Disease Strategy

Bovine brucellosis

Version 3.0, 2005

AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

Primary Industries Ministerial Council
This disease strategy forms part of:

AUSVETPLAN Edition 3

This strategy will be reviewed regularly. Suggestions and recommendations for amendments should be forwarded to:
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IMPORTANT NOTE: Important regulatory information is contained in the OIE Terrestrial Animal Health Code for bovine brucellosis, which is updated annually and is available on the internet at the OIE website: http://www.oie.int/eng/normes/en_mcode.htm. Further details are given in Appendix 3 of this manual).

DISEASE WATCH HOTLINE

1800 675 888

The Disease Watch Hotline is a toll-free telephone number that connects callers to the relevant state or territory officer to report concerns about any potential emergency disease situation. Anyone suspecting an emergency disease outbreak should use this number to get immediate advice and assistance.
This disease strategy for the control and eradication of bovine brucellosis is an integral part of the Australian Veterinary Emergency Plan, or AUSVETPLAN (Edition 3). AUSVETPLAN structures and functions are described in the AUSVETPLAN Summary Document.

This strategy sets out the disease control principles that have been approved by the Primary Industries Ministerial Council (PIMC) out-of-session at meeting 7 on 17 January 2005 for use in an animal health emergency caused by the occurrence of bovine brucellosis in Australia.

Bovine brucellosis is included on the OIE (World Organisation for Animal Health, formerly Office International des Epizooties) list of notifiable diseases as a multiple species disease. This obliges OIE member countries to notify the OIE within 24 hours of confirming the presence of bovine brucellosis. OIE-listed diseases are diseases with the potential for international spread, significant mortality or morbidity within the susceptible species and/or potential for zoonotic spread to humans.1 The principles contained in this document for the diagnosis and management of an outbreak of bovine brucellosis conform with the OIE Terrestrial Animal Health Code (see Appendix 3). In Australia, bovine brucellosis is included as a Category 2 emergency animal disease in the Government and Livestock Industry Cost Sharing Deed In Respect of Emergency Animal Disease Responses (EAD Response Agreement).2

Category 2 diseases are emergency animal diseases that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the livestock industries that are involved. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).

Detailed instructions for the field implementation of AUSVETPLAN are contained in the disease strategies, operational procedures manuals, management manuals and wild animal manual. Industry-specific information is given in the relevant enterprise manuals. The full list of AUSVETPLAN manuals that may need to be accessed in an emergency is:

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1 These criteria are described in more detail in Chapter 2.1.1 of the OIE Terrestrial Animal Health Code (http://www.oie.int/eng/normes/mcode/en_chapitre_2.1.1.htm).

2 Information on the EAD Response Agreement can be found at http://www.animalhealthaustralia.com.au/programs/eadp/eadra.cfm
Disease strategies
   Individual strategy for each disease

Operational procedures manuals
   Decontamination
   Destruction of animals
   Disposal
   Public relations
   Valuation and compensation

Management manuals
   Control centres management
      (Volumes 1 and 2)
   Animal Health Emergency Information System
   Laboratory preparedness

Enterprise manuals
   Animal quarantine stations
   Artificial breeding centres
   Aviaries and pet shops
   Feedlots
   Meat processing
   Poultry industry
   Saleyards and transport
   Veterinary practices
   Zoos

Wild animal manual
   Wild animal response strategy

Summary document


The revised manual has been reviewed and approved by:

**Government**
- Commonwealth of Australia
- State of New South Wales
- State of Queensland
- State of South Australia
- State of Tasmania
- State of Victoria
- State of Western Australia
- Northern Territory
- Australian Capital Territory

**Industry**
- Australian Dairy Farmers’ Ltd
- Australian Lot Feeders’ Association
- Cattle Council of Australia

The complete series of AUSVETPLAN documents is available on the internet at: http://www.animalhealthaustralia.com.au
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1 Nature of the disease

Bovine brucellosis is a chronic infectious disease of cattle that causes abortions, the birth of weak or dead calves, infertility and, as a consequence, reduced milk production. All ages of cattle are susceptible and infection can last for many years. In females, abortion is the major clinical sign, typically occurring between five and seven months of gestation. After an abortion or following the birth of a weak or dead calf, it is common for the placenta to be retained and the uterus to become infected. The animals are most infectious at the time of an abortion or birth of a calf. Infected bulls develop infection and swelling of the testicles and may become lame due to infected bursae.

1.1 Aetiology

Brucellosis in cattle is primarily caused by the bacterium *Brucella abortus*, which is one of six species of the genus *Brucella*. Nine biotypes have been identified, all of which are intracellular, parasitising, gram-negative, short rods. Brucellae have a wide host range but cattle are the preferred host of *B. abortus*.

Other species of *Brucella* cause significant disease in domestic livestock. *B. ovis* causes significant reproductive disease in sheep. *B. suis* and *B. melitensis* cause serious disease in pigs and sheep/goats respectively. However, these species of *Brucella* are not readily transmitted from their preferred hosts to species other than humans and, although cattle can become infected with these species, such infections are generally restricted to a single animal and are of minor epidemiological significance to bovine brucellosis.

Corbel (1997) noted that in some areas in South America, *B. suis* has become established in cattle, which have subsequently become more important than pigs as a source of infection.

*B. canis* is associated with abortion and testicular infection in dogs and has been recorded in many countries. Strains isolated from marine mammals form a separate group designated *B. maris*.

1.2 Susceptible species

Infection with *B. abortus* has been recorded in most species of domestic livestock, as well as in dogs, cats and humans. However, these species have not been found to be significant in spreading the disease to cattle. Horses can become infected with *B. abortus*, but in this case the bacteria have a preference for bursae, tendons, muscles and joints and are commonly found in cases of fistulous withers and poll-evil.

In the United States, there is a high prevalence in bison and other wild animals but there are no documented cases of spread from these animals to farmed livestock.

*Brucella* can infect humans and cause significant disease (‘undulant fever’; see Section 1.4.1). The most important brucellosis disease in humans is ovine/caprine brucellosis caused by *B. melitensis* (Corbel 1997). However, *B. abortus*, *B. suis* and (rarely) *B. canis* are also human pathogens. *B. ovis* has not been demonstrated to cause overt disease in humans; it is also not confirmed whether *B. maris* causes human disease.
1.3 World distribution and occurrence in Australia

Bovine brucellosis is present in the cattle population of most countries, especially in dairy cattle. The incidence varies enormously both within and between countries. Advances in control and eradication practices have led to a significant reduction in incidence and to complete eradication in some countries, including the United Kingdom, Scandinavian countries, Australia (1989) and New Zealand (1986).

*B. melitensis, B. suis* and *B. canis* are not present in domestic livestock in Australia although *B. suis* occurs in feral pigs in Queensland and has, on rare occasions, involved domestic pigs. *B. suis* was isolated from cattle in a number of beef herds as part of the *B. abortus* eradication campaign in central Queensland. Cattle and feral pigs had a close association on the four properties involved (Cook and Noble 1984). Cow-to-cow transmission is thought not to occur. *B. ovis* is present in the sheep population; however, state accreditation schemes involving biosecurity standards and regular testing have reduced its influence.

Bovine brucellosis remains a significant threat in Africa, the Middle East, Central and South America, and other developing areas of the world. During 2001, infection was reported in Indonesia, South Korea, Thailand and Malaysia. Japan reported its last case in 1995. In the United States, where there has been a program to eradicate brucellosis from the cattle population, nine newly affected herds were detected in the 2002 financial year compared to six the year before. Forty-eight states held brucellosis class-free status at the end of the year.

1.4 Diagnostic criteria

Suspicion of bovine brucellosis may be confirmed by serological and bacteriological investigation. A definitive diagnosis requires positive bacteriological identification of *B. abortus*. A presumptive diagnosis is made when there is significant serological evidence from several animals in a herd.

1.4.1 Clinical signs

**Cattle**

The primary clinical sign in female cattle is a significant number of late-term (5–7 months) abortions. In a population that has not been exposed to the disease before, these may appear as an ‘abortion storm’, with many cows aborting over a short period. Geering et al (1995) reported 30–80% abortions in fully susceptible herds. Many cases of endometritis and retained placentae also occur. However, such overt clinical evidence may not be seen in dry areas (where conditions are unfavourable for survival on pasture) or in large, extensively managed herds.

In bulls, clinical signs include inflammation of the testis (orchitis) and lameness due to bursitis, which is typically seen in infected bulls and occasionally in cows. Sexually immature cattle do not usually show any signs but may remain subclinically infected until maturity and pregnancy.
Other species

There is little information available on the clinical signs in domestic animals, including dogs and cats, and feral animals such as deer. However, eradication programs have been successfully completed without involvement of these species. In horses, *B. abortus* is commonly associated with chronic bursal enlargements and with fistulous withers and poll-evil.

Humans

Brucellosis causes a significant disease in humans, called ‘undulant fever’ because it is associated with intermittent fever. Infection most commonly occurs during occupational contact with infected animals and their discharges, particularly at calving, but also during slaughtering if the uterus is broken. Infection can also occur by consumption of unpasteurised milk and dairy products from infected animals, by inhalation, through cuts and abrasions or by droplet infection of the eyes. In endemic areas, veterinarians are particularly prone to brucellosis infection and are also at risk of exposure to organisms from live vaccines.

Acute brucellosis in humans usually begins with intermittent fever, weakness, chills, sweating, headaches, muscle and joint aches and malaise. Human infections can also cause behavioural changes. Characteristically, the fever spikes each day, giving rise to the term ‘undulant fever’. Undulant fever may be chronic and persist for many years.

1.4.2 Pathology

Cows

In cows, the main sites of infection are the endometrium of the uterus and the foetal placenta. The uterus appears normal externally but the endometrium is invariably infected. The intercotyledonary areas of the placenta are generally thickened with yellow gelatinised fluid and may be ulcerated, appear like leather and have mucoid or fibrino-purulent deposits on the surface. Placental cotyledons are hyperaemic and may have areas of yellow–grey necrosis and be covered with a sticky brown exudate. When examined microscopically, the membranes and cotyledons contain many mononuclear cells with some neutrophils and the chorionic epithelial cells are packed with the bacteria. An abnormally firm attachment of the chorionic villi of the placenta results from necrosis and enlargement of the maternal villi and the presence of inflammatory exudate.

Foetus

The foetus is usually swollen, with blood-tinged fluid found subcutaneously and in the body cavities; the umbilical cord may be thickened and swollen. The most important lesion is a catarrhal or fibrinous pneumonia. Microscopic examination of the lungs shows scattered foci of bronchitis and bronchopneumonia.

Bulls

*B. abortus* causes infection and swelling of the testicles that may not be obvious, but increasing pressure results in necrotic foci that grow and coalesce and may lead to total testicular necrosis with sequestration by inflammatory thickening of the tunica. *B. abortus* may also infect the accessory sex glands.

Brucellae in cattle may localise in the carpal and other bursae, where hygromas containing large numbers of bacteria may be found.
Pathogenesis

When brucellosis is introduced into a susceptible herd, it spreads easily because of the environmental contamination that occurs following an abortion. In cattle, infection with *B. abortus* is usually due to ingestion of infected material. The bacteria penetrate the mucosal epithelium of the gastrointestinal tract and are transported, either free or within phagocytic cells, to regional lymph nodes. If these bacteria do not remain localised or are not killed, they can spread to other organs, joints and bursae. This bacteraemic phase is subclinical and may take several weeks to some months. The bacteria then localise in the pregnant uterus and udder of cows, and the testicles and accessory sex glands of bulls.

In pregnant cows, the chorioallantoic membrane becomes inflamed and ulcerated, and bacteria can spread via the blood to the foetus and placenta. The preference of the bacteria for these sites is thought to be due to the presence of the sugar alcohol erythritol, which is a foetal product concentrated in the chorion, cotyledons and foetal fluids. In mature, nonpregnant cows, the bacterium localises in the udder. Infection of the udder is often clinically inapparent, with no gross lesions. Brucellae localise and replicate primarily in macrophages in mammary secretions or in phagocytes; they form an important source of organisms for periodic reinfection (and potentially for infection of calves and humans via the milk). Hence, if the cow later becomes pregnant, the uterus can become infected during a subsequent bacteraemic phase.

1.4.3 Laboratory tests

Specimens collected from suspect animals should be sent to the state or territory veterinary diagnostic laboratory. Samples may then be forwarded to the CSIRO Australian Animal Health Laboratory (AAHL) at Geelong for confirmatory testing. See Section 2.2.14 for occupational health and safety considerations.

Specimens required

Specimens of milk from each quarter of the udder, and whole aborted foetuses or spleen, lung and stomach contents and foetal membrane cotyledons, should be hygienically collected from each animal that aborts (Geering et al 1995). Vaginal swabs collected in the six-week period following calving or abortion may also be useful. Blood samples for serum should be collected from all animals that have recently calved or aborted.

Where suspect cows are slaughtered, various lymph nodes, including the mammary lymph nodes, and samples of spleen, mammary gland, uterine tissues and fluids, and blood for serum, are valuable diagnostic materials. In mature cows, about 90% of infections can be detected by culture of the mammary lymph nodes; the inclusion of samples of mandibular and medial iliac lymph nodes and the uterine caruncles (if present) will increase the chance of successful culture to almost 100%. In heifers, additional tissues, including the spleen, will be needed to obtain meaningful results (see Appendix 5 for details).

Samples must be individually labelled so that they can be related to each animal tested. Care must be taken to protect samples from extremes of heat during collection, storage and transport to the laboratory.
Transport of specimens

Samples must be forwarded to a testing laboratory as soon as possible after collection. All specimens should be placed in sterile, leakproof containers that are themselves placed into securely fastened plastic bags as a further precaution against leakage. Tissue, tissue fluid and serum samples should be cooled immediately and transported on ice. See the Laboratory Preparedness Manual for further information.

Specimens should initially be sent to the state or territory diagnostic laboratory from where they may be forwarded to AAHL, Geelong for confirmation (see ‘Bacteriology’, below), after obtaining the necessary clearance from the chief veterinary officer (CVO) of the state or territory of the disease outbreak and after informing the CVO of Victoria about the transport of the specimens to Geelong.

Laboratory diagnosis

Diagnostic tests for brucellosis can be classified into those that identify the organism, those that demonstrate specific immunoglobulins and those that demonstrate a specific allergic response. Laboratory diagnosis of brucellosis can generally be made by the state or territory veterinary diagnostic laboratory.

Bacteriology

Initial bacterial culture can be carried out at the state or territory laboratory but samples of isolates should be sent to the National Brucellosis Reference Laboratory at AAHL for confirmation.

In the past, cultural examination for the diagnosis of bovine brucellosis was considered unreliable. Often, there are only small numbers of bacteria in the tissues and it has been difficult to obtain uncontaminated specimens. Primary isolation may take up to eight days. Accurate identification of brucellae and their biotypes is important, as this may assist in the determination of the host range and potential reservoirs of infection. There is no test by which an organism can be identified as belonging to the genus Brucella but a combination of serological and bacteriological methods usually enables an organism to be correctly classified.

Serology

In Australia, detection of immunoglobulins is based on the Rose Bengal plate test (RBPT), complement fixation test (CFT) and enzyme-linked immunosorbent assay (ELISA) on serum, and the milk ring test (MRT) on milk. Results must be tested and interpreted to the standard defined in the Australian Standard Diagnostic Techniques for Animal Diseases (Corner and Bagust 1993). Two ELISAs are mentioned in the OIE Terrestrial Manual: an indirect ELISA specific for IgG1; and a competitive (inhibition) ELISA using monoclonal antibodies. The value of ELISA testing is that it is relatively unaffected by the condition and age of the blood samples and should minimise the need to resample cattle whose serum samples are unsuitable for testing by the CFT. Nicoletti (1992) reported the problem of false positives with the CFT when sampling infected water buffalo cows.

Nielsen et al (1995) and Uzal et al (1996) evaluated an improved competitive ELISA and reported it had a specificity in excess of 99.6% on a negative population and a sensitivity of 100% for infected animals. They concluded that the new test was easy to perform and useful in areas of low prevalence.
The United States Department of Agriculture, Animal and Plant Health Inspection Service has also reported a new serologic test for detection of brucella antibodies. Termed the rapid automatic presumptive (RAP) test, it uses a computer reader and recorder device to assess and report test results. This minimises subjectivity and has enhanced laboratory-to-laboratory uniformity.

Cross-reactions to other organisms may cause some diagnostic problems. Several authors have reported serological reactions to the presence of *Yersinia enterocolitica*. In New Zealand, 35% of deer in a large export consignment reacted to the *Brucella abortus* serum agglutination test (SAT). This reaction was later considered to have been caused by previous exposure to *Yersinia enterocolitica* (Hilbink et al 1995).

**Other tests**

The MRT performed on bulk milk samples is effective for screening and monitoring dairy cattle for brucellosis, but is less reliable in large herds. An alternative immunological test is the brucellin skin test, which can be used for screening unvaccinated herds, including beef cattle, provided that a purified, standardised antigen preparation is used.

The diagnostic tests currently available in Australia are shown in Table 1.

<table>
<thead>
<tr>
<th>Test</th>
<th>Specimen required</th>
<th>Test detects</th>
<th>Time taken to obtain result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture and identification of <em>B. abortus</em></td>
<td>Tissue</td>
<td>Brucellae</td>
<td>6 days</td>
</tr>
<tr>
<td>Rose Bengal plate test (RBPT)</td>
<td>Serum</td>
<td>Antibody</td>
<td>10 minutes</td>
</tr>
<tr>
<td>Complement fixation test (CFT)</td>
<td>Serum</td>
<td>Antibody</td>
<td>4 hours</td>
</tr>
<tr>
<td>Enzyme-linked immunosorbent assay (ELISA)</td>
<td>Serum</td>
<td>Antibody</td>
<td>2 hours</td>
</tr>
<tr>
<td>Serum agglutination test (SAT)</td>
<td>Serum</td>
<td>Antibody</td>
<td>24 hours</td>
</tr>
<tr>
<td>Bulk milk ring test (BMRT)</td>
<td>Milk</td>
<td>Antibody</td>
<td>1 hour</td>
</tr>
<tr>
<td>Individual milk ring test (IMRT)</td>
<td>Milk</td>
<td>Antibody</td>
<td>1 hour</td>
</tr>
</tbody>
</table>

Note: Testing resources are available at a number of veterinary laboratories in Australia.

**1.4.4 Differential diagnosis**

There are many potential causes of abortion in cattle. Endemic infectious causes of abortion include viral diseases such as infectious bovine rhinotracheitis and mucosal disease; and infections with other organisms such as *Trichomonas foetus*, *Neospora caninum*, *Campylobacter foetus*, *Listeria monocytogenes*, *Sarcosporidia*, various *Leptospira* species and fungi. Exotic viral diseases causing abortion include Rift Valley fever and Wesselsbron disease (in sheep). There are also a range of potential noninfectious causes resulting from nutritional and toxic factors.
Generally bovine brucellosis can be differentiated from these conditions due to its pathology, its presentation and the excellent range of laboratory diagnostic methods.

1.4.5 Treatment of infected animals

Several chemotherapeutic agents have been employed in recent decades for the treatment of *Brucella abortus* infection in cows; however, none of these has been entirely successful. Radwan et al (1993) identified two therapeutic regimens that were effective in eliminating brucellae from naturally infected cows. Each involved repeat treatments with long-acting oxytetracycline and streptomycin administered by intramuscular injection and intramammary infusion for up to six weeks. Before treatment commenced, all cows were dried off. For a number of reasons (expense, withholding periods after treatment, development of antibiotic resistance, proof of success) such treatments are impracticable as part of an eradication program in Australia.

1.5 Resistance and immunity

1.5.1 Innate and passive immunity

Establishment of infection by *Brucella* spp depends on the number and virulence of organisms and the relative resistance of the host animal, as determined by innate and acquired immune mechanisms. Sexually mature cows, pregnant heifers and bulls are the most susceptible to infection with *B. abortus*. A small proportion of crossbred cattle appear to be innately resistant due to the ability of macrophages to limit the replication of *B. abortus*. This innate resistance is inherited as a dominant trait.

Sexually immature cattle are quite resistant to exposure to *B. abortus*, with susceptibility increasing with sexual development and pregnancy. Calves may acquire infections in utero or by ingestion of contaminated milk (Nicoletti 1980). Usually calves show only a transient antibody response after exposure. However, calves may continue to excrete organisms for several weeks after milk feeding has ceased. A small but important percentage of heifer calves that are infected in early life and are negative to serological tests abort or have an infected calving during the first pregnancy (Cunningham 1977) There is a tendency for males to become infected at a younger age than females; they may acquire infection during calfhood and retain it into adult life (Rankin 1965).

1.5.2 Active immunity

The rate of production of antibody depends on the type of stimulus received. The immunoglobulins produced following natural infection are different from those produced following vaccination; this difference is used to discriminate between them. It is generally agreed that cell-mediated responses are the dominant immune response to bovine brucellosis, and that dermal hypersensitivity and lymphocyte stimulation are poor indices. The cell-mediated response generally appears at least one week before the appearance of agglutinating antibodies. Because the bacterium is an intracellular, facultative organism, attenuated (‘live’) vaccines have been far more successful than inactivated vaccines.
1.5.3 Vaccination

Effective vaccines have played an important role in reducing the incidence of brucellosis in many countries.

Strain 19

The most widely used vaccine for the prevention of brucellosis in cattle is prepared from \textit{B. abortus} strain 19. It is an attenuated (‘live’) vaccine and is normally given to female calves aged between three and six months as a single subcutaneous dose of \(5-8 \times 10^{10}\) viable organisms. A disadvantage of strain 19 is that it causes vaccinated animals to produce antibodies that on standard diagnostic tests are indistinguishable from the antibodies produced by animals infected with \textit{Brucella}.

A reduced dose of from \(3 \times 10^{8}\) to \(3 \times 10^{9}\) organisms can be administered to beef or dairy cattle aged 4–12 months, but 5–10% of the animals will develop persistent antibody titres (Beckett and MacDiarmid 1985). Alternatively, the vaccine can be administered to cattle of any age as two doses of \(5-10 \times 10^{8}\) viable organisms given by the conjunctival route; this produces protection without a persistent antibody response (OIE Terrestrial Manual).

Strain 19 is of low virulence for cattle. Subcutaneous vaccination of pregnant cattle can cause abortions, but this is rare, occurring in less than 1% to 2.5% of animals under field conditions (Beckett and MacDiarmid 1985).

\textit{B. abortus} strain 19 vaccine induces good immunity to moderate challenge by virulent organisms. Each batch must be checked for purity, viability, smoothness and absence of toxicity or virulence.

The United States Centers for Disease Control and Prevention (CDC) recommend concomitant regimens of doxycycline and rifampin for human postexposure prophylaxis against the strain 19 vaccine.

Strain 45/20

\textit{B. abortus} strain 45/20 vaccine is prepared by suspending inactivated cells in an oil adjuvant. It is normally administered as two doses, given 6–12 weeks apart, followed by an annual booster. The degree of protective immunity conferred by strain 45/20 vaccine is probably less than that conferred by strain 19 vaccine. Batch variation in immunogenicity and a tendency to stimulate antibodies reactive with \textit{Brucella} antigens can be major problems.\(^3\) In most countries where herd vaccination appears to be useful, reduced doses of strain 19 are now used instead of strain 45/20 vaccine (OIE Terrestrial Manual).

Strain RB51

The RB51 vaccine strain is an attenuated, genetically stable, rough morphology mutant of \textit{B. abortus} that was approved for use in the United States in 1996. Vaccination with RB51 does not result in measurable antibody titres to \textit{B. abortus}

\(^{3}\) During the Australian eradication campaign, the use of 45/20 vaccine did interfere with diagnostic tests.
using standard diagnostic tests. This is an important feature for use in efforts to eradicate brucellosis in domestic cattle and replacing strain 19 vaccine with the RB51 vaccine eliminates costs associated with the retesting and trace-backs of false positive reactors.

United States data indicate that RB51 is protective at doses comparable to those used for strain 19 when given to calves at 3–10 months of age. RB51 can infect the placenta and uterus in the pregnant animal. Unpublished reports by the vaccine manufacturers in the United States indicate that vaccination with a reduced dose ($1 \times 10^9$) of strain RB51 can lead to abortion in 0.5% of vaccinated animals.

Detection of possible human infection with the RB51 vaccine strain and development of recommendations for chemoprophylaxis are complicated by two characteristics of the new vaccine strain. Firstly, an immune response to the RB51 strain is not detected on routinely available serological tests. An experimental dot-blot assay used for serological measurement of RB51 postvaccination titres has been evaluated under experimental and field conditions in cattle, but this assay has not been validated by using human serum. Secondly, RB51 was derived by selection in rifampin-enriched media and is resistant to rifampin in vitro.

Veterinarians and other animal health-care personnel should be made aware of the possible risk for infection associated with the veterinary use of RB51, although evidence of serious disease for humans with a normal immune system has not been officially documented (CDC 1998).

*B. suis* biovar 1 strain 2

Since 1971, a smooth strain of *B. suis* biovar 1 strain 2 has been used as an oral vaccine to control brucellosis in cattle, sheep, goats and pigs in China. This vaccine protects cattle against *B. abortus*, is safe if administered orally, and does not induce persistent antibody titres.

For further details see Sections 2.2.10 and 3.2.4.

### 1.6 Epidemiology

The most significant feature of bovine brucellosis epidemiology is the shedding of large numbers of organisms during the 10 days after abortion or calving of infected cows and the consequent contamination of the environment. The movement of infected cattle into a herd can result in transfer of the disease when cattle ingest the bacteria from aborted foetuses, placentae, discharge from cows that have aborted or contaminated pasture or water.

#### 1.6.1 Incubation period

The length of the incubation period in an individual animal is influenced by sexual maturity, state of pregnancy at the time of infection (inversely proportional), size of the challenge dose and previous exposure to infection or vaccination. For example, the average incubation period is 67 days for cows infected at six months of pregnancy. The minimum incubation period is about one month.
There is experimental evidence that localised foci of viable organisms remain in an unknown proportion of calves born of infected dams that have been serologically negative for considerable periods. There is a danger that such a focus may break down at a later stage in life and cause active disease (Lapraik et al 1975).

In humans, the incubation period for the disease is 5–30 days or longer.

### 1.6.2 Persistence of agent

**General properties and persistence in environment**

Under ideal conditions, *B. abortus* can persist in organic materials such as faeces, abortion fluids and milk for up to six months. It may survive up to eight months in an aborted foetus in the shade (Geering et al 1995). Table 2 summarises survival times of *B. abortus* in the environment. It should be noted that the bacteria are particularly susceptible to heat and desiccation, and direct sunlight will rapidly destroy exposed organisms. All standard disinfectants destroy *Brucella* spp.

In Australia, the persistence of the agent will be substantially influenced by the geographic location and whether the herd is managed intensively or extensively.

<table>
<thead>
<tr>
<th>Medium</th>
<th>Temperature/environment</th>
<th>Viability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunlight</td>
<td>&lt; 31°C</td>
<td>4.5 hours</td>
</tr>
<tr>
<td>Water</td>
<td>– 4°C</td>
<td>114 days</td>
</tr>
<tr>
<td>Water</td>
<td>Room</td>
<td>77 days</td>
</tr>
<tr>
<td>Soil</td>
<td>Room dried</td>
<td>&lt; 4 days</td>
</tr>
<tr>
<td>Soil</td>
<td>Cellar wet</td>
<td>66 days</td>
</tr>
<tr>
<td>Manure</td>
<td>Summer (Russia)</td>
<td>1 day</td>
</tr>
<tr>
<td>Liquid manure</td>
<td>Summer (Russia)</td>
<td>108 days</td>
</tr>
<tr>
<td>Manure</td>
<td>Winter (Russia)</td>
<td>53 days</td>
</tr>
<tr>
<td>Liquid manure</td>
<td>Winter (Russia)</td>
<td>174 days</td>
</tr>
</tbody>
</table>

*Source: Adapted from Nicoletti (1980)*

**Live animals**

Congenitally infected calves may be initially seropositive from colostral antibodies, may then become seronegative and generally do not convert until they have calved or aborted, when organisms may be shed (Lapraik et al 1975). Infection may occur in cattle of all ages but persists most commonly in sexually mature animals. Calves fed infected milk may excrete virulent brucellae in their faeces for several weeks.

An infected cow generally aborts once and then becomes a chronic carrier, intermittently excreting bacteria in the milk and reproductive secretions for many years. However, cows generally spread much less infection at parturitions subsequent to an abortion.

Other species are not normally important to the persistence or transfer of *B. abortus*. However, transfer between horses and cattle grazing the same pasture was reported by Elliott and Christiansen (1977).
Animal products and byproducts
Cows may excrete bacteria intermittently in milk (including colostrum) throughout lactation.

Equipment and personnel
Due to the fragility of the bacteria in the environment, fomites are not considered a likely source of infection.

1.6.3 Modes of transmission

Live animals
*B. abortus* is usually transmitted by ingestion of contaminated feed or water or by licking an infected placenta, calf or foetus, or the genitalia of an infected cow soon after it has aborted or calved. Inhalation and direct contact, especially with abraded skin or mucous membranes, may be a factor (Nicoletti 1980). Heifer calves infected in this manner may not be detected by serological testing and will be a source of infection after puberty.

Transfer into a free population is primarily by importation of cows and heifers that are latently infected.

Infected cows
The large numbers of *B. abortus* shed by an infected cow at the time of calving or abortion are the main source of infection. Infected females may also intermittently shed organisms in colostrum and milk. Faeces, urine and hygroma fluid may be involved but these are of minor importance. Genital discharges may continue to contain high numbers of organisms for several weeks following normal parturition or abortion. Chronically infected cows are known to excrete organisms each time they calve. Congenital transfer from an infected cow to a foetus occurs infrequently.

Infected bulls
Bulls usually only become infected when there are abortions due to *B. abortus* in the herd. Once infected, the organisms tend to localise in the testes; large numbers may be excreted in the semen during the acute phase, making semen a potentially important source of infection. Bulls may also excrete *B. abortus* in faeces, urine and hygroma fluid.

Artificial breeding
Natural service by the bull is unlikely to transfer infection. However, there is a real risk of transferring infection through artificial insemination, given the method used and the delivery point of semen in the reproductive tract of the dam (Manthei et al 1950). The risk of introducing the disease through embryos is negligible provided the embryos are properly handled between collection and transfer (Anon 1998).

Animal products and byproducts
*B. abortus* is sensitive to pasteurisation temperatures. Yoghurt is presumed to be safe because of its low pH.
Equipment and personnel
Mechanical transfer from milking machines contaminated by infected milk is a possible, though unlikely, source of spread.

Generally, removal of infected animals from contaminated premises for one month is sufficient to prevent infection, provided the facilities have been sufficiently disinfected.

Vectors
Reservoirs of infection have been reported in a wide range of domestic animals, birds and carnivores such as dogs. They may move infective material between properties; however, their role is limited. The transmission of brucellosis by ticks, fleas or mosquitoes from an infected herd to a non-infected herd has never been proved.

1.6.4 Factors influencing transmission
Given that environmental survival of the organism depends on favourable temperatures and low exposure to sunlight, winter conditions in the south of Australia favour survival. The concentrated husbandry of dairy herds and seasonal calving provide ideal conditions for transmission within a herd should an infected cow abort following introduction.

Many factors affect the epidemiology of bovine brucellosis; the most important are herd size and mobility, contiguity to infected herds, concentration of cattle and nature of production (dairy herds are more susceptible than beef cattle).

1.7 Manner and risk of introduction to Australia
The greatest risk of introduction of bovine brucellosis would be with cattle imported from countries with endemic infection. With current import requirements, however, this method of introduction is unlikely.

The disease could also be introduced with imported semen but this risk is minimised by effective import controls.

Because the bacterium is intracellular, it may exist without being detected by serological methods. Herds should be considered free only after a series of tests has confirmed the absence of the bacterium.
2 Principles of control and eradication

2.1 Introduction

Bovine brucellosis was eradicated in Australia after many years of control and eradication effort, so the social, economic and political impacts of a fresh outbreak would be great. Many other countries have also eradicated brucellosis. In each case the infection was so widespread that a long period of vaccination was necessary to reduce the incidence to a level where eradication by test and slaughter was feasible. However, vaccination alone has never achieved eradication.

In a naive population the infection is likely to spread rapidly unless detected early. In a dairy herd, abortions would give an early indication that infection had occurred and the extent of an outbreak could be limited. However, in extensively farmed beef herds, the disease may remain undetected because of the lack of close observation and may not be detected until it spreads to more intensively managed properties. In either case, spread to further herds from cattle movements is unlikely until the first abortion occurs.

Brucellosis can be eradicated in two principal ways:

- stamping out all exposed cattle
- serological testing and slaughter of animals showing a positive reaction.

In either case, it is important to promptly remove all infected and suspicious animals from a confirmed infected herd to reduce the opportunity for further spread. Section 2.2 describes these methods in more details, as well as the other measures necessary to eradicate the disease.

2.2 Methods to prevent spread and eliminate pathogens

2.2.1 Depopulation of infected animals

Stamping out
The most reliable way to eradicate B. abortus is through quarantine of infected premises (IPs) and dangerous contact premises (DCPs), and destruction of all susceptible cattle, including juveniles, on IPs (and probably on DCPs, according to circumstances). Under such a policy, live cattle would only be permitted to move from the IPs or DCPs for slaughter at an approved abattoir. The property should remain free of susceptible animals and under quarantine until freedom from environmental contamination is assured.

DCPs are properties that adjoin IPs, as well as those identified by tracing (see Appendix 1). Once potentially infected cattle are removed from these premises, and there is no clinical or serological evidence of disease, they should continue to be monitored for evidence of brucellosis by milk or serological testing.
Depopulation has serious economic effects; the availability of compensation is an important incentive to ensure that owners promptly report any evidence of infection.

**Test and slaughter of reactors**

In a test and slaughter strategy, all cattle over the age of six months are repeatedly tested using agreed serological tests. All animals reacting positively to such a test are destroyed or consigned for immediate slaughter at an approved abattoir, and tissues are submitted for culture of *B. abortus*. Because of latent infection in young animals, all calves of reactor cows are also culled from the herd.

Herd s should be retested at regular intervals (between 30 and 60 days) until two clean no-reactor tests have been achieved. Further surveillance tests are done six months and 12 months after the clean test (taking into account the herd calving pattern). Before quarantine is lifted, all breeding females must have calved and tested negative at least 30 days after calving. Additional surveillance testing may be required. Animals should be permanently identified. Mingling of animals of different age groups should be minimised.

Eradication by test and slaughter is not always successful. Problems occur for about 5% of herds, often due to latently infected calves that remain serologically negative to standard tests until late into their first pregnancy.

2.2.2 **Quarantine and movement controls**

Where there is any suspicion of bovine brucellosis, quarantine must be imposed immediately to ensure that any infection is contained. Quarantine may be partial or total, depending on the extent of infection and herd management. For example, on very large properties or where there are valuable stud animals involved, a group of infected or suspicious animals that are isolated from the rest of a herd may be quarantined and managed separately. However, all animals in such herds will require repeated serosurveillance to confirm their freedom from infection.

Prompt examination of movement records will assist in tracing any movements that may be suspect. Movement of latently infected cows and heifers presents the greatest risk, but the potential for movement of infected material by dogs or birds cannot be ignored. Strict sanitation measures must be applied immediately to isolate animals likely to calve, the area surrounding an abortion or calving area must be disinfected, and effective fencing is required.

Susceptible cattle on quarantined properties may only be moved directly to an abattoir for slaughter. Where isolation of animals from an infected group is confirmed to the satisfaction of the chief veterinary officer (CVO), such animals may be moved off the property after two negative tests at a minimum interval of 60 days.

Declaration of a *restricted area* (RA) or *control area* (CA) is unlikely to assist disease control but could be used to provide additional assurance that the infection is contained to contiguous properties during the period of initial investigation.

**Zoning**

If a disease is endemic in only part of a country, it is possible to establish diseased and disease-free zones. Tight controls on the movement of cattle have to be enforced between zones. Zoning is of most benefit when there are implications for
international trade. Bovine brucellosis is not considered an impediment to international trade in meat, although the small export market in breeding stock is likely to be affected.

Zoning may be used to clearly identify infection within regions of Australia. However, it may help or hinder domestic trade, depending on whether the state or region is a net exporter or importer of cattle. Zoning restrictions placed along state borders would severely restrict existing marketing arrangements involving the frequent long-distance and interstate transport of both breeding and slaughter cattle within Australia.

2.2.3 Tracing

When infection is suspected or confirmed, trace-back and trace-forward of cattle movements is essential to identify the index case and other potentially infected herds. Movements of other domestic animals and wild animals are of secondary importance. Trace-back should extend to all herds where an infected animal has been for any period of its life. Trace-forward of all movements off the property must commence with the most recent movements, moving back in time according to the results of trace-back. Tolson and Jervois (1990) reported that the source of infection was not determined in 18% of Australian herds found to be infected in the period 1984–89.

2.2.4 Surveillance

The purpose of surveillance is to identify any infected herds not already identified by tracing and investigation of neighbouring properties. It provides assurance that the infection has not spread to other herds in the immediate area. Additional surveillance may be needed to assist the design and implementation of the control strategy. Surveillance for evidence of antibodies to \( B.\ abortus \) by the milk ring testing of dairy factories and serological testing of high-risk herds is the preferred approach. On-farm activities also include examination of production records for evidence of abortions and/or infertility. Reports of abortions should be investigated.

As cattle movements are the most likely way in which the disease is spread, special attention should be given to herds selling breeding animals and those with a history of recent introductions. Closed herds are unlikely to introduce \( B.\ abortus \), and breeding stock from such herds are unlikely to spread the disease.

Routine surveillance is usually based on the use of cheap screening tests such as the RBPT. This is then followed with the CFT and ELISA to confirm infection. The bulk MRT is a very effective screening tool in dairy herds and is cheap, easily carried out and effective in identifying infected herds even where the within-herd prevalence is very low. However, the bulk MRT does not detect infected heifers, recently aborted cows or the presence of a few reactors in a large herd (see Section 1.4.3 for further information on these tests).

The brucellin skin test has been used in several countries. In New Zealand, it has been found to be cheap and reliable for defining the size and distribution of a brucellosis outbreak and for post-eradication surveillance. The cost was estimated to be approximately 60% of that of on-farm serological testing (MacDiarmid and Hellstrom 1988).
2.2.5 Treatment of infected animals

For various reasons (see Section 1.4.5) treatment with antibiotics is not normally used in bovine brucellosis eradication programs.

2.2.6 Destruction of animals

Confirmed infected cows that are close to calving or that have a vaginal discharge pose a disease risk to personnel; they are preferably destroyed and disposed of on the property. Care is required to ensure that burning and/or burial comply with local requirements. Where such cattle must be removed from the property for disposal, they should be destroyed and then transported in leakproof vehicles to the place of disposal.

Reactor animals can be sent to abattoirs for slaughter but this may involve a risk to employees (see Section 2.2.8) and approval by the CVO is required. Abattoirs must be advised of the date of arrival of reactors before they are dispatched and supervision of the slaughter is mandatory. Reactor cattle must be permanently identified and must be transported in isolation from other animals; cleaning of vehicles after unloading is required.

Destruction of animals other than cattle is generally unnecessary. Infected horses are not usually contagious and should be isolated from any contact with cattle. Euthanasia of infected horses may be negotiated with the owner on humane and/or human health grounds. Destruction of property is unnecessary, as *B. abortus* is susceptible to sunlight, high temperature, cleaning and disinfection.

See the Destruction Manual, Section 4.1 for appropriate methods for the destruction of cattle.

2.2.7 Treatment of animal products and byproducts

No special processing is required for meat produced from cattle depopulated as part of brucellosis eradication. Precautions should be taken in the handling and disposal of the placenta, uterus and mammary gland from suspect cattle on farms, abattoirs and animal byproduct establishments.

Milk for human consumption must be pasteurised.

Standard rendering techniques effectively inactivate any organisms.

2.2.8 Disposal of animal products and byproducts

Hygienic measures should include the disposal of aborted foetuses and membranes, removal and disposal of infected animals and disinfection of areas contaminated by aborted foetuses and membranes. Strict personal hygiene precautions must be applied when handling potentially infective materials.

Care must be taken during disposal to ensure that infected fluids and tissues do not come into contact with humans or other animals. Cattle carcases may also be rendered (see the Disposal Manual).
2.2.9 Decontamination

*B. abortus* is susceptible to sunlight, high temperatures and a range of chemicals, including 0.03% formalin, 1% phenol, 0.01% beta propiolactone, sodium hypochlorite, sodium hydroxide, iodines, quaternary ammonium compounds, ether and chloroform (see the Decontamination Manual).

Other measures to reduce the likelihood of environmental survival of infective bacteria include draining wet areas and ploughing to improve the rate of desiccation.

The spread of infection can be minimised by cleaning and disinfecting vehicles used to transport infected cattle.

2.2.10 Vaccination

Attenuated (live) vaccines such as strain 19 have generally provided better protection than inactivated vaccines (eg strain 45/20). Strain 19 effectively controls abortions in a cattle population but does not totally prevent the spread of infection. It has the disadvantage of stimulating the production of IgG1 antibodies that can persist into adulthood and interfere with serological testing. It is thus usually suitable only as a precursor to eradication and to reduce economic damage where there is a high prevalence of brucellosis.

In February 1996, a new attenuated vaccine, strain RB51, was licensed by the United States Department of Agriculture, Animal and Plant Health Inspection Service for use in cattle in the United States. This vaccine does not stimulate the production of antibodies detectable in standard diagnostic tests but does stimulate production of other antibodies that can be detected with a special assay and indicate that the animal has been vaccinated. Strain RB51 has been reported to be as effective as strain 19. Vaccinated animals need to be permanently identified.

Strain 19 is potentially virulent to humans. *B. abortus* RB51 infection in humans is possible but has not been documented.

Because strain 19 and strain RB51 are live bacteria, vaccine packs should be kept cool and away from sunlight and chemicals during storage and handling; they should be used as soon as possible when opened.

For further details see Sections 1.5.3 and 3.2.4.

2.2.11 Wild animal control

Feral animals, including cattle, buffalo and deer, may become infected with brucellosis; if they graze the same area as domesticated stock, they should be controlled by mustering or field destruction.

The disease will be less likely to spread if contaminated areas are cleaned up promptly, the integrity of perimeter fences is ensured and access to potentially heavily contaminated areas such as dairy effluent disposal sites and carcase burial or disposal sites is prevented.
2.2.12 Vector control
Mechanical transfer of *B. abortus* by feral livestock, foxes, dogs, cats and birds is theoretically possible but their role is considered unimportant.

Despite the ability of flies and ticks to experimentally transfer infection, their role in spreading *B. abortus* from infected to uninfected herds has not been established.

2.2.13 Sentinel animals and restocking
*B. abortus* is rapidly inactivated by desiccation and sunlight. Properties that have been depopulated in summer can normally be restocked 30 days after the completion of decontamination, with minimal risk of reinfection. However, if depopulation occurs during winter in southern Australia, an additional period may be required. The replacement herd should be tested (see Appendix 4 for further details).

2.2.14 Human infection
Because brucellosis is a significant zoonosis, all people handling infective material, including live vaccines, should wear protective glasses, gloves and clothing and protect skin breaks from infection. There is no risk to the general public except from unpasteurised milk (see Section 1.4.1). Vaccine strains may cause human disease, although transmission of infection to humans through milk has not been recorded with strain 19. The RB51 vaccine strain is of concern (see Section 1.5.3).

2.2.15 Public awareness
A media campaign must emphasise the importance of cattle producers inspecting susceptible animals regularly and reporting abortions, the birth of weak or dead calves, or infertility. An abortion investigation program that relieves producers of the costs of investigation is a useful strategy. Details of any imposed movement controls need to be readily available and clearly explained to industry.

Given the important zoonotic implications, people at risk must be advised of appropriate occupational health and safety requirements and health authorities alerted to the potential for human infection.

2.3 Feasibility of control in Australia
Bovine brucellosis was endemic in Australia before 1989 and was eradicated. There is no reason why a new incursion could not also be eradicated. Many other countries have also controlled and then eradicated bovine brucellosis. The extent of the task and how long it might take will depend on the location and circumstances at the time. In a prolonged eradication program, the previously developed Standard Rules and Definitions may need to be reintroduced.
3 Policy and rationale

3.1 Overall policy

Bovine brucellosis is an OIE-listed disease that has the potential for rapid spread within a herd and may spread to other herds. It is important in the trade of cattle and is a significant public health issue. It is difficult to recommend a single strategy for the eradication of bovine brucellosis for Australia that will be practical for all circumstances or locations.

The overall policy is to eradicate brucellosis by:

- *destocking*, which involves quarantine, slaughter of all infected and exposed susceptible animals and sanitary disposal of destroyed animals (where only a small number of properties are involved, this strategy will be extended to include them); and

- *test and slaughter*, which involves regular serological testing of suspect animals and slaughter of those that test positive, used if brucellosis has spread more widely.

These strategies will be supported by:

- *quarantine and movement controls* on animals on infected and suspect properties to prevent the spread of infection;

- *tracing and surveillance* to determine the source and extent of infection and to provide proof of freedom from the disease;

- *vaccination*, which should be considered for assisting in the eradication of the disease if a major disease outbreak occurs in Australia or if particular situations warrant;

- *zoning* to define infected and disease-free areas; and

- *a public awareness campaign* to facilitate cooperation from industry.

An uncontrolled outbreak of brucellosis would cause severe production losses to the affected producers with potential dislocation and financial losses to the cattle industry from effects on exports. There is potential for human disease and occupational health and safety measures must be adopted.

Bovine brucellosis is an Animal Health Australia Category 2 disease under the government-industry EAD Response Agreement for cost-sharing arrangements. Category 2 diseases are those for which costs will be shared 80% by government and 20% by industry.
The chief veterinary officer (CVO) in the state or territory in which the outbreak occurs will be responsible for developing an emergency animal disease response plan (EAD response plan). This plan will be approved for technical soundness and consistency with AUSVETPLAN by governments and affected livestock industry technical representatives on the Consultative Committee on Emergency Animal Diseases (CCEAD). The plan will ultimately be approved and cost-shared by government chief executive officers and industry leaders through the national management group (NMG) of government and industry representatives established for the incident.

CVOs will implement disease control measures as agreed in the EAD response plan and in accordance with relevant legislation. They will make ongoing decisions on follow-up disease control measures in consultation with the CCEAD and the NMG. The detailed control measures adopted will be determined using the principles of control and eradication (Section 2) and epidemiological information about the outbreak.

For further information on the responsibilities of the state or territory disease control headquarters and local disease control centres, see the Control Centres Management Manual, Part 1.

### 3.2 Strategy for control and eradication

The strategy is to use partial destocking as the primary option for eradication. However, test and slaughter is an alternative option that can be used if the disease has spread widely beyond the index property, if a herd infection is found to be recent and/or if suspect animals are of high value or large in number and compensation costs must be limited. A combination of the two strategies is likely to be warranted. The prompt implementation of individual property quarantine will reduce the potential for spread between farms by cattle movements. Effective tracing of the disease is the key to rapid resolution of an outbreak. Surveillance will determine the distribution of the disease and the herd prevalence, allowing the best strategy to be selected. The approach adopted should be thoroughly discussed with the industry and individual producers to ensure maximum cooperation in the implementation of the agreed strategies.

#### 3.2.1 Depopulation of infected animals

**Depopulation**

Unlike a test and slaughter strategy, depopulation has the advantage of being quick and of allowing the country to be declared free without undue delay. Depopulation will therefore be used immediately if the disease is restricted to a few herds, if the herds are small and if the disease is contained and unlikely to spread. The slaughtered animals will be disposed of by the most appropriate means for each situation.

**Test and slaughter**

Eradication by test and slaughter is not always successful; any indication of a problem (that is, the disease spreading more quickly than the instituted eradication measures) should therefore be treated severely, by cattle depopulation or a vaccination program.
3.2.2 Quarantine and movement controls

Quarantine and movement controls will be imposed on infected premises (IPs), dangerous contact premises (DCPs) and suspect premises (SPs) that are identified through tracing and surveillance (see Appendix 1).

Declaration of a restricted area (RA) or control area (CA) that includes contiguous properties may provide additional reassurance during the period of initial investigation.

People and vehicles will not be subject to any restriction.

See Appendixes 1 and 2 for further details on quarantine and movement controls.

Zoning

Zoning may help to define the extent of the disease and enable better controls for the movement of live animals and products. However, zoning is only likely to offer a trade advantage for international markets where countries have specific import requirements. The worth of these markets must be balanced against the cost to domestic trade. There is no justification for states to impose special conditions based on state boundaries.

3.2.3 Tracing and surveillance

Tracing all cattle movements involving the infected premises will be undertaken as a matter of priority. Adjacent properties will also be investigated and the cattle serologically tested.

Serosurveillance also needs to be undertaken on all premises that have provided or received breeding cattle from the IP.

Targeted monitoring and surveillance in the form of milk ring tests and examination of abortions should be carried out. There should also be targeted serological monitoring in designated abattoirs.

If premises have been depopulated, they can be restocked with disease-free cattle after a period of freedom from all susceptible species. Depending upon the environmental conditions, this period may be a minimum of 30 days after depopulation and decontamination. Surveillance of the new herd should be maintained until 30 days after calving, with serological testing of all breeding animals at the end of this period.

See Appendix 4 for further details on surveillance.

3.2.4 Vaccination

Effective vaccines against brucellosis are available and their use should be given serious consideration. Strain 19 is still the vaccine of choice for Australia. The use of live vaccines must address the potential danger to humans.

Criteria to be used in making decisions on vaccination include:

- interval from incursion to detection
- nature of enterprises affected
- number of herds or cattle affected
• analysis of the costs and benefits of vaccination/test and slaughter versus a slaughter policy
• ability to effectively zone vaccination areas
• public health risks to those handling infected stock
• need for permanent identification of vaccinates.

See Sections 1.5.3 and 2.2.10 for further details on vaccination, including vaccines available and methods of vaccination.

3.2.5 Treatment of infected animals

Treatment of infected animals with antibiotics has no place in the eradication of *B. abortus*.

3.2.6 Treatment of animal products and byproducts

Confirmed infected cows that are close to calving or that have a vaginal discharge must not be sent to slaughter, because there is a risk of human infection. Such animals must be handled with care and destroyed on the property. *B. abortus* is readily destroyed by heat, and infected carcasses and parts can be safely rendered.

Unpasteurised milk from infected cows must not be used for human consumption.

3.2.7 Disposal of animal products and byproducts

Precautions should be taken in the handling and disposal of the placenta, uterus and mammary gland from suspect cattle on farms, abattoirs and animal byproduct establishments.

3.2.8 Decontamination

Decontamination has little role in eradication if destocking is employed. After a property is destocked and decontaminated (to eliminate any moist organic areas) it should be spelled for a minimum of 30 days (see Section 2.2.13).

3.2.9 Wild animal control

Effective fencing is required to prevent the entry of feral cattle, buffalo and deer to heavily contaminated areas. Where the numbers of feral animals are high, and infection in them is confirmed or judged likely, population control may be necessary.

3.2.9 Vector control

Mechanical vectors such as feral animals, foxes, cats, dogs, flies and ticks are rarely important in the epidemiology; for practical purposes, they can be disregarded in an outbreak.

3.2.10 Public awareness and media

See Section 2.2.15 for further details on what to include in a public awareness campaign.
3.2.11 Public health implications

Brucellosis is a significant zoonosis, and health authorities must be alerted to the potential for human infection.

The only risk to the general public is from consumption of unpasteurised milk from infected cows.

People handling infective material (including vaccines) must be advised of appropriate occupational health and safety requirements (see Section 2.2.14).

3.3 Social and economic effects

Social and economic effects are likely to be felt primarily by the owners of affected herds. Infection with B. abortus can have severe effects on production, including the loss of calves, interference with seasonal calving, infertility, decreased milk production, weak calves, joint infections and increased culling of nonproductive cows.

Quarantine of infected herds immediately restricts an owner’s options for selling cattle, especially breeding stock, and studs are therefore severely affected. The index IP, and any other infected or suspect properties that may be depopulated, will be severely affected due to the immediate stoppage of productive operations and loss of income.

These effects can be reduced by prompt action to remove affected stock and implement hygiene and disinfection measures, thus enabling restocking at the earliest opportunity.

Neighbouring producers and those subject to investigation as a result of tracing will also suffer disruption to their operations. Generally, this will not be severe, being restricted to farm survey, discussion and potentially the testing of all breeding cattle on the property, or at least those at risk.

Declaration of an RA would affect a wider group of producers, especially producers of stud cattle who will be prevented from selling cattle until the distribution of the disease is clarified. Prevention of cattle markets within an area would have minimal direct effects. Where the disease is restricted to a small number of properties and a depopulation strategy is adopted, the economic effects will be minimised.

The presence of brucellosis in Australia is unlikely to affect beef exports even to countries free of the disease. Of the major importers of Australian beef, Japan, South Korea and the United States all have bovine brucellosis. However, trade of Australian breeding cattle to countries free of brucellosis may be temporarily affected. There is potential for a decrease in domestic consumption of beef, at least in the short term.

Zoning would potentially interrupt the free movement of breeding stock and the movement of cattle to slaughter at preferred markets. The effects are likely to be minimal, especially where a protocol for serological testing to enable movements is implemented.
3.4 Criteria for proof of freedom

The OIE Terrestrial Code has two key criteria related to proof of freedom. The first requires confirmation that the rate of brucellosis infection is less than 0.2% of the cattle herds in the country or area under consideration. This indicates that the presence of a small number of infected herds should not affect brucellosis-free status. It also highlights the importance of prompt action to restrict the number of herds that become infected. The second key criterion requires that no vaccine should have been used for at least the past three years.

Nevertheless, a formal declaration of continuing freedom may assist the resumption of trade in live breeding stock to countries that are brucellosis free and reassure other countries that the disease has been effectively managed.

After an outbreak of brucellosis, a survey of the cattle population would be required to demonstrate proof of freedom. This may be carried out by a combination of field and abattoir serological testing and by milk ring tests of dairy herds (see Appendix 4). The survey would concentrate on all herds affected, those in contact and neighbours, and be based on the results of tracing of cattle movements.

See Appendix 4 for further details on proof of freedom.

3.5 Funding and compensation

Brucellosis (due to *B. abortus*) is classified as a Category 2 emergency animal disease under the EAD Response Agreement between the governments of Australia and the livestock industries.

Category 2 diseases are emergency animal diseases that have the potential to cause major national socioeconomic consequences through very serious international trade losses, national market disruptions and very severe production losses in the livestock industries that are involved. Category 2 also includes diseases that may have slightly lower national socioeconomic consequences, but also have significant public health and/or environmental consequences. For this category, the costs will be shared 80% by governments and 20% by the relevant industries (refer to the EAD Response Agreement for details).

Information on the cost-sharing arrangements can be found in the AUSVETPLAN Summary Document and in the Valuation and Compensation Manual.

3.6 Strategy if the disease becomes established

Despite the high costs of disease eradication strategies, such as depopulation/repopulation and test and slaughter, it is unlikely that, given the effort to originally achieve disease-free status for bovine brucellosis, the Australian

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cattle industry, state and territory governments or the Australian Government would allow this disease to become re-established.

The primary strategy would be to define the prevalence and distribution of the disease so that the two eradication strategies could be logically applied to remove infection from the population as quickly as possible. The use of vaccine may be warranted where intractable infection is found in many large or valuable herds and where such use does not compromise the proposed timetable for achieving eradication.
Appendix 1 Guidelines for classifying declared areas

Premises

Infected premises (IP)
A premises classified as an IP will be a defined area (which may be all or part of a property) in which brucellosis is confirmed. An IP is subject to quarantine served by notice and to eradication and control procedures.

Dangerous contact premises (DCP)
Premises classified as DCPs will be those that contain animals, animal products, waste or other items that have recently been introduced from an IP and are likely to be infected or contaminated, or any of these items that may have been in substantial contact with people, vehicles and equipment that have been associated with an infected premises.

For bovine brucellosis, premises classified as DCPs will most likely be:

- all neighbouring properties on which susceptible animals have been sharing a common fenceline with infected animals on an IP and where it is considered necessary to impose disease control measures;
- all properties to which susceptible animals have moved from an IP and it is considered necessary to impose disease control measures; and
- all other properties owned or managed in conjunction with an IP.

DCPs will be subject to quarantine and to eradication or control measures.

Suspect premises (SP)
Premises classified as SPs will be those that contain animals that have possibly been exposed to \textit{B. abortus}, such that quarantine and surveillance are warranted; OR animals not known to have been exposed to \textit{B. abortus} but showing clinical signs requiring differential diagnosis.

For bovine brucellosis, premises most likely to be classified as SPs will be:

- other neighbouring properties containing susceptible animals;
- all properties that people have visited after handling or having close contact with susceptible animals on the IP and it is considered that subsequent transmission of disease is possible; and
- all premises where it is considered that disease could possibly have spread.

SPs will be subject to quarantine and intensive surveillance.
‘Suspect premises’ is a temporary classification because the premises contains animals that are suspected of having the disease. High priority should be given to clarifying the status of the suspect animals so that the SP can be reclassified as either an infected premises (IP) and disease control measures implemented, or as free from disease, in which case no further disease control measures are required.

Areas

Restricted area (RA)
If an RA is deemed necessary it may be as large as is necessary for satisfactory control, based on epidemiological evidence, geographical features, and other factors. The movement of all breeding cattle within the RA will be subject to restrictions.

Control area
Not applicable.
Appendix 2  Recommended quarantine and movement controls

Note: Susceptible stock/animals are defined here as all entire males and females, and exclude females spayed more than 12 months previously and castrated males.

Premises

<table>
<thead>
<tr>
<th>Quarantine/movement controls</th>
<th>Infected premises, dangerous contact premises and suspect premises</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Movement out of:</strong></td>
<td></td>
</tr>
<tr>
<td>Susceptible cattle</td>
<td>Approved under permit direct to immediate slaughter at an approved abattoir, except confirmed infected cows that are close to calving or that have a vaginal discharge. These animals must be destroyed on the property or consigned to a rendering works under supervision.</td>
</tr>
<tr>
<td>Nonsusceptible cattle</td>
<td>No restriction</td>
</tr>
<tr>
<td>Animal products and byproducts</td>
<td>Movement of destroyed cattle is permitted for burial or rendering. No restriction on other products.</td>
</tr>
<tr>
<td>Hay, crops, grains, wool, eggs, milk and meat</td>
<td>Permitted</td>
</tr>
</tbody>
</table>

| **Movement in and out of:** |
| People                      | No restriction                                               |
| Horses                      | No restriction unless showing clinical signs of the disease. Horses confirmed with *B. abortus* must be placed in prescribed restrictions and strictly isolated from all cattle. |
| Vehicles and equipment      | Livestock transport vehicles to be thoroughly cleaned if involved with known infected animals |

| **Movement in of:**         |
| Susceptible cattle          | Restrictions apply. Introductions should not be allowed until *B. abortus* is thought to have been eliminated. |
| Nonsusceptible cattle       | No restriction                                               |
### Area

<table>
<thead>
<tr>
<th>Quarantine/ movement control</th>
<th>Restricted area (if declared)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Movement into of:</strong></td>
<td></td>
</tr>
<tr>
<td>Susceptible stock</td>
<td>Controlled by inspector using permits</td>
</tr>
<tr>
<td><strong>Movement out of:</strong></td>
<td></td>
</tr>
<tr>
<td>Susceptible stock</td>
<td>Until disease status established, susceptible animals permitted to move for slaughter only. Then moved under permit.</td>
</tr>
<tr>
<td><strong>Movement within of:</strong></td>
<td></td>
</tr>
<tr>
<td>Susceptible stock</td>
<td>Controlled by inspector by the use of permits</td>
</tr>
<tr>
<td><strong>Movement through of:</strong></td>
<td></td>
</tr>
<tr>
<td>Susceptible stock</td>
<td>Controlled by inspector by the use of permits</td>
</tr>
<tr>
<td><strong>Movement of specified products</strong></td>
<td>No restriction on movement of products</td>
</tr>
<tr>
<td><strong>Movement of people and equipment</strong></td>
<td>No restrictions</td>
</tr>
<tr>
<td><strong>Movement of vehicles</strong></td>
<td>No requirement except livestock transport vehicles to be cleaned if involved with known infected or suspect animals</td>
</tr>
<tr>
<td><strong>Risk enterprises</strong></td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Sales, shows (gatherings of susceptible animals)</strong></td>
<td>Covered by above restrictions</td>
</tr>
<tr>
<td><strong>Stock routes, rights of way</strong></td>
<td>Covered by above restrictions</td>
</tr>
<tr>
<td><strong>Containment of susceptible animals</strong></td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
Appendix 3  OIE animal health code and diagnostic manual for terrestrial animals

OIE Terrestrial Code

The objective of the OIE Terrestrial Animal Health Code is to prevent the spread of animal diseases, while facilitating international trade in live animals, semen, embryos and animal products. This annually updated volume is a reference document for use by veterinary departments, import/export services, epidemiologists and all those involved in international trade.

The OIE Terrestrial Code is amended in May each year. The current edition is published on the OIE website at:

http://www.oie.int/eng/normes/mcode/A_summry.htm

The following chapters are relevant to this manual:

Chapter 2.3.1.  Bovine brucellosis

Chapter 1.3.5.  Zoning, regionalisation and compartmentalisation

Chapter 1.3.6.  Surveillance and monitoring of animal health

OIE Terrestrial Manual

The purpose of the OIE Manual of Standards for Diagnostic Tests and Vaccines for Terrestrial Animals is to contribute to the international harmonisation of methods for the surveillance and control of the most important animal diseases. Standards are described for laboratory diagnostic tests and the production and control of biological products (principally vaccines) for veterinary use across the globe.

The OIE Terrestrial Manual is updated approximately every four years. The current edition is available on the OIE website at:

http://www.oie.int/eng/normes/mmanual/A_summry.htm

The following chapter is relevant to this manual:

Chapter 2.3.1.  Bovine brucellosis
Appendix 4 Procedures for surveillance and proof of freedom

Procedures to establish proof of freedom

Proof of freedom from brucellosis can best be achieved by the reporting and investigation of abortions, milk ring testing at dairy factories and use of targeted serological testing.

Initial serological surveillance should target former IPs, DCPs and SPs, which require two negative tests at six month intervals, because they were either:

- depopulated, in which case testing of the new herd after repopulation is required; OR
- subject to test and slaughter, and testing of all breeding cattle until a negative herd test has been achieved.

In DCPs and SPs where no evidence of infection was found on initial investigation, milk ring testing or serological evidence of continued freedom would be sufficient. Serological evidence would involve the testing of breeding cattle over the age of six months to achieve 99% confidence of less than 1% seropositivity.

In herds with no history of infection and where it has been established that there has been no contact with known affected properties, the only action required is to ensure that the owners are aware of the disease and the need to promptly report abortions so they can be fully investigated.

Where vaccinates are present in a herd, three years must elapse from the time of the last vaccination to establish freedom.

Surveillance

The objective of surveillance is to meet OIE requirements, as outlined in Chapter 1.3.6 and Appendix 3.8.1 of the OIE Terrestrial Code (see Appendix 3).
Appendix 5 Specimens yielding *Brucella abortus* from known infected cows and heifers

### Cows

<table>
<thead>
<tr>
<th>Specimen</th>
<th>No. examined</th>
<th>No. positive on culture</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lymph nodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parotid</td>
<td>136</td>
<td>70</td>
<td>51.5</td>
</tr>
<tr>
<td>Mandibular (submaxillary)</td>
<td>136</td>
<td>70</td>
<td>51.5</td>
</tr>
<tr>
<td>Medial retropharyngeal</td>
<td>137</td>
<td>94</td>
<td>68.6</td>
</tr>
<tr>
<td>Caudal superficial cervical (prescapular)</td>
<td>137</td>
<td>78</td>
<td>56.9</td>
</tr>
<tr>
<td>Caudal mediastinal</td>
<td>136</td>
<td>47</td>
<td>34.6</td>
</tr>
<tr>
<td>Hepatic</td>
<td>90</td>
<td>16</td>
<td>17.8</td>
</tr>
<tr>
<td>Jejunal mesenteric</td>
<td>88</td>
<td>6</td>
<td>6.8</td>
</tr>
<tr>
<td>Medial iliac</td>
<td>137</td>
<td>101</td>
<td>73.7</td>
</tr>
<tr>
<td>Subiliac (prefemoral)</td>
<td>136</td>
<td>93</td>
<td>68.4</td>
</tr>
<tr>
<td>Mammary (superficial inguinal)</td>
<td>136</td>
<td>121</td>
<td>88.0</td>
</tr>
<tr>
<td>Spleen</td>
<td>136</td>
<td>32</td>
<td>23.5</td>
</tr>
<tr>
<td>Udder</td>
<td>91</td>
<td>75</td>
<td>82.4</td>
</tr>
<tr>
<td>Uterine caruncle or foetal tissue</td>
<td>136</td>
<td>57</td>
<td>41.9</td>
</tr>
<tr>
<td>Milk</td>
<td>107</td>
<td>90</td>
<td>84.1</td>
</tr>
</tbody>
</table>

Source: Corner et al 1987
### Heifers

<table>
<thead>
<tr>
<th>Specimen</th>
<th>No. examined</th>
<th>No. positive on culture</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymph nodes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parotid</td>
<td>61</td>
<td>42</td>
<td>68.9</td>
</tr>
<tr>
<td>Mandibular (submaxillary)</td>
<td>61</td>
<td>45</td>
<td>73.8</td>
</tr>
<tr>
<td>Medial retropharyngeal</td>
<td>61</td>
<td>38</td>
<td>62.3</td>
</tr>
<tr>
<td>Caudal superficial cervical (prescapular)</td>
<td>61</td>
<td>36</td>
<td>59.0</td>
</tr>
<tr>
<td>Caudal mediastinal</td>
<td>61</td>
<td>31</td>
<td>50.8</td>
</tr>
<tr>
<td>Jejunal mesenteric</td>
<td>24</td>
<td>8</td>
<td>33.3</td>
</tr>
<tr>
<td>Medial iliac</td>
<td>61</td>
<td>36</td>
<td>59.0</td>
</tr>
<tr>
<td>Subiliac (prefemoral)</td>
<td>61</td>
<td>39</td>
<td>63.9</td>
</tr>
<tr>
<td>Mammary (superficial inguinal)</td>
<td>61</td>
<td>36</td>
<td>59.0</td>
</tr>
<tr>
<td>Spleen</td>
<td>61</td>
<td>30</td>
<td>49.2</td>
</tr>
<tr>
<td>Liver</td>
<td>23</td>
<td>4</td>
<td>17.4</td>
</tr>
<tr>
<td>Lung</td>
<td>22</td>
<td>5</td>
<td>22.7</td>
</tr>
<tr>
<td>Kidney</td>
<td>22</td>
<td>6</td>
<td>27.3</td>
</tr>
<tr>
<td>Uterine caruncle or foetal tissue</td>
<td>58</td>
<td>12</td>
<td>20.7</td>
</tr>
<tr>
<td>Udder</td>
<td>22</td>
<td>4</td>
<td>18.2</td>
</tr>
<tr>
<td>Milk</td>
<td>5</td>
<td>5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note: A heifer is defined here as an animal < 18 months of age (ie having no permanent incision teeth).

Source: Corner et al (1987)
Appendix 6 Occupational health and safety issues for persons handling Brucella reactors committed for destruction

The aim of this appendix is to identify and address occupational health and safety issues for transporters, abattoir workers and other people involved in livestock and carcase handling where Brucella reactors have been identified for destruction. All people in contact with reactors must be aware of the personal procedures outlined in the following section.

Infection occurs mainly through the handling of infected foetuses, birth membranes or mammary glands, or through the ingestion of raw milk. Meat and meat products pose very slight risk. Cows that have aborted from brucellosis are thought to pose a negligible risk three weeks later.

Personal procedures for handling a Brucella reactor

All personnel handling potentially infected animals should be thoroughly informed of the danger of contracting the disease from carcases, milk, blood, urine, faeces and birth products or discharges. Personnel should be made aware that human infection can occur readily through:

- damaged or intact skin
- the conjunctiva
- respiratory tree
- (more rarely) the oral route.

All personnel physically handling the carcase should wear the following protective apparel:

- long rubber gloves
- protective eye shields
- masks that form a seal on the face covering the mouth and nose
- impervious apron
- impervious boots.

Personal hygiene while working with carcases is extremely important. Protective apparel such as gloves and eyeshields should be washed and disinfected immediately after use. Masks should be disposed of safely.

Individuals with uncovered wounds should not be permitted to perform these procedures. Cuts and abrasions that occur in the process of carcase handling should be treated immediately. Eating and smoking are not allowed during handling and/or slaughtering procedures. Splashes of animal material on clothing, equipment or skin should be removed as soon as possible.

For abattoir workers, particular care should be taken when handling udders, uteri, bladders, brisket saws and knives in slaughtering positions where there is a risk of spillage.

Occupationally exposed groups should have access to specialised medical services to facilitate the early and correct diagnosis of brucellosis.
Physical procedures for handling a Brucella reactor

Where a decision has been made to destroy a reactor, a decision will also be made on where the destruction will be carried out. Destruction will occur at an abattoir or slaughterhouse within the control area, where practicable. Destruction may be ordered to take place on the infected premises when a heavily pregnant animal is identified or where the risk of spreading infection during transport to an abattoir or slaughterhouse is deemed to be too great. Taking into account the personal procedures listed above, transport workers must ensure that vehicles used to transport reactors are disinfected following each journey.

Destruction of reactor(s) at abattoir/slaughterhouse

Animals that have reacted to diagnostic tests for brucellosis should be segregated, prior to slaughter, in an area that can readily be disinfected.

Such animals should be slaughtered without unreasonable delay after arrival at an abattoir; if possible, they should be slaughtered at the end of the day’s operations.

All slaughtering, washing and cleaning procedures must be carried out in a fashion that minimises the opportunity for spillage or splash of potentially infective fluids.

The blood from such animals should not be saved for human consumption.

For cattle, udders must be carefully dissected away from the underlying suspensory tissues in order to prevent spillage of milk. Such a precaution is most important if the cow has been lactating and the udder is unduly distended.

‘Ringing’ of the anus and vulva followed by removal of the external anal and vulval skin and then sealing of the rectum and vagina must be performed by a competent person.

Removal of the urinary bladder should be performed only after the neck of the bladder is securely tied.

Removal of the uterus should be performed by a competent person. Should a cow be pregnant, no disruption to the uterus should occur and no attempt to save the slink (foetus) is allowed.

Opening of the nuchal bursa should be supervised by a person with meat inspection experience. Any evidence of the presence of ‘rice grain’–like objects in the bursal fluid should warrant condemnation of the neck and thoracic tissues back to the third thoracic vertebra.

Strict attention should be paid to the limb joints, particularly the stifle, for possible presence of a hygroma. The presence of any such fluid-filled swelling (determined by palpation only) warrants the removal of that limb at the next joint above (ie closer to the carcase).

Inspectors on the head chain should supervise the removal of both tonsils. The pharyngeal lymph nodes should be left until last for slicing and then the entire tongue root should be removed and disposed of in a sanitary manner as condemned tissue. The inspector should then sterilise his/her knife.
Inspectors on the ‘fronts’ should leave the slicing of the superficial inguinal lymph nodes until last. The inspector should then sterilise his/her knife.

As frequently as possible, all utensils, instruments, machinery, chutes, floors and other areas of potential contamination should be cleaned using standard procedures and agents and then cleansed with water at temperatures above 82°C.

Facilities for washing and disinfection should be made available.

**Destruction of reactor(s) on infected premises**

Animals that have reacted to diagnostic tests for brucellosis should be segregated, prior to slaughter, in an area that can readily be disinfected.

Unless slashing is necessary as part of the burial process, the carcase should remain intact.

The reactor should be buried or burned, whichever is the most practicable in the situation (refer to the AUSVETPLAN *Disposal Manual*).

All utensils, instruments and machinery should be cleaned using procedures and agents outlined in the AUSVETPLAN *Decontamination Manual* to ensure that the risk of human infection is minimised.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal byproducts</td>
<td>Products of animal origin that are not for consumption but are destined for industrial use (e.g., hides and skins, fur, wool, hair, feathers, hooves, bones, fertiliser).</td>
</tr>
</tbody>
</table>
| Animal Health Committee | A committee comprising the CVOs of Australia and New Zealand, Australian state and territory CVOs, Animal Health Australia, and a CSIRO representative. The committee provides advice to PIMC on animal health matters, focusing on technical issues and regulatory policy (formerly called the Veterinary Committee).  
*See also* Primary Industries Ministerial Council (PIMC) |
| Animal products | Meat, meat products and other products of animal origin (e.g., eggs, milk) for human consumption or for use in animal feedstuff. |
| Australian Chief Veterinary Officer | The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry — Australia who manages international animal health commitments and the Australian Government's response to an animal disease outbreak.  
*See also* Chief veterinary officer |
| AUSVETPLAN | *Australian Veterinary Emergency Plan*. A series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans. |
| Chief veterinary officer (CVO) | The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction.  
*See also* Australian Chief Veterinary Officer |
| Compensation | The sum of money paid by government to an owner for stock that are destroyed and property that is compulsorily destroyed because of an emergency animal disease. |
| Complement fixation test | A serological test designed to detect and measure the presence of antibody or antigen in a sample. Most commonly used test that is readily automated. |
Consultative Committee on Emergency Animal Diseases (CCEAD)  
A committee of state and territory CVOs, representatives of CSIRO Livestock Industries and the relevant industries, and chaired by the Australian CVO. CCEAD convenes and consults when there is an animal disease emergency due to the introduction of an emergency animal disease of livestock, or other serious epizootic of Australian origin.

Control area  
A declared area in which the conditions applying are of lesser intensity than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an outbreak according to need).  
See Appendix 1 for further details.

Dangerous contact animal  
A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.

Dangerous contact premises  
Premises that contain dangerous contact animals or other serious contacts.  
See Appendix 1 for further details

Declared area  
A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation.  
Types of declared areas include restricted area, control area, infected premises, dangerous contact premises and suspect premises.  
See Appendix 1 for further details

Decontamination  
Includes all stages of cleaning and disinfection.

Depopulation  
The removal of a host population from a particular area to control or prevent the spread of disease.

Destroy (animals)  
To slaughter animals humanely.

Disease agent  
A general term for a transmissible organism or other factor that causes an infectious disease.

Disease Watch Hotline  
24-hour freecall service for reporting suspected incidences of exotic diseases — 1800 675 888

Disinfectant  
A chemical used to destroy disease agents outside a living animal.

Disinfection  
The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.

Disposal  
Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease

A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications.

See also Endemic animal disease, Exotic animal disease

Emergency Animal Disease Response Agreement

Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include funding mechanisms, the use of appropriately trained personnel and existing standards such as AUSVETPLAN.

Endemic animal disease

A disease affecting animals (which may include humans) that is known to occur in Australia.

See also Emergency animal disease, Exotic animal disease

Enzyme-linked immunosorbent assay

The test uses an enzyme reaction with a substrate to produce a colour change when antigen-antibody binding occurs.

Enterprise

See Risk enterprise

Epidemiological investigation

An investigation to identify and qualify the risk factors associated with the disease.

See also Veterinary investigation

Exotic animal disease

A disease affecting animals (which may include humans) that does not normally occur in Australia.

See also Emergency animal disease, Endemic animal disease

Exotic fauna/feral animals

See Wild animals

Fomites

Inanimate objects (e.g., boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.

Hygroma

Excess fluid in a joint cavity.

Immunoglobulin – IgG

Antibody protein

The main form of immunoglobulin produced in response to an antigen. It is mainly found in body fluids.

In-contact animals

Animals that have had close contact with infected animals, such as non-infected animals in the same group as infected animals.

Incubation period

The period that elapses between the introduction of the pathogen into the animal and the first clinical signs of the disease.
Index case
The first or original case of the disease to be diagnosed in a disease outbreak on the index property.

Index property
The property on which the first or original case (index case) in a disease outbreak is found to have occurred.

Infected premises
A defined area (which may be all or part of a property) in which an emergency disease exists, is believed to exist, or in which the infective agent of that emergency disease exists or is believed to exist. An infected premises is subject to quarantine served by notice and to eradication or control procedures. See Appendix 1 for further details.

Local disease control centre (LDCC)
An emergency operations centre responsible for the command and control of field operations in a defined area.

Milk ring test
A very sensitive test used on milk from individual or bulk samples. Stained brucella cells are used as the antigen and adhere to the surface of fat globules, producing a stained layer of cream.

Monitoring
Routine collection of data for assessing the health status of a population. See also Surveillance

Movement control
Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.

National management group (NMG)
A group established to direct and coordinate an animal disease emergency. NMGs may include the chief executive officers of the Australian Government and state or territory governments where the emergency occurs, industry representatives, the Australian CVO (and chief medical officer, if applicable) and the chairman of Animal Health Australia.

Native wildlife
See Wild animals

OIE Terrestrial Code
OIE Terrestrial Animal Health Code. Reviewed annually at the OIE meeting in May and published on the internet at: http://www.oie.int/eng/normes/mcode/a_summry.htm See Appendix 3 for further details

OIE Terrestrial Manual

Operational procedures
Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).</td>
</tr>
<tr>
<td>Premises</td>
<td>A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.</td>
</tr>
<tr>
<td>Prevalence</td>
<td>The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.</td>
</tr>
<tr>
<td>Primary Industries Ministerial Council (PIMC)</td>
<td>The council of Australian national, state and territory and New Zealand ministers of agriculture that sets Australian and New Zealand agricultural policy (formerly the Agriculture and Resource Management Council of Australia and New Zealand). See also Animal Health Committee</td>
</tr>
<tr>
<td>Quarantine</td>
<td>Legal restrictions imposed on a place or a tract of land by the serving of a notice limiting access or egress of specified animals, persons or things.</td>
</tr>
<tr>
<td>Restricted area</td>
<td>A relatively small declared area (compared to a control area) around an infected premises that is subject to intense surveillance and movement controls. See Appendix 1 for further details</td>
</tr>
<tr>
<td>Risk enterprise</td>
<td>A defined livestock or related enterprise, which is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold stores, AI centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges, garbage depots.</td>
</tr>
<tr>
<td>Rose Bengal plate test</td>
<td>A serological spot agglutination test used to screen for brucellosis in cattle herds.</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>The proportion of truly positive units that are correctly identified as positive by a test. See also Specificity</td>
</tr>
<tr>
<td>Sentinel animal</td>
<td>Animal of known health status that is monitored to detect the presence of a specific disease agent.</td>
</tr>
<tr>
<td>Serotype</td>
<td>A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).</td>
</tr>
<tr>
<td>Specificity</td>
<td>The proportion of truly negative units that are correctly identified as a negative by a test. See also Sensitivity</td>
</tr>
</tbody>
</table>
Stamping out
Disease eradication strategy based on the quarantine and slaughter of all susceptible animals that are infected or exposed to the disease.

State or territory disease control headquarters
The emergency operations centre that directs the disease control operations to be undertaken in that state or territory.

Surveillance
A systematic program of investigation designed to establish the presence, extent of, or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.

Susceptible animals
Animals that can be infected with a particular disease See also Susceptible cattle

Susceptible cattle
For bovine brucellosis, this includes all male and female cattle except for females spayed more than 12 months previously and castrated males.

Suspect animal
An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-emptive slaughter, is warranted.
OR
An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.

Suspect premises
Temporary classification of premises containing suspect animals. After rapid resolution of the status of the suspect animal(s) contained on it, a suspect premises is reclassified either as an infected premises (and appropriate disease-control measures taken) or as free from disease. See Appendix 1 for further details

Tracing
The process of locating animals, persons or other items that may be implicated in the spread of disease, so that appropriate action can be taken.

Vaccination
Inoculation of healthy individuals with weakened or attenuated strains of disease-causing agents to provide protection from disease.

Vaccine
Modified strains of disease-causing agents that, when inoculated, stimulate an immune response and provide protection from disease.

-attenuated
A vaccine prepared from infective or ‘live’ microbes that have lost their virulence but have retained their ability to induce protective immunity.

- inactivated
A vaccine prepared from a virus that has been inactivated (‘killed’) by chemical or physical treatment.
### Vector

A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A **biological** vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A **mechanical** vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.

### Veterinary investigation

An investigation of the diagnosis, pathology and epidemiology of the disease. *See also* Epidemiological investigation

### Wild animals

- **native wildlife**
  
  Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (e.g., bats, dingoes, marsupials).

- **feral animals**
  
  Domestic animals that have become wild (e.g., cats, horses, pigs).

- **exotic fauna**
  
  Nondomestic animal species that are not indigenous to Australia (e.g., foxes).

### Zoning

The process of defining disease-free and infected areas in accord with OIE guidelines, based on geopolitical boundaries and surveillance, in order to facilitate trade.

### Zoonosis

A disease of animals that can be transmitted to humans.
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AAHL</td>
<td>Australian Animal Health Laboratory</td>
</tr>
<tr>
<td>AUSVETPLAN</td>
<td>Australian Veterinary Emergency Plan</td>
</tr>
<tr>
<td>CA</td>
<td>control area</td>
</tr>
<tr>
<td>CCEAD</td>
<td>Consultative Committee on Emergency Animal Diseases</td>
</tr>
<tr>
<td>CFT</td>
<td>complement fixation test</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>CVO</td>
<td>chief veterinary officer</td>
</tr>
<tr>
<td>DAFF</td>
<td>Department of Agriculture, Fisheries and Forestry (Australian Government)</td>
</tr>
<tr>
<td>DCP</td>
<td>dangerous contact premises</td>
</tr>
<tr>
<td>IP</td>
<td>infected premises</td>
</tr>
<tr>
<td>LDCC</td>
<td>local disease control centre</td>
</tr>
<tr>
<td>MRT</td>
<td>milk ring test</td>
</tr>
<tr>
<td>NMG</td>
<td>national management group</td>
</tr>
<tr>
<td>OIE</td>
<td>World Organisation for Animal Health (Office International des Epizooties)</td>
</tr>
<tr>
<td>PIMC</td>
<td>Primary Industries Ministerial Council</td>
</tr>
<tr>
<td>RA</td>
<td>restricted area</td>
</tr>
<tr>
<td>RBPT</td>
<td>Rose Bengal plate test</td>
</tr>
<tr>
<td>SDCHQ</td>
<td>state or territory disease control headquarters</td>
</tr>
<tr>
<td>SP</td>
<td>suspect premises</td>
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**Further reading**


**Video/training resources**

[See the Summary Document for a full list of training resources.]
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