or toxicity of the GMO, and dealings involving pathogens that require PC3 or PC4 containment. Applications for DNIRs are first submitted and approved by the IBC before being
passed on to the OGTR. The OGTR has 90 days to approve a license. DNIRs must be conducted in a PC2 or higher OGTR certified facility.

7.2.4 Dealings Involving Intentional Release
Dealings Involving Intentional Release (DIRs) are dealings conducted outside containment facilities, for example GM Crops. DIRs must be licensed by the regulator and applications must include a risk assessment and risk management plan. All applications are submitted to the IBC before being passed on to the OGTR. The OGTR has default timeframe of 225 working days to decide on a DIR application. If the project is a ‘limited and controlled’ release the approval timeframe is 150-170 working days.

7.3 Synthetically Modified Organisms
Synthetic biology is a multidisciplinary and rapidly evolving field. It can be summarised as the design and construction of new biological parts, devices and systems that do not exist in nature, and the re-design of existing, natural biological systems for research and industrial purposes. The effect of synthetically modified organisms (SMOs) on biological diversity or the environment is not understood.

Currently there is no internationally agreed consensus about a definition of synthetic biology or its potential regulatory and risk assessment challenges. The United Nation’s Convention on Biological Diversity (CBD) has formerly urged for regulation and that member countries (which includes Australia) follow a precautionary approach to synthetic biology. The CBDs decision on synthetic biology urges all member countries to:

- Follow a precautionary approach to synthetic biology.
- Set up systems to regulate the environmental release of any synthetic biology organisms or products. These regulations must ensure that activities in one country cannot harm the environment of another. (Article 3 of the CBD)
- Ensure that no synthetic biology organisms are released for field trials without a formal prior risk assessment.
- Submit synthetic biology organisms, components and products to scientific assessments that consider risks to conservation and sustainable use of biodiversity as well as human health, food security and socio-economic considerations.
- Encourage research funds to assess the safety of synthetic biology as well the socio-economic impacts of the technology.
- Support developing countries to develop their capacity to assess synthetic biology.

8. Biosecurity
Biosecurity is a critical part of the government’s efforts to prevent, respond to and recover biologicals that threaten the health of humans and animals, the environment, and the economy. Specific laboratory biosecurity processes should be developed by facilities dealing with quarantine materials and SSBAs to ensure security measures are designed to prevent loss, theft, misuse, diversion or intentional release of pathogens or toxins that have the potential to cause significant damage to human health, the environment and the Australian economy.
Biosecurity in Australia is the responsibility of two Federal Government Departments which oversee all importation, exportation and use of biological materials of biosecurity concern:

**Department of Agriculture and Water Resources** – Prevent and control the importation and use of biological materials and are currently acting under the *Biosecurity Act 2015*.

**Department of Health** – (Formerly Department of Health and Aging) Prevent the deliberate release of harmful biological agents such as viruses, bacteria, fungi and toxins. Currently acting under the *National Health Security Act 2007, National Health Security Regulations 2008* and the SSBA Regulatory Scheme.

Strict control measures have been put in place for the importation, exportation and use of these biological materials. Please refer to the specific website for more detailed information.

### 9. Biosecurity and Quarantine

#### 9.1 Introduction

*The Department of Agriculture and Water Resources (DAWR)* (formerly Department of Agriculture, prior to that Department of Agriculture, Fisheries and Forestry: Biosecurity and prior to that AQIS) administers the importation and use of biological products to ensure the safe handling, security and disposal of such products in Australia. The aim of the DAWR is to prevent or control entry, establishment or spread of pests and diseases that will or could cause significant damage to humans, animals, plants, the environment or the economy. Imported biological materials should be considered as potentially infectious and handled and disposed of accordingly. The DAWR has specific regulations and requirements regarding the use (import, use, storage, and disposal) of agents requiring containment or approval under the *Biosecurity Act, 2015*.

#### 9.2 Imported Biologicals

Imported biological materials are considered to pose a potential quarantine risk. Imported biological materials are products containing material from human, animal, plant or microbial origin and include foods, therapeutics, laboratory materials and vaccines. Any person wishing to import biological materials may be required to have a Permit to **Import Quarantine Material** from the DAWR. Since January 2015, some of the conditions relating to quarantine compliance have changed; visit the DAWR and **BICON** websites for further detailed information. The university has a multi-user **BICON** account, to join please email biosafety@mq.edu.au.

It is mandatory to keep records of imported goods and should include the following details:

- Date the material was received
- Quarantine entry number and import permit number
- Name of the supplier
- Description of material
- Batch number
- Proposed research and analysis details
- Details of any special treatments
- Date when research or analysis was completed
• Methods and dates of disposal

Items are usually assessed by the DAWR as unrestricted, restricted or prohibited. Persons wanting to use restricted materials are required to obtain a permit for importation and use of the materials. The conditions of use will be detailed on the import permit. Some imported biological materials may need to be kept in Biosecurity Approved Arrangements (AAs; previously termed QAPs).

It is necessary to obtain an in vivo approval from the DAWR for the use of restricted imported biological products in non-laboratory animals and plants. Please note that an in vivo approval does not act as an import permit.

9.3 Biosecurity Approved Arrangements

Biosecurity AAs are containment facilities that have been approved by the DAWR to hold biological materials that are a concern to the Australian environment. The DAWR determines the level of quarantine containment required (BC1 – BC4) and this is stated on the import permit. There are several different classes of AAs and each type, and level has certain requirements governing its operation. Class 5 AAs relate to the Facilities at Macquarie University, within this class there are four different sets of criteria (5.1 – 5.4) for corresponding quarantine containment levels (BC1 – BC4). Macquarie University has Class 5 BC1 and BC2 Facilities. Please refer to the AA Facility DAWR information page for detailed information on the regulations associated with the different AA types (microbiological, animal and plant facilities).

All AA users must:

• Obtain DAWR import permits and in vivo approvals as required
• Undertake online DAWR training as advised by the Facility Manager
• Complete the Macquarie University Fit and Proper Person Self Declaration and lodge with the respective Facility Manager
• Comply with DAWR legislation and AS/NZS2243.3:2010 standards
• Ensure that all biological waste is disposed of appropriately
• Comply with conditions as described in the import permit

10. Security Sensitive Biological Agents (SSBAs)

10.1 Introduction

Security-sensitive biological agents (SSBAs) are biological agents that may be deliberately used to harm human and animal health or the Australian economy. They consist of infectious agents, such as bacteria and viruses, as well as toxins derived from plants or microorganisms. In 2009 the Federal Department of Health (DoH) implemented the SSBA Regulatory Scheme which includes:

• The National Health Security Act 2007
• National Health Security Regulation, 2008
• The Security Sensitive Biological Agent Standards

The scheme was implemented to improve the security of biological agents of concern in Australia. The scheme regulates the acquisition, isolation, storage, handling, transport and disposal of SSBAs.
10.2 SSBA Classification

SSBAs are categorised into two lists, Tier 1 and Tier 2. Regulation of Tier 1 list agents came into effect in January 2009 and that of Tier 2 agents in January 2010.

Individuals are in breach of the SSBA Regulatory Scheme if they have not registered their individual SSBA’s by 31st January 2010 with the Department of Health. Registration of SSBA’s requires the development of numerous documents, review of these documents by a committee, as well as requiring certain levels of security on the individual laboratory where the organisms are stored or used.

<table>
<thead>
<tr>
<th>Tier 1 Agents</th>
<th>Tier 2 Agents</th>
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</thead>
<tbody>
<tr>
<td>Abrin (reportable quantity 5mg)</td>
<td>African swine fever virus</td>
</tr>
<tr>
<td><em>Bacillus anthracis</em> (Anthrax—virulent strains)</td>
<td><em>Capripoxvirus</em> <em>(Sheep pox virus and Goat pox virus)</em></td>
</tr>
<tr>
<td>Botulinum toxin (reportable quantity 0.5mg)</td>
<td><em>Classical swine fever virus</em></td>
</tr>
<tr>
<td><em>Ebolavirus</em></td>
<td><em>Clostridium botulinum</em> <em>(Botulism; toxin-producing strains)</em></td>
</tr>
<tr>
<td>Foot-and-mouth disease virus</td>
<td>Francisella tularensis <em>(Tularaemia)</em></td>
</tr>
<tr>
<td>Highly pathogenic influenza virus, infecting humans</td>
<td>Lumpy skin disease virus</td>
</tr>
<tr>
<td>Marburgvirus</td>
<td><em>Peste-des-petits-ruminants virus</em></td>
</tr>
<tr>
<td>Ricin (reportable quantity 5 mg)</td>
<td><em>Salmonella Typhi</em> <em>(Typhoid)</em></td>
</tr>
<tr>
<td><em>Rinderpest virus</em></td>
<td><em>Vibrio cholerae</em> <em>(Cholera)</em></td>
</tr>
<tr>
<td>(serotypes O1 and O139 only)</td>
<td><em>(serotypes O1 and O139 only)</em></td>
</tr>
<tr>
<td><em>SARS coronavirus</em></td>
<td><em>Yellow fever virus</em> <em>(non-vaccine strains)</em></td>
</tr>
<tr>
<td><em>Variola virus</em> <em>(Smallpox)</em></td>
<td></td>
</tr>
<tr>
<td><em>Yersinia pestis</em> <em>(Plague)</em></td>
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</tbody>
</table>

10.3 Research Approval and Reporting

Handling of any Tier 1 or Tier 2 SSBA must be approved by the IBC and no work with the SSBA can commence until the University and facility have been registered with DoH.

The National Health Security Act 2007 requires Universities and facilities handling SSBAs to report their holdings to DoH for inclusion on a National Register and comply with relevant security standards. The following events must be reported to the DoH within 2 business days:

- The University starts to handle an SSBA
• The University starts to handle an SSBA that has not previously been included on the National Register
• If a University that is not registered to handle an SSBA at a facility and, as a result of its normal testing procedures, an SSBA is at least presumptively identified

In case of loss, misuse or theft the IBC must be advised immediately.

11. Laboratory Animals

11.1 Introduction
The use of animals or animal tissues for educational or research purposes is regulated in Australia by State Government legislation; the *NSW Animal Research Act 1985* and *Animal Research Regulations 2010* and the *Australian code for the care and use of animals for scientific purposes (8th Edition, 2013:NHMRC)*, which is incorporated by reference into the Animal Research Regulations.

Individuals intending to use animals as part of their teaching or research must be aware of the associated human health risks:

- Allergens (hair, fur, urinary proteins, faeces and parasites)
- Bites, scratches and kicks
- Zoonoses (diseases transmissible from animals to humans)
- Manual handling (lifting and carrying cages, animals and feed)
- Hazardous substances (anaesthetic gases, cytotoxic drugs, radioactive materials)
- Other risks associated with animal houses such as slips (especially in wet animal houses) and contact injuries from needles and sharps

Health surveillance may apply where as a worker you attend a pre-employment medical to ensure the workplace can be reasonably adjusted to accommodate any medical restrictions. This is handled in a confidential and implemented in accordance with the University Health Surveillance Program. For more information refer to the Macquarie University Health and Safety webpage.

11.2 Use of Animals at Macquarie University
It is the responsibility of the Animal Ethics Committee (AEC) to ensure, on behalf of the University, that animal research is conducted in accordance with the Australian code for the care and use of animals for scientific purposes (8th Edition, 2013:NHMRC).

At Macquarie University all teaching and research proposals involving the use of live vertebrate animals or cephalopods must have approval from the AEC before they can proceed. This includes the use of animals in research, teaching, field trials, product testing, diagnosis, the production of biological products, environmental studies and observational studies of wildlife. Please refer to the Macquarie University Animal Ethics website for application forms, training resources and legislative requirements.

If the project involves the use biohazardous materials, microorganisms classified as risk group 2 and above, GMOs, radioactive isotopes or other hazardous substances approvals will also need to be sought from the relevant committee and/or Officer. If working in one of the University’s Animal
Facilities individuals must also meet with the facility manager to ensure there is adequate space and resources available to complete the study and to schedule training.

12. Facility Work Practices

12.1 General Rules and Regulations

Laboratories are potentially hazardous work places. Strict adherence to laboratory safety rules and regulations can greatly reduce the risks associated with potential laboratory hazards. It is a condition of entry that all persons must understand the general laboratory safety rules and accepts their responsibility under WHS Legislation to adhere to the safety rules at all times.

All laboratory work shall be carried out with regard to the safety of laboratory occupants. The following requirements apply to all laboratory personnel:

- Individuals shall familiarise themselves with the recommendations and requirements in the laboratory safety manual.
- Individuals shall be familiar with, and shall use, the appropriate safety equipment provided.
- Individuals, who alone know the nature and contents of their experimental materials and apparatus, shall ensure that the apparatus (or the remains, if broken) is decontaminated before maintenance or disposal, and that materials are processed in accordance with laboratory policy before disposal.

Please see the Macquarie University General Laboratory Safety Guidelines and AS/NZS 2243.3 Section 2 for further information. It is recommended that individual Departments develop and implement local laboratory safety guidelines that are designed to meet their specific needs whilst still remaining compatible with these rules.

12.2 PC1 Facility

PC1 work practices are additional to general laboratory work practices. The following practices as described in AS/NZS 2243.3:2010 Section 5 are to be observed when working in a PC1 facility:

- Access to the laboratory is limited
- No food or drink is to be consumed or stored in the laboratory. Eating, drinking, smoking, shaving and the application of cosmetics shall be prohibited
- PPE worn and used in the laboratory shall comply with the requirements in AS/NZS 2243.1.
- Long hair shall be tied back
- All cultures must be clearly labelled and dated
- Do not store cultures for long periods of time on the bench. Transfer cultures to a dedicated storage area, such as refrigerators and cold rooms
- Used sharps, syringes and needles must be placed in the approved yellow sharps bins provided. Before placing into the yellow bins, needles must not be removed, bent, sheared or recapped. The use of sharps shall be restricted in the laboratory for use only when there is no alternative. Take care to prevent the dissemination of...
material while flaming a wire loop, by drawing the loop from the cooler to the hotter part of the Bunsen burner flame, or by using a hooded or an electric Bunsen burner

- Petri dish cultures of fungi must be sealed to prevent dispersal of spores
- Handle diagnostic kits and control sera with care as the exclusion of all pathogens cannot be guaranteed
- Take care to minimise the production of aerosols whilst working on an open bench
- Take precautions to ensure that reading and writing materials do not become contaminated
- Use self-adhesive labels
- Clean up all spills immediately and decontaminate the area
- Report significant spills and incidents immediately to the facility Manager
- Decontaminate benches at least daily and after each task is completed
- Remove laboratory coats and gowns and store in the facility
- Thoroughly wash hands and under fingernails before leaving the facility

12.3 PC2 Facility
The following work practices described in AS/NZS2243.3:2010 Section 5 must be followed in addition to the general laboratory and PC1 facility work practices:

- Instruction and training in handling infectious microorganisms shall be provided to laboratory personnel
- All individuals must receive an induction before they can work in the facility
- Potentially contaminated surfaces must be disinfected before maintenance of equipment is conducted
- Facility shall be inspected at least annually by the IBC to ensure its containment requirement still comply with AS/NZS 2243.3:2010 clause 5.4.4
- All clinical specimens shall be regarded as potentially hazardous. Leaking containers must be handled in a biological safety cabinet and the outside of the container disinfected. Where a replacement sample is obtainable, the leaking specimen shall be sterilised and disposed of
- For work that creates aerosols, such as shaking, mixing, ultrasonic disruption, a biological safety cabinet (BSC) or other equipment designed to contain he aerosol must be used
- A period of at least 5 minutes shall be allowed for aerosols to settle before opening homogeniser or sonicator containers in a BSC
- Special care must be taken when handling human blood, serum, other body fluids and substances that are visibly contaminated with blood, as they may contain viruses. The risk extends to human sera and derivatives used as control reagents
- Any container of viable micro-organisms transported outside the facility must be within a second unbreakable, closed and labelled container (secondary containment) which can be readily decontaminated. There should also be sufficient absorbent material (such as tissue paper) placed around the primary container to absorb any potential spill
- Potentially contaminated, reusable glassware must be pressure steam sterilised or chemically disinfected prior to washing and re-use
• Minor cuts, abrasions and dermatitis should be adequately covered and kept dry
• Bacterial cultures must not be sniffed for odours
• Laboratory work books must be kept separate from all research and experimental processes
• Protective clothing shall not be worn outside the facility and shall be decontaminated or disinfected prior to laundering or disposal

12.4 PC3 Facilities
The following practices as described in AS/NZS 2243.3:2010 Section 5 must be followed in addition to the general laboratory, PC1 and PC2 facility work practices:

• Facility shall be inspected at least annually by the IBC to ensure its containment requirement still comply with AS/NZS 2243.3:2010 clause 5.4.4
• The laboratory management shall establish policies and written procedures whereby only persons who have been advised of the biohazard, and who meet any medical requirements, shall enter the laboratory
• An effective emergency evacuation plan is in place
• All laboratory staff have specific training in handling pathogenic organisms and in the use of safety equipment and controls
• All laboratory procedures with risk group 3 infectious materials, shall be conducted in a BSC of Class I, Class II or Class III
• Outer clothing and personal effects shall not be taken into the containment facility
• No one shall enter the laboratory for cleaning, servicing of equipment, repairs or other activities before the relevant, potentially contaminated surfaces have been decontaminated and authorisation has been obtained from the facility manager
• Dedicated cleaning equipment shall be stored within the facility
• Viable biological materials to be removed from the containment laboratory shall be transferred to a non-breakable, sealed primary container, the external surface of which is decontaminated before enclosure in a non-breakable sealed secondary container
• Laboratory wastes shall be rendered safe, preferably by decontamination in a pressure steam steriliser before professional disposal
• If a double ended pressure seam steriliser is installed across the barrier, it shall be decontaminated after each exposure to the laboratory environment
• Protective clothing shall be removed in a predetermined appropriate order (note: in most circumstances this involves removing the gloves then decontaminating the hands followed by removal of eye protection, gown and respiratory protection, taking care not to touch potentially contaminated parts of PPE when doing so, then decontaminating hands again.
• Measures shall be taken to ensure no microbiological contamination is removed from the facility on footwear
• In the event of a power failure, entry to the facility shall be restricted until services have been restored.
12.5 GMO Physical Containment Facilities
Any person working with GMOs in a laboratory is required to follow the guidelines for containment facilities as set out by the OGTR in addition to all other requirements relating to the Physical Containment level as listed in the AS/NZS2243.3:2010 Section 5.

12.6 Biosecurity Approved Arrangements (AA)
Any person wishing to import microorganisms, animals, human products, plants or soil for their research is required to have an Import Permit from the Department of Agriculture and Water Resources (DAWR). The DAWR will assess if the products can be released on arrival or if they need to be used in an AA facility. If they need to be used and stored in an AA facility, conditions set by the DAWR must be met in addition to all other requirements listed in AS/NZS 2243.3:2010 (see section 9 of this manual).

13. Biological Spills

13.1 Introduction
To control the hazards associated with biological spills, every laboratory working with biohazards must develop written emergency spill/clean-up procedures appropriate to the hazards of that material. All laboratories working with biohazards must keep emergency spill/clean-up kits within the laboratory area that are tailored to suit the type of biological material and risk group of the microorganism being used in the work area. AS/NZS 2243.3:2010 provides information on the contents of basic spill kits.

The nature of the spill will determine the type of clean-up response required. Factors include:

- The size of the spill (small or large)
- The risk group classification of the organisms that has been spilled and how infectious it is
- If the spill is confined (in a BSC, incubator, refrigerator) or in the open (bench, floor)
- Whether aerosols are being produced
- If other hazards are involved (chemicals, isotopes, sharps)

Spill clean-up procedures are well documented in AS/NZS 2243.3:2010. Detailed instructions are also available from the Macquarie University Clean up – Biological Spills Safe Working Procedure and in Appendix 2.

13.2 Disinfectants
Characteristics of microorganisms affect their susceptibility to disinfection. All laboratory work areas and benches should be wiped down with 70%w/v (80%v/v) ethanol at the end of each experiment. Refer to Appendix 3 for recommended chemical disinfection in microbiological laboratories.

The DAWR also provides a list of broad spectrum disinfectants and sanitisers suitable for use in Approved Arrangements.
14. Laundering of Laboratory Gowns

Laboratory gowns should be laundered on a regular basis. Before being sent to laundry facilities, gowns used in PC2 or higher facilities must be autoclaved, unless otherwise specified. Refer to your respective Department for laundry procedures relating to specific laboratories.

15. Disposal of Biological Waste

15.1 Introduction

Biological waste management procedures must be adopted by Macquarie University to protect the health and safety of persons in control of or exposed to biohazardous waste in the workplace and the community in general. Faculties and Departments must develop, implement, maintain and monitor a biological waste management strategy. The waste management strategy adopted by Faculties and Departments must be environmentally responsible and comply with Federal and State legislation and any other regulatory requirements.

Laboratory waste disposal procedures should clearly outline:

- Who is responsible and the training requirements
- The categories into which waste is to be sorted or segregated
- The temporary storage facilities for waste storage
- The collection schedules
- The final disposal arrangements with a NSW Environment Protection Authority (EPA) approved waste disposal contractor
- Records of disposal of waste in accordance with health and government requirements

15.2 Waste Tracking Requirements

The transport of some wastes presents a high risk to the environment and human animal health. These wastes must be tracked when transported into, within or out of NSW. The waste consignor, transporter and receiving facility all have obligations to ensure that the waste is properly tracked. The Protection of the Environment Operations Act 1997 (POEO Act) is the key piece of environment protection legislation administered by the EPA.

Under the POEO Act and the NSW EPAs Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes, wastes classified as Clinical and related waste are subject to special monitoring and reporting requirements. The specific requirements of other biosafety standards and legislation (AS/NZS 2243.3: 2010, OGTR and DAWR) should also be consulted for additional waste handling requirements when required.

Macquarie University maintain waste disposal agreements with EPA-Licenced contractors for the transportation and disposal of waste. All records in regard to waste transportation, facility receipt and disposal are to be retained for 5 years. It is mandatory that all hazardous waste collection and disposal contracts are passed through Macquarie University Research Policy and Contracts to ensure they meet our obligations under the POEO Act.
15.3 Segregation of Laboratory Waste

Laboratories generate many different types of wastes. Each category of waste (chemical, biological, clinical, sharps and radioactive) requires segregation prior to storage and disposal. All personnel handling bagged laboratory wastes must:

- Not compress bags
- Not place hands inside the bag
- Not hold bags close to their body

Under AS/NZS 2243.1:2005 laboratory wastes should at least be sorted into the following categories:

- Non-contaminated paper and plastics which may be disposed of as general waste (AS/NZS 2243.3:2010)
- Non-contaminated broken glass which is placed in a designated container
- Contaminated broken glass which is disposed of in a dedicated container
- Sharps (AS/NZS 2243.3:2010)
- Clinical (AS/NZS 2243.3:2010)
- Biological (AS/NZS 2243.3:2010)
- Cytotoxic
- Radioactive (AS/NZS 2243.4:1998)
- Drugs of addiction

15.4 Clinical and Biological Waste

Clinical and biological waste has the potential to cause injury, infection or public offence. All laboratory waste contaminated with or potentially contaminated with microorganisms must be decontaminated before final disposal. It is understood that in house decontamination may not be possible for all biological waste generated at Macquarie University. In these circumstances alternative arrangements will be made after consultation with the IBC and Research Policy and Contracts to ensure the University meets obligations under current legislative requirements. It is recommended that local waste management plans for Faculties and departments are designed and implemented to meet their specific needs but they must be developed in accordance with:

- AS/NZS 2243.3:2010, Section 12 Contaminated materials and waste
- Protection of the Environment Operations Act 1997
- the NSW EPAs Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes
- OGTR and DAWR guidelines when applicable

Clinical and biological wastes include:

- Clinical specimens or samples of human origin (e.g. blood, body fluids, tissues, other clinical samples, swabs, bandages, wound dressing etc)
- Microbiological waste (petri-dish, other micro-organisms cultures, cell culture materials
- Recombinant DNA waste, genetically modified organisms and materials
• Animal waste (animal tissue and remains, carcasses, bedding and other animal materials)
• Quarantine waste
• Sharps waste
• Cytotoxic and pharmaceutical waste
• Radioactive waste

15.4.1 Microorganisms, clinical or other infectious waste
As defined in AS/NZS 2243.3:2010, wastes contaminated with microorganisms, clinical or other infectious waste can be treated by either two methods depending on local requirements:

*Best Practice*

Option 1: Wastes able to be rendered non-hazardous are to be done so by autoclaving (pressure steam sterilisation). Wastes are to be sealed in opaque impervious bags that render the waste “unrecognisable”. If waste is to be transported outside of the laboratory to autoclave facilities, it is to be done in a secondary sealed, leak-proof, unbreakable container. Although considered non-hazardous after autoclaving, the waste is deposited into the dedicated and locked contaminated waste bins and awaits collection by an EPA approved contractor. Liquid cultures that have been thoroughly decontaminated by pressure steam sterilisation may be disposed of to sewer (sink).

*Disposal by this method requires monitoring of the autoclave sterilisation cycles to ensure that the waste is thoroughly decontaminated prior to disposal. Monitoring includes the use of steam indicators (autoclave tape and indicator strips) or chemical or biological indicators.*

Option 2: Wastes that cannot be rendered non-hazardous prior to disposal must be sealed in appropriately labelled “yellow contaminated waste bags” at point of generation. These bags must be transported from the laboratory area in a secondary sealed, leak-proof, unbreakable container (garbage bin with sealable lid). Waste bags are to be placed in dedicated and locked contaminated waste bins until collection by an EPA approved contractor for disposal by incineration or autoclaved and shredded.

*Disposal by this method is subject to university approval to ensure waste obligations are met and that staff have been trained in the safe handling of hazardous wastes.*

15.4.2 GMO waste
OGTR mandates that recombinant DNA or GMOs be rendered non-hazardous before final disposal. For detailed instructions please consult the OGTR *Guidelines for the Transport, Storage and Disposal of GMOs*. GMO waste can be treated by either two methods depending on local requirements:

*Best Practice*

Option 1: Wastes able to be rendered non-hazardous are to be done so by autoclaving (pressure steam sterilisation). Wastes are to be double bagged and sealed in suitable impervious bags that render the waste “unrecognisable”. If waste is to be transported outside of the laboratory to autoclave facilities, it is to be done in a secondary sealed, leak-proof, unbreakable container. Although considered non-hazardous after autoclaving, the waste is deposited into the dedicated and locked contaminated waste bins and awaits collection by an EPA approved contractor. Liquid GMO
cultures that have been thoroughly decontaminated by pressure steam sterilisation may be disposed of to sewer (sink).

**Disposal by this method requires monitoring of the autoclave sterilisation cycles to ensure that the waste is thoroughly decontaminated prior to disposal. Monitoring includes the use of steam indicators (autoclave tape and indicator strips) or chemical or biological indicators.**

Option 2: Wastes are to be placed into lockable GMO dedicated bins within the laboratory. Once full, bin lids are to be permanently locked. Prior to bins being loaded onto the transporter trolley and removed from the laboratory, external surfaces must be decontaminated. Using the transporter trolley, full bins are to be store in a dedicated and locked storage area for the EPA approved contractor for disposal.

**Disposal by this method is subject to university approval to ensure waste obligations are met under OGTR and EPA legislation.**

15.4.3 Sharps waste
Sharps must be placed into a sharps container as soon as possible after use. To avoid needlestick injuries, needles must not be re-capped or bent and disposable needles/syringe sets should be discarded as a single unit. Sharps must be disposed of in approved yellow sharps containers which comply with AS4031-1992 *Non-reusable containers for the collection of sharp medical items used in health care areas*. Sharps containers are not be filled past the indicated line and once full, the sharps container must be sealed and placed in a yellow contaminated waste bags before being disposed of in lockable contaminated waste bins. Used sharps containers must not be emptied or reused under any circumstances.

15.4.4 Cytotoxic waste
Cytotoxic waste must be segregated from all other waste streams wherever possible and must be placed into dedicated purple cytotoxic waste bags, lockable bin or the purple cytotoxic sharps containers. If bins are to be used, once full they need to be locked permanently with the side locks, decontaminated on all external surfaces and stored in a dedicated lockable area for disposal contractor. Cytotoxic waste bags and sharps containers must be placed into a purple cytotoxic clinical waste bin for contractor. Disposal is by incineration at 1100°C.

15.4.5 Animal carcasses

15.4.5.1 Non-Biohazardous animal carcasses
Non-biohazardous animal carcasses are those that; are used for dissection purposes only in teaching; are surplus to experimental requirements; do not contain any GMOs, SMOs or SSBAs; or those that are not mandated under quarantine regulations. The EPA classifies non-biohazardous animal carcasses as putrescible (organic) waste which means they can be disposed of, without treatment, directly for deep burial at a landfill facility. Animals suitable for this disposal are required to be packaged into black garbage bags and de-identified of any labelling. Carcasses are to be refrigerated at 4°C or frozen until collected.

15.4.5.2 GMO animal carcasses
GMO animals that do not contain any hazardous or GMO microorganisms are rendered non-biohazardous through euthanasia. Such carcasses can then be disposed of as non-biohazardous.
Animals suitable for this disposal are required to be packaged into black garbage bags and de-identified of any labelling. Carcasses are to be refrigerated at 4˚C or frozen until collected.

15.4.5.3 Biohazardous and quarantine regulated animal carcasses
Imported animals or animal carcasses contaminated, or potentially contaminated with biohazardous materials, GMOs, SMOs or imported biologicals must be rendered non-hazardous prior to disposal. If facilities exist, animal carcasses may be rendered safe by autoclaving on site prior to landfill disposal.

**Disposal by this method requires monitoring of the autoclave sterilisation cycles to ensure that the waste is thoroughly decontaminated prior to disposal.**

If in-house autoclaving is not available, animal carcasses are to be double bagged and held in the freezer before being transported by an approved transporter to the designated waste disposal contractor for high temperature incineration or other methods approved by the Department of Agriculture and Water Resources. For materials and animals regulated by quarantine the methods of disposal must be consistent with the import permit.

**Disposal by this method is subject to university approval to ensure waste obligations are met under OGTR and EPA legislation**

15.4.5.4 Perfused animal carcasses
Animals and animal tissues perfused with formaldehyde or paraformaldehyde are deemed non-biohazardous. However, these animals are unable to be autoclaved due to the generation of toxic fumes. Perfused animals and animal tissues must be placed in plastic bags with a label indicating the chemical hazard and segregated from non-perfused materials. Carcasses are to be refrigerated at 4˚C or frozen until collected.

15.4.6 Drugs of addiction
Drugs of addiction are substances which are addiction producing or potentially addiction producing. Possession and use are strictly limited. Destruction of a drug of addiction may be carried out only by or under the direct personal supervision of a person authorised by the NSW Ministry of Health such as Pharmaceutical Services Senior Pharmaceutical Officers, a police officer or another authorised individual. The destruction is to be recorded in the facilities drug register, and show the date, the name of the person who carried out the task and their registration number. Please refer to the local Facility Manager for the disposal procedure of empty containers used to store drugs of addiction.

### 16. Appendix 1 Biosafety Legislation

<table>
<thead>
<tr>
<th>Commonwealth Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Controls Act 1984</td>
</tr>
<tr>
<td>Biosecurity Act 2015</td>
</tr>
<tr>
<td>Crimes (Biological Weapons) Act1976</td>
</tr>
<tr>
<td>Crimes (Biological Weapons) Regulation 1980</td>
</tr>
<tr>
<td>Gene Technology Act 2000</td>
</tr>
</tbody>
</table>

Contact: biosafety@mq.edu.au  
Version: 1.5  
Date: June 2018
Gene Technology Regulations 2001
National Health Security Act 2007
National Health Security Regulations 2008
Prohibition of Human Cloning Act 2002
Quarantine Act 1908
Research Involving Human Embryos Act 2002

**NSW Legislation**

- Anatomy Act 1977
- Animal Research Act 1985
- Animal Research Regulation 2010
- Biological Control Act 1985
- Gene Technology (NSW) Act 2003
- Human Tissue Act 1983
- NSW Work Health and Safety Act 2011
- NSW Work Health and Safety Regulations 2011
- Protection of the Environment Operations Act 1997
- Public Health Act 1991
- Public Health (Microbial Control) Regulation 2000
- Research Involving Human Embryos (NSW) Act 2003

**Australian Standards**

- AS/NZS 2243.3:2010 Microbiological Safety and Containment
- AS/NZS 2243.1:2005 Safety in Laboratories – Planning and Operational Aspects
- AS/NZS 2982:2010 Laboratory Design and Construction
- AS/NZS 4501.1:2008 Occupational Protective Clothing
- AS/NZS 4501.2:2006 Occupational Protective clothing

**Other**

- SafeWork NSW
- World Health Organisation Biosafety Manual
## Clean up - Biological Spills

<table>
<thead>
<tr>
<th>Safe Working Procedure No:</th>
<th>SWP - 2014-043</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faculty:</td>
<td>Science</td>
</tr>
<tr>
<td>Department/Office:</td>
<td>Biological Sciences &amp; CBMS</td>
</tr>
<tr>
<td>Contact(s):</td>
<td>Elsa Mardones &amp; Marita Holley</td>
</tr>
</tbody>
</table>

### Location of Equipment
Not applicable

### Approvals, Training or Qualifications required:
Only properly equipped and adequately trained personnel to clean spills.

### Supervision Required
Periodic checks by Lab Supervisor to ensure work areas are clean

### Warnings
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Wording</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Biohazard" /></td>
<td>Biohazard</td>
</tr>
<tr>
<td><img src="image" alt="Aerosol production" /></td>
<td>Aerosol production</td>
</tr>
<tr>
<td><img src="image" alt="Environmental contamination" /></td>
<td>Environmental contamination</td>
</tr>
<tr>
<td><img src="image" alt="Infectious substance" /></td>
<td>Potential Infectious substance</td>
</tr>
<tr>
<td><img src="image" alt="Take care with sharps" /></td>
<td>Take care with sharps</td>
</tr>
</tbody>
</table>

### Restrictions
Trained personnel only to clean

### Personal Protective Equipment
<table>
<thead>
<tr>
<th>PPE</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves</td>
<td><img src="image" alt="Gloves" /></td>
</tr>
<tr>
<td>Enclosed footwear</td>
<td><img src="image" alt="Enclosed footwear" /></td>
</tr>
<tr>
<td>Lab coat</td>
<td><img src="image" alt="Lab coat" /></td>
</tr>
<tr>
<td>Eye Wear</td>
<td><img src="image" alt="Eye Wear" /></td>
</tr>
<tr>
<td>Face Mask</td>
<td><img src="image" alt="Face Mask" /></td>
</tr>
</tbody>
</table>

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_Hard copies of this document are considered uncontrolled. Please refer to (Area) for latest version._

_Source: Manager, Health & Safety_
_Created: August 2009_
_Revised: June 2010_
_Version No: 1_
<table>
<thead>
<tr>
<th>Potential Hazards</th>
<th>Hazard</th>
<th>Possible Consequences</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biohazard, Infectious substances, Genetically Modified Organisms</td>
<td>Cross contamination, Infection, illness, damage to environment</td>
<td>Physical containment used were possible supported by PPE and training</td>
<td></td>
</tr>
<tr>
<td>Sharps, Broken Glass</td>
<td>Cuts, infection</td>
<td>PPE &amp; training</td>
<td></td>
</tr>
</tbody>
</table>

**Environment**

Ensure biohazard does not enter unfiltered air ventilation or environment.

**Procedure**

*Small spill of Risk group 1 or 2 material outside of Biological Safety cabinet (< 100mls)*

1. Put on appropriate PPE.
2. Contain the spill do not spread it, wipe material towards the centre.
3. Remove any sharp objects with forceps.
4. Cover the biological spill with absorbent material such as paper towels.
5. Dispose of contaminated paper towels in the biological waste bin.
6. Cover area with suitable disinfectant and leave for the appropriate contact time.
7. Autoclave or disinfect any equipment used in the clean-up.
8. Do not autoclave anything that has been in contact with chlorine as this will produce chlorine gas when heated.
9. Remove and decontaminate any PPE (including lab coats) according to laboratory protocols.

*Large spill of Risk group 1 material outside of a Biological safety cabinet (>100mls)*

1. Get help if required but take steps to minimise exposure to others.
2. Procedure is the same as for small risk group 1 but on a larger scale.
3. Notify the lab manager or supervisor that there has been a spill.

*Large spill of Risk group 2 material outside of a Biological safety cabinet (>100mls)*

1. Get help if required but take steps to minimise exposure to others.
2. Contact the PC2 lab manager immediately.
3. Keep people out of the area except for trained personnel assisting in clean up. If the spill is potentially infectious the area must be vacated for 30 minutes to allow aerosols to settle before the clean-up procedure can commence.
4. Follow the instructions inside the Biohazard Spill kit.
5. Remove and decontaminate any PPE (including lab coats) according to laboratory protocols.
6. Report the incident to the lab manager and the University Health & Safety unit.

**Spill in a Biological Safety Cabinet**

1. Ensure that the cabinet is on and continues to operate during the clean-up procedure.
2. Put on PPE.
3. Remove any sharp objects with forceps.
4. Cover the spill with absorbent material and dispose of in the biological waste bin.
5. **All surfaces must be decontaminated.** Cover the affected area with suitable disinfectant and leave for the appropriate contact time.
6. Ensure that the surfaces below the work area are also treated.
7. Remove and decontaminate any PPE (including lab coats) according to laboratory protocols.
   - Risk group 1: Lab manager or supervisor
**Spill in a centrifuge**

A biological spill in a centrifuge has the potential for creating aerosols. As soon as the operator becomes aware of a spill immediate action is required.

1. Turn off centrifuge.
2. If hazardous or infectious aerosols have been generated then close the centrifuge.
3. Notify others working in the area of the potential hazard.
4. Allow 30 minutes settling time before clean up procedures commence.
5. Put on PPE.
6. Remove debris.
7. Place contaminated equipment in leak proof bag and if possible transfer to Biological Safety cabinet for disinfection.
8. Disinfect inside of centrifuge.
9. Remove and decontaminate any PPE (including lab coats) according to laboratory protocols.
   - Risk group 1: Lab manager or supervisor
   - Risk group 2: Lab manager and the University Health & Safety unit

### Emergency Procedures

In the event of a biological spill over 100mls or any Risk group II organism contact Lab Manager and Biosafety officer.

### Clean Up & Waste Disposal

Autoclave or disinfect any equipment, including PPE and materials used in the clean-up procedure. Dispose of waste material in the locked yellow waste bins.

### Maintenance

Regular cleaning and maintenance of filters and air extraction systems.

---

<table>
<thead>
<tr>
<th>Date Approved</th>
<th>27/03/2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of Commencement</td>
<td>27/03/2014</td>
</tr>
<tr>
<td>Date for Next Review</td>
<td>27/03/2016</td>
</tr>
</tbody>
</table>

**Supporting Documentation**


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**Macquarie University Biosafety and Biosecurity Manual**

**Version**: 1.5

**Contact**: biosafety@mq.edu.au

**Date**: June 2018
## Appendix 3 Summary of recommended disinfectants for microbiological laboratories

<table>
<thead>
<tr>
<th>Site or equipment</th>
<th>Routine or preferred method or usage</th>
<th>Acceptable alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benches and surfaces (not obviously contaminated)</td>
<td>Alcohols e.g. 70% w/v (=80% v/v) ethyl or 60-70% v/v isopropyl – swabbed</td>
<td>Synthetic phenolics*</td>
</tr>
<tr>
<td>Biological safety cabinet (BSC) work surfaces</td>
<td>Alcohols e.g. 70% w/v (=80% v/v) ethyl – swabbed or high concentration chlorine disinfectant at 5000 – 10 000 p.p.m. (0.5 – 1%) or other disinfectant depending on the organism</td>
<td>For BSC with capture hoods, glutaraldehyde** (with cabinet fan operating) – swabbed (See AS/NZS 2647)</td>
</tr>
<tr>
<td>Room space e.g. laboratory or animal room, BSC before servicing or testing or after a major spill</td>
<td>Formaldehyde vapour</td>
<td>Vaporized hydrogen peroxide or chlorine dioxide</td>
</tr>
<tr>
<td>Centrifuge rotor or sealable bucket after leakage or breakage</td>
<td>Disinfection not the preferred method. Pressure steam sterilising at 121°C for 15 min recommended</td>
<td>glutaraldehyde** for 10 min or synthetic phenolics* for bacterial spills for 10 min</td>
</tr>
<tr>
<td>Centrifuge bowl after leakage or breakage</td>
<td>Glutaraldehyde** for 10 min (swabbed twice within the 10 min period then wiped with water)</td>
<td>Synthetic phenolics* for bacterial spills for 10 min</td>
</tr>
<tr>
<td>Discard containers (pipette jars)</td>
<td>Chlorine disinfectant at 2000 – 2500 p.p.m. (0.2% - .25%)</td>
<td>Synthetic phenolics* for bacteriological work (Changed weekly) or detergent with pressure steam sterilising for virus work</td>
</tr>
<tr>
<td>Equipment surfaces before services or testing</td>
<td>Surfaces disinfected according to manufacturer’s instructions</td>
<td>Alcohol (80% v/v ethyl or 60-70% v/v isopropyl) except when its flammability poses a hazard or glutaraldehyde** then water</td>
</tr>
<tr>
<td>Gnotobiotic animal isolators</td>
<td>Peracetic acid at 2% v/v – swabbed</td>
<td>Isopropyl (60 – 70% v/v or ethyl alcohol (80% v/v) with emollients or Povidone-iodine (0.75 – 1% av I) for 2 min</td>
</tr>
<tr>
<td>Hands disinfection</td>
<td>Chlorhexidine (0.5 – 4% w/v) in alcoholic formulations for 2 min *</td>
<td>Detergent cleansers or soap for 15 s</td>
</tr>
<tr>
<td>Hygienic hand wash</td>
<td>Chlorhexidine (4%w/v) in detergent formulation (or alcoholic formulations) for 15 S</td>
<td></td>
</tr>
</tbody>
</table>

* Dilute according to manufacturer’s instructions

** Glutaraldehyde as 2% w/v activated aqueous or 1% w/v glycol-complex formulations
<table>
<thead>
<tr>
<th>Site or equipment</th>
<th>Routine or preferred method or usage</th>
<th>Acceptable alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spills of blood/serum (or viral cultures)</td>
<td>High concentration chlorine at 5000 – 10 000 p.p.m (0.5 – 1%) for 10 min (active against hepatitis viruses and HIV)</td>
<td>glutaraldehyde** for 10 min</td>
</tr>
<tr>
<td>Spills of bacterial cultures</td>
<td>High concentration chlorine at 5000 – 10 000 p.p.m (0.5 – 1%) or Iodophor * for 10 min</td>
<td>Synthetic phenolics* unaffected by organic load) for 10 min</td>
</tr>
<tr>
<td>Animal cages</td>
<td>Wash with detergent followed by pressure steam sterilising at 121°C for 15 min if infected</td>
<td></td>
</tr>
<tr>
<td>Drains and animal rooms (surfaces)</td>
<td>Sodium Hydroxide 1M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Dilute according to manufacturer’s instructions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>** Glutaraldehyde as 2% w/v activated aqueous or 1% w/v glycol-complex formulations</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** QAP facilities must follow disinfectants approved by the Department of Agriculture and Water Resources. Please visit their website below:

19. Appendix 4: Good Hand washing technique
Source: World Health Organisation

How to Handwash?

WASH HANDS WHEN VISIBLY SOILED! OTHERWISE, USE HANDRUB

Duration of the entire procedure: 40-60 seconds

1. Apply enough soap to cover all hand surfaces;
2. Rub hands palm to palm;
3. Right palm over left dorsum with interlaced fingers and vice versa;
4. Palm to palm with fingers interlaced;
5. Backs of fingers to opposing palms with fingers interlocked;
6. Rotational rubbing of left thumb clasped in right palm and vice versa;
7. Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;
8. Rinse hands with water;
9. Dry hands thoroughly with a single use towel;
10. Use towel to turn off faucet;
11. Your hands are now safe.

Source: World Health Organisation

World Health Organization  Patient Safety  SAVE LIVES
A World Alliance for Safer Health Care  Clean Your Hands
20. Appendix 5: The hierarchy of risk control

Source: SafeWork NSW, Code of Practice: How to manage work health and safety risks


20.1 Key Terms

Hazard means a situation or thing that has the potential to harm a person. Hazards at work may include manual tasks, biological, radiation, hazardous chemicals, noise, electricity, machinery and equipment.

Risk is the possibility that harm (death, injury or illness) might occur when exposed to a hazard.

Risk control means taking action to eliminate health and safety risks so far as is reasonably practicable, and if that is not possible, minimising the risks so far as is reasonably practicable. Eliminating a hazard will also eliminate any risks associated with that particular hazard.

20.2 Hierarchy of risk control

The ways of controlling risks are ranked from highest level of protection and reliability to the lowest as shown in the below figure. This ranking is known as the hierarchy of risk control. Biohazard risk assessments include this hierarchy to assist in managing the risks associated with working with biological agents. Elimination of a hazard is the most effective control. If this is not reasonably practicable, you must minimise the risk by working through the other alternatives in the hierarchy.

![Hierarchy of risk control diagram]

**FIGURE 2: The hierarchy of risk control**

- **Level 1**: Eliminate the hazards
  - Substitute the hazard with something safer
  - Isolate the hazard from people
  - Reduce the risks through engineering controls

- **Level 3**: Reduce exposure to the hazard using administrative actions
  - Use personal protective equipment
Level 1 control measures are the most effective and involve eliminating the hazard and associated risk. For example, you can eliminate the risk of working with a risk group 2 organism by eliminating its infectivity e.g. irradiation.

Level 2 control measures are used when it is not reasonably practicable to eliminate the hazard and associated risk. There are three approaches to reduce risk at this level:

Substitute the hazard with something safer. For example, using a non-human pathogenic strain

Engineering controls / Isolate the hazard by physically separating the source of harm from people by distance or using barriers. For example, working inside a physical containment facility or conducting work inside a biosafety cabinet.

Level 3 control measures These controls are the least effective in minimising risks and should be used as a last resort or to supplement the higher-level control measures. Two approaches to reduce risk in this way are:

Administrative controls are work methods or procedures that are designed to minimise exposure to a hazard. For example, providing training for working with biohazardous materials, laboratory inductions, safe work procedures and signage.

Personal protective equipment (PPE) is the final control measure and limits exposure to the hazard only if it is used correctly. For example, laboratory coats, eye protection, face masks and gloves.
(Source: Centre for Disease Control)
## 22. Appendix 7: Examples of microorganisms for risk groups 2 and 3

### 22.1 Risk group 2 microorganisms

<table>
<thead>
<tr>
<th>Examples of risk group 2 bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiototripha spp.</td>
</tr>
<tr>
<td>Acidovorax spp.</td>
</tr>
<tr>
<td>Acinetobacter spp.</td>
</tr>
<tr>
<td>Actinobacillus spp.</td>
</tr>
<tr>
<td>Actinomyces pyogenes</td>
</tr>
<tr>
<td>Aeromonas hydrophila</td>
</tr>
<tr>
<td>Afipia spp.</td>
</tr>
<tr>
<td>Arcanobacterium haemolyticum</td>
</tr>
<tr>
<td>Bacillus cereus</td>
</tr>
<tr>
<td>Bartonella henselae, B. quintana, B. vinsonii, B. elizabethiae, B. weisi</td>
</tr>
<tr>
<td>Bordetella pertussis</td>
</tr>
<tr>
<td>Brucella ovis</td>
</tr>
<tr>
<td>Campylobacter coli, C. fetus, C. jejuni</td>
</tr>
<tr>
<td>Capnocytophaga canimorsus</td>
</tr>
<tr>
<td>Chlamydia spp. (except avian strains of C. psittaci)</td>
</tr>
<tr>
<td>Clostridium spp. (except those known to be nonpathogenic)</td>
</tr>
<tr>
<td>Corynebacterium diphtheriae, C. renale, C. pseudotuberculosis</td>
</tr>
<tr>
<td>Dermatophilus congolensis</td>
</tr>
<tr>
<td>Edwardsiella tarda</td>
</tr>
<tr>
<td>Eikenella corrodens</td>
</tr>
<tr>
<td>Enterococcus spp. (Vancomycin-resistant strains)</td>
</tr>
<tr>
<td>Erysipelothrix rhusiopathiae</td>
</tr>
<tr>
<td>Pathogenic Escherichia coli (except Verocytotoxin-producing (VTEC) strains and genetically crippled strains)</td>
</tr>
<tr>
<td>Fusobacterium spp.</td>
</tr>
<tr>
<td>Gardnerella vaginalis</td>
</tr>
<tr>
<td>Risk group 2 bacteria requiring special precautions</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td><strong>Borrelia (mammalian) spp.</strong></td>
</tr>
<tr>
<td><strong>Burkholderia pseudomallei</strong></td>
</tr>
<tr>
<td><strong>Clostridium botulinum</strong></td>
</tr>
<tr>
<td><strong>Clostridium tetani</strong></td>
</tr>
<tr>
<td><strong>Corynebacterium diphtheriae</strong></td>
</tr>
<tr>
<td><strong>Coxiella burnetii (smears and serology from samples)</strong></td>
</tr>
<tr>
<td><strong>Escherichia coli Vero cytotoxin-producing strains, e.g. 0157, 0111</strong></td>
</tr>
<tr>
<td><strong>Leptospira interrogans (all serovars)</strong></td>
</tr>
<tr>
<td><strong>Listeria monocytogenes</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of risk group 2 parasites (infective stages only)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ancylostoma duodenale</strong></td>
</tr>
<tr>
<td><strong>Ascaris lumbricoides</strong></td>
</tr>
<tr>
<td><strong>Babesia divergens</strong></td>
</tr>
<tr>
<td><strong>Babesia micro-organismst</strong></td>
</tr>
<tr>
<td><strong>Brugia spp.</strong></td>
</tr>
<tr>
<td><strong>Cryptosporidium spp.</strong></td>
</tr>
<tr>
<td><strong>Echinococcus spp.</strong></td>
</tr>
<tr>
<td><strong>Entamoeba histolytica</strong></td>
</tr>
<tr>
<td><strong>Giardia duodenalis</strong> (also known as Giardia lamblia and Giardia intestinalis)**</td>
</tr>
<tr>
<td><strong>Hymenolepis diminuta</strong></td>
</tr>
<tr>
<td><strong>Hymenolepis nana</strong> (human origin)**</td>
</tr>
<tr>
<td><strong>Leishmania</strong> (mammalian) <strong>spp.</strong></td>
</tr>
<tr>
<td><strong>Loa loa</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of risk group 2 fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aspergillus fumigatus and A. flavus</strong></td>
</tr>
<tr>
<td><strong>Candida albicans</strong></td>
</tr>
<tr>
<td><strong>Cryptococcus neoformans</strong></td>
</tr>
</tbody>
</table>
### Examples of risk group 2 viruses and prions

<table>
<thead>
<tr>
<th>Family</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenoviridae</td>
<td>Respiratory syncytial virus</td>
</tr>
<tr>
<td>Adenovirus</td>
<td>Respirovirus</td>
</tr>
<tr>
<td>Arenaviridae</td>
<td>Parainfluenza 1, 2, 3 and 4</td>
</tr>
<tr>
<td>Arenavirus</td>
<td>Parvoviridae</td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis (LCM) non-neurotropic strains</td>
<td>Human parvovirus</td>
</tr>
<tr>
<td>Tacaribe virus complex</td>
<td>Picornaviridae</td>
</tr>
<tr>
<td>Caliciviridae</td>
<td>Encephalomyocarditis</td>
</tr>
<tr>
<td>Feline calicivirus</td>
<td>Encephalomyocarditis virus</td>
</tr>
<tr>
<td>Norwalk-like</td>
<td>Enterovirus</td>
</tr>
<tr>
<td>Sapporo-like</td>
<td>Coxsackie</td>
</tr>
<tr>
<td>Largovirus</td>
<td>Echo</td>
</tr>
<tr>
<td>Rabbit haemorrhagic disease</td>
<td>Entero</td>
</tr>
<tr>
<td>Coronavirus</td>
<td>Parecho</td>
</tr>
<tr>
<td>Coronavirus</td>
<td>Polio 1, 2 and 3</td>
</tr>
<tr>
<td>Flaviviridae</td>
<td>Rhinovirus</td>
</tr>
<tr>
<td>Flavivirus</td>
<td>Hepatovirus</td>
</tr>
<tr>
<td>Dengue 1, 2, 3 and 4</td>
<td>Hepatitis A</td>
</tr>
<tr>
<td>Japanese encephalitis (Nakayama strain)</td>
<td>Poxviridae</td>
</tr>
<tr>
<td>Kokobera</td>
<td>Orthopoxivirus</td>
</tr>
<tr>
<td>Kunjin</td>
<td>Vaccinia</td>
</tr>
<tr>
<td>Murray Valley encephalitis</td>
<td>Parapoxvirus</td>
</tr>
<tr>
<td>Sarafend</td>
<td>Orf</td>
</tr>
<tr>
<td>Saumarez Reef</td>
<td>Prions</td>
</tr>
<tr>
<td>Yellow fever (strain 17D)</td>
<td>Gerstmann-Sträussler syndrome,</td>
</tr>
<tr>
<td>Hepacivirus</td>
<td>Kuru and Creutzfeldt-Jakob agents (See Note 1 and Clause 3.5)</td>
</tr>
<tr>
<td>Hepatitis C</td>
<td>Reoviridae</td>
</tr>
<tr>
<td>Hepadnaviridae</td>
<td>Orbivirus</td>
</tr>
<tr>
<td>Duck hepatitis B</td>
<td>Bluetongue viruses (endemic strains)</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Epizootic haemorrhagic disease viruses of deer (endemic strains)</td>
</tr>
<tr>
<td>Herpesviridae</td>
<td>Rotavirus</td>
</tr>
<tr>
<td>Alphaherpesvirinae</td>
<td>Rotaviruses</td>
</tr>
<tr>
<td>Simplex</td>
<td>Retroviridae (serology, other tests on samples)</td>
</tr>
<tr>
<td>Varicella</td>
<td>Oncovirina</td>
</tr>
<tr>
<td>Betaherpesvirinae</td>
<td>Human lymphotropic virus 1</td>
</tr>
<tr>
<td>Cytomegalovirus</td>
<td>Human lymphotropic virus 2</td>
</tr>
<tr>
<td>gammaherpesvirinae</td>
<td>Lentivirina</td>
</tr>
<tr>
<td>Herpes 6 and 7</td>
<td>Human immunodeficiency virus</td>
</tr>
<tr>
<td>Lymphocryptovirus (EB-like viruses)</td>
<td>Togaviridae</td>
</tr>
<tr>
<td>Orthomyxovirida</td>
<td>Alphavirus</td>
</tr>
<tr>
<td>Influenza (except those in Table 3.10)</td>
<td>Barmah Forest</td>
</tr>
<tr>
<td>Paramyxovirida</td>
<td>Ross River</td>
</tr>
<tr>
<td>Paramyxovirinae</td>
<td>Semliki Forest</td>
</tr>
</tbody>
</table>

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Contact: biosafety@mq.edu.au | Date: | June 2018
### Morbillivirus
- Measles
- Rubulavirus
- Menangle
- Mumps
- Newcastle disease virus (non-virulent endemic strains)

### Arterivirus
- Rubivirus
- Hepatitis D
- Hepatitis E

### Rubulavirus
- Rubella

### Rubivirus

### Menangle

### Rubulavirus
- Mumps

### Hepatitis D

### Newcastl
- Newcastle disease virus (non-virulent endemic strains)

### Pneumovirus

### 22.2 Risk group 3 microorganisms

#### Examples of risk group 3 bacteria

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacillus anthracis</td>
<td>Coxiella burnetii (cultures, animal work and concentrates)</td>
</tr>
<tr>
<td>Bartonella bacilliformis</td>
<td>Francisella tularensis (type A)</td>
</tr>
<tr>
<td>Burkholderia mallei</td>
<td>Multi-drug resistant Mycobacterium tuberculosis complex</td>
</tr>
<tr>
<td>Brucella spp. (except B. ovis)</td>
<td>Rickettsia spp.</td>
</tr>
<tr>
<td>Chlamydia psittaci (avian strains)</td>
<td>Yersinia pestis</td>
</tr>
</tbody>
</table>

#### Examples of risk group 3 fungi

<table>
<thead>
<tr>
<th>Fungi</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphanomyces astaci</td>
<td>Histoplasma spp.</td>
</tr>
<tr>
<td>Blastomyces dermatitidis</td>
<td>Paracoccidioides brasiliensis</td>
</tr>
<tr>
<td>Ceratocystis ulmi</td>
<td>Phytophthora cinnamomi</td>
</tr>
<tr>
<td>Coccidioides immitis</td>
<td></td>
</tr>
</tbody>
</table>

#### Examples of risk group 3 viruses

<table>
<thead>
<tr>
<th>Viruses</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arenaviridae</td>
<td>Mapuera</td>
</tr>
<tr>
<td>Arenavirus</td>
<td>Newcastle disease (exotic strains)</td>
</tr>
<tr>
<td>Lymphocchoriomeningitis (LCM) neurotropic strains</td>
<td>Retroviridae (from cultures and concentrates)</td>
</tr>
<tr>
<td>Bunyaviridae</td>
<td>Oncovirinae</td>
</tr>
<tr>
<td>Group C</td>
<td>Human lymphotropic virus 1</td>
</tr>
<tr>
<td>Oropouche</td>
<td>Human lymphotropic virus 2</td>
</tr>
<tr>
<td>Phlebovirus</td>
<td>Lentivirinae</td>
</tr>
<tr>
<td>Hantavirus</td>
<td>Human immunodeficiency virus</td>
</tr>
<tr>
<td>Hantaan and related viruses</td>
<td>Rhabdoviridae</td>
</tr>
<tr>
<td>Flaviridae</td>
<td>Lyssavirus</td>
</tr>
<tr>
<td>Flavivirus</td>
<td>Australian bat lyssavirus</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>Rabies fixed strain (CVS II)</td>
</tr>
<tr>
<td>St Louis encephalitis</td>
<td>Togaviridae</td>
</tr>
<tr>
<td>Tick-borne viruses</td>
<td>Alphavirus</td>
</tr>
<tr>
<td>West Nile</td>
<td>Eastern equine encephalitis</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Western equine encephalitis</td>
</tr>
<tr>
<td>Paramyxoviridae</td>
<td>Venezuelan equine encephalitis</td>
</tr>
<tr>
<td>Rubulavirus</td>
<td></td>
</tr>
</tbody>
</table>
23. Appendix 8 Examples of zoonotic diseases

<table>
<thead>
<tr>
<th>Host</th>
<th>Disease in humans</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>Brucellosis</td>
<td>Direct contact with infected semen, foetuses, foetal membranes and vaginal secretions</td>
</tr>
<tr>
<td>Sheep</td>
<td>Q-fever</td>
<td>Inhalation, direct contact with amniotic fluid or placenta</td>
</tr>
<tr>
<td>Sheep, non-human primates</td>
<td>Campylobacteriosis</td>
<td>Ingestion</td>
</tr>
<tr>
<td>Sheep, non-human primates</td>
<td>Tuberculosis</td>
<td>Inhalation, direct contact, ingestion</td>
</tr>
<tr>
<td>Macaques</td>
<td>Cercopithecine (B virus) encephalitis</td>
<td>Direct contact, bite wounds</td>
</tr>
<tr>
<td>Rodents, Farm and wild animals</td>
<td>Leptospirosis Weil’s disease</td>
<td>Direct contact, urine, contaminated soil and water</td>
</tr>
<tr>
<td>Rodents Rabbits Sheep Farm animals</td>
<td>Ringworm/Tapeworm</td>
<td>Direct contact, soil may be a reservoir</td>
</tr>
<tr>
<td>Farm animals Rodents Amphibians</td>
<td>Salmonellosis</td>
<td>Ingestion, Inhalation Direct contact</td>
</tr>
<tr>
<td>Farm animals Rodents Amphibians</td>
<td>Giardia/Parasitic infections</td>
<td>Ingestion Direct contact</td>
</tr>
<tr>
<td>Zebrafish Amphibians Aquarium water</td>
<td>Bacterial/Protozoal infections</td>
<td>Direct contact Ingestion</td>
</tr>
<tr>
<td>Bats</td>
<td>Australian Bat Lyssavirus</td>
<td>Bites/scratches</td>
</tr>
</tbody>
</table>

24. Appendix 9 Document History

**Approved by:** Macquarie University Institutional Biosafety Committee

**Date of implementation:** November 2015

**Major Review date [5 years]:** November 2020

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Activity</th>
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<tr>
<td>1.3</td>
<td>Document Approved</td>
<td>November 2015</td>
</tr>
<tr>
<td>1.4</td>
<td>Document amended to reflect new approval system and Biosecurity Act 2015</td>
<td>October 2017</td>
</tr>
<tr>
<td>1.5</td>
<td>Websites updated</td>
<td>June 2018</td>
</tr>
<tr>
<td>Macquarie University Biosafety and Biosecurity Manual</td>
<td>Version</td>
<td>1.5</td>
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<tr>
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<tr>
<td><strong>Contact:</strong> <a href="mailto:biosafety@mq.edu.au">biosafety@mq.edu.au</a></td>
<td><strong>Date:</strong></td>
<td>June 2018</td>
</tr>
</tbody>
</table>