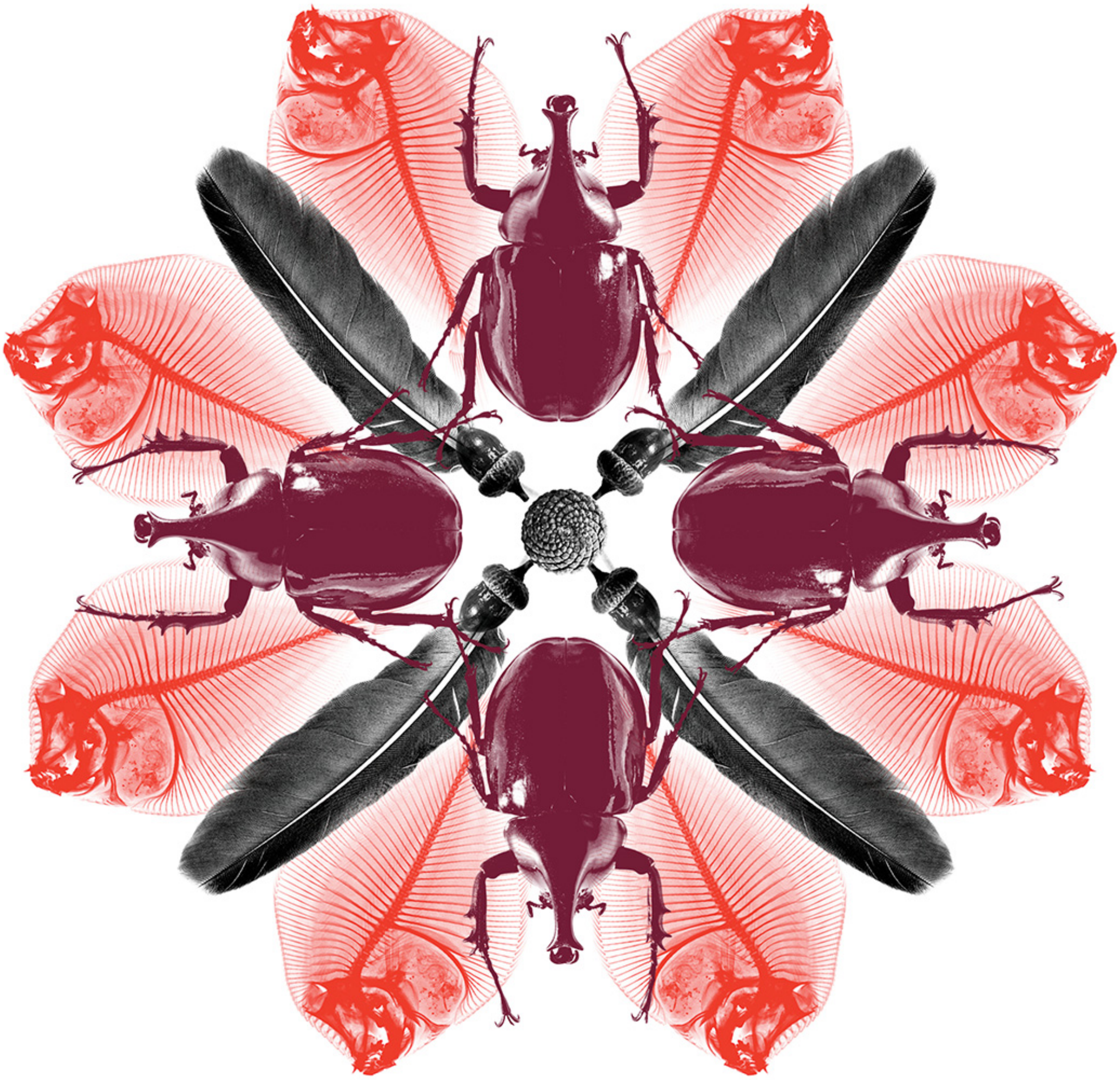
Australian Government
Department of Agriculture, Water and the Environment

Assessment of bulk wheat from Canada

Part B: Animal biosecurity risk advice

Biosecurity Animal Division



Cataloguing data

This publication (and any material sourced from it) should be attributed as: Biosecurity Animal Division 2020, *Assessment of bulk wheat from Canada Part B: Animal biosecurity risk advice*, Department of Agriculture, Water and the Environment, Canberra, February. CC BY 4.0.

ISBN 978-1-76003-224-1

This publication is available at http://www.agriculture.gov.au/biosecurity/risk-analysis/plant/

Department of Agriculture, Water and the Environment

GPO Box 858 Canberra ACT 2601
Telephone 1800 900 090
Web awe.gov.au

Contents

Summary **1**

Introduction **3**

1 Purpose of this advice **4**

2 Scope **4**

3 General requirements for imported bulk grains for processing **4**

4 Animal biosecurity risks associated with bulk wheat from Canada **4**

4.1 Animal diseases of biosecurity concern to Australia associated with bulk grain 4

4.2 Identification of animal pathogens of biosecurity concern 7

4.3 Review of animal biosecurity risks 8

4.4 Diseases of animal biosecurity concern 8

5 Risk management measures **16**

5.1 Pre-export requirements 17

5.2 Entry requirements 18

5.3 Grain processing requirements 18

6 Conclusion **19**

7 References **20**

8 Version history **25**

Summary

In late 2018, the Department of Agriculture, Water and the Environment received an application to import commercially-produced bulk wheat from the Canadian Prairies (Alberta, Manitoba and Saskatchewan) for commercial processing. As part of assessing this application, in February 2019 scientists from the department undertook a pathway risk analysis and visited Canada to verify the pest status of wheat grown in Canada and the integrity of the export pathway to Australia.

Plant biosecurity risks

The only identified fungal pathogens of biosecurity concern to Australia that are present in Canada are *Cephalosporium gramineum* and *Tilletia controversa*. *Tilletia controversa* is not present in the Canadian Prairie Provinces (Manitoba, Saskatchewan and Alberta) or the Peace River district in the northern part of the province of British Columbia. *C. gramineum* is primarily a pathogen of winter wheat in Canada and that there is a very low prevalence of this fungus in the Canadian Prairies. The majority of wheat grown in the Canadian Prairies is spring wheat which may explain the low prevalence of *C. gramineum* in this area. Other biosecurity concerns include various stored grain pests and weed seeds. The introduction and spread of these pests and diseases could have significant consequences for Australia's grain industry and therefore require risk mitigation measures to manage the biosecurity risks.

Animal biosecurity risks

The animal diseases of biosecurity concern to Australia that are present in Canada include bovine tuberculosis, brucellosis, chronic wasting disease, avian influenza, infectious bursal disease (IBD), Maedi-visna, Newcastle disease, swine enteric coronavirus diseases and scrapie. It is unlikely that the causal organisms for bovine tuberculosis, brucellosis, IBD and Maedi-visna would contaminate grains produced under broad acre production and mechanical harvesting in Canada. Therefore, these diseases do not require specific risk management measures.

Newcastle Disease, avian influenza, swine enteric coronavirus diseases, chronic wasting disease and scrapie are potential concerns and therefore require risk mitigation measures.

The risk management strategy for bulk wheat from the Canadian Prairies for processing is based on critical control points along the pathway that reduce the risk of introducing these pests and diseases and therefore achieve the appropriate level of protection for Australia. Control points will be applied:

- pre-export, by sourcing spring wheat from low risk areas with low foreign material proportions, using clean transport units and obtaining regulatory assurance (e.g. certification from Canada's National Plant Protection Organisation (NPPO) – Canada Food Inspection Agency (CFIA) and the Canadian Grain Commission)
- on-arrival, by consignment inspection and verification, and the use of secured handling and transport to manage the risks and impacts of spillage and limitation of diversion.
- at processing stages, by use of department-approved facilities under an Approved Arrangement.

This report, published in two parts: *Assessment of bulk wheat from Canada Part A: Pathway analysis* and *Assessment of bulk wheat from Canada Part B: Animal biosecurity risk advice,* presents the findings and recommendations of a pathway analysis by the department of the plant and animal biosecurity risks to Australia of commercially produced bulk wheat from Canada; and the systems in place for the production, harvesting, storing, transporting and processing of bulk wheat from the Canadian Prairies destined for export.

Introduction

The Department of Agriculture, Water and the Environment has a major role in regulating imports of bulk grain through granting import permits, which provide commercial supply options for grain users and suppliers where there are shortfalls in domestic production.

The decision to import grain is a commercial decision by the importer. The department's responsibility is to ensure that any imports do not compromise Australia's biosecurity status.

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

Applications to import grain are considered on a case-by-case basis and require thorough risk assessment and site and desk audits of the proposed import pathway.

For each request we receive to import grain, we undertake a pathway risk analysis for the proposed source country.

A pathway risk analysis involves looking at the scientific and economic evidence for a potential pest, weed or pathogen species of biosecurity concern to Australia, its regulation, and the management actions we would impose to reduce the risk of its entry and spread within Australia.

We also verify the presence or absence of pests of biosecurity concern, pest control practices, and the systems in place for the production, harvesting, storing, transporting and processing of grain destined for export.

If we are not satisfied that the management strategies applied can reduce the biosecurity risks to an acceptable level, we will not allow bulk grains to be imported into Australia.

In late 2018, the department received an application to import commercially-produced bulk wheat from the Canadian Prairies (Alberta, Manitoba and Saskatchewan) for commercial processing. As part of assessing this application, in February 2019 scientists from the department undertook a pathway risk analysis and visited Canada to verify the pest status of wheat grown in Canada and the integrity of the export pathway to Australia.

1 Purpose of this advice

This risk advice reviews the animal biosecurity risks to Australian animal and animal-based industries associated with the importation of commercially produced bulk whole wheat from the Canadian Prairies (Alberta, Manitoba and Saskatchewan) exported via the Port of Vancouver for processing at commercial facilities in Australia.

Risk management measures to manage the animal biosecurity risks in a least trade-restrictive manner, where required, are described in section 5 of this report.

2 Scope

This advice assesses the animal biosecurity risks associated with imported bulk whole wheat from Canada where all or part of the grain is intended for processing into stockfeed. It focusses on the cross-contamination risks related to whole grain production from the farm to the port of export and exposure risks to susceptible species onshore in Australia.

The bulk imported whole wheat from the Canadian Prairies is not for use as seed for planting, not for direct human consumption, not for feeding without moderate thermal processing to livestock as a stockfeed, stockfeed ingredient or supplement, and not for any other unintended use.

3 General requirements for imported bulk grains for processing

For general requirement, see section 3 of *Assessment of bulk wheat from Canada Part A: Pathway analysis.*

4 Animal biosecurity risks associated with bulk wheat from Canada

4.1 Animal diseases of biosecurity concern to Australia associated with bulk grain

Grain, other plant crops and products derived from these, such as stockfeed and fertiliser, present a potential pathway for animal diseases to be introduced from overseas farms to animals in Australia. The potential for the grain to be contaminated with pathogens of animal biosecurity concern to Australia varies substantially for each type of crop, the country of origin, type and scale of production, methods of harvesting, threshing, storage, transport and collection of the raw and processed material, the degree of product cleaning/washing during processing and any thermal or chemical treatment that may be applied to the product.

The use of imported stockfeed poses a high potential animal biosecurity risk due to its direct pathway to susceptible livestock. Australia is free from many significant infectious animal diseases such as foot-and-mouth disease (FMD), African swine fever (ASF), porcine epidemic diarrhoea (PED), chronic wasting disease (CWD), highly pathogenic avian influenza, Newcastle disease, scrapie and bovine spongiform encephalopathy (BSE –“mad cow disease”).

Contaminated imported stockfeed could introduce these or other animal diseases into Australia.

BSE and scrapie are examples of diseases called transmissible spongiform encephalopathies, or TSEs. The widespread BSE outbreak in cattle in the United Kingdom starting in the mid-late 1980s was due, in large part, to the feeding of contaminated meat and bone meal (MBM) to cattle. Even small amounts of cross contamination of plant-based stockfeed with infected animal material could lead to cases of BSE.

Concerns over TSEs generally, and BSE in particular, have led to a range of measures designed to manage the risk of introduction of these diseases into Australia. These measures include the ban on feeding Restricted Animal Material (RAM) to ruminants.

Australia's approach to preventing the entry of TSEs and other animal pathogens via plant-derived products includes strict controls to ensure that they do not contain materials derived from animals. Samples from stockfeed shipments may be tested for the presence of RAM (Department of Agriculture 2015).

Grains and other crops can also be contaminated with insects, parasites, bacteria and viruses of animal biosecurity concern. For example, stockfeed produced from root crops can be contaminated with a range of animal pathogens, including FMD virus, anthrax, Newcastle disease virus, infectious bursal disease virus and ASF virus.

Stockfeed produced from standing crops can also be contaminated with manure (including through the use of animal manure as fertiliser), other animal excretions, soil, and water-borne disease causing organisms. The use of animal manure or effluent on pastures or where livestock are closely associated with crop production is therefore of particular animal biosecurity concern.

In general, raw materials grown, harvested, dried and stored on small household farms, using basic mechanical equipment or facilities are likely to be exposed to livestock, their faeces and other excretions. Drying or storing raw materials such as whole grain on the ground in open areas – more commonly seen on small household farms – poses a much greater risk of being contaminated with animal disease causing organisms than products sourced from broad acre production using modern mechanical harvesting, drying and processing equipment.

Grain crops are particularly attractive to wild animals, rodents and a range of bird species. Various animal diseases of biosecurity concern of significance to poultry, livestock species and the environment can be introduced into stored grains as a result of failure to exclude access by rodents, birds and other animals.

The type of production and offshore processing methods and controls used prior to onshore thermal processing, has a strong bearing on the risk of contamination of the harvested grain with animal-derived materials and pathogens. Where bulk harvested grain is not held under biosecure storage conditions, environmental exposure is likely, including to rodents, birds, and animals including pigs and deer.

Establishments where a range of stockfeed or grains are produced or stored provide additional opportunities for contamination with animal-derived materials and disease causing pathogens. This can be a result of incorrect identification of lots, contamination from transport or production lines, contamination from material left in storage areas, and/or inadequate cleaning of lines and equipment. It can occur during transport, storage, or on production lines previously used for feeds which incorporate animal derived material.

There may be potential for contamination during packaging if the same equipment or storage area is also used for animal derived material or has been previously contaminated with animal pathogens. Also, contamination could occur if packaging in contact with the grain has been reused. Stockfeed or stockfeed ingredients that are enclosed in sealed packages such as new plastic bags, drums or glass containers are less likely to be contaminated unless the packages are broken. Biosecure packaging at the point of production is an effective means of preventing subsequent contamination.

Transport from the point of production to the point of export also provides opportunities for contamination. If the product is moved in bulk and the transport vehicles/containers are not clean, there is a risk of contamination because such vehicles/containers may have been previously used for products containing animal-derived materials or had been previously cross-contaminated by animal pathogens in other materials.

Further contamination can occur at storage depots, which may be used before loading for export. Where the security of containers is inadequate, there may be opportunities for cross-contamination of product, or errors in the identification of lots. Where storage is in bulk following consolidation of lots from various sources, a range of the above situations may occur.

Shipping containers and ships' holds that are used for transport to Australia may also present opportunities for contamination with animal-derived materials or animal pathogens. Product that is bulk packed into a container or into the hold of a ship can be contaminated if residues of stockfeed or animal-derived materials are present from previous trips.

The contaminants introduced into the transported bulk grain are not homogenously distributed through the entire lot during the above steps up to and including export. The viability of some may be attenuated by the duration of the transport prior to arrival on-shore. However, some may remain at levels capable of transmitting disease to susceptible species if the consignment is not adequately contained prior to processing or if thermal processing does not meet levels prescribed in the import permit.

4.1.1 Status in Canada of pathogens of animal biosecurity concern to Australia

Canada, through the Canadian Food Inspection Agency, has an effective national veterinary service and well-developed animal disease surveillance and control programs. Canada reports routinely and in a timely manner to the World Organisation for Animal Health (OIE). While being free from a number of significant animal diseases of biosecurity concern (e.g. FMD and ASF) a number of other diseases of animal biosecurity concern to Australia are present in Canada but not in Australia.

For the purposes of imported whole wheat intended for stockfeed use, Canada is considered to have a low animal pathogen risk status, taking into account Canada's freedom from significant animal diseases.

4.2 Identification of animal pathogens of biosecurity concern

For the purpose of this advice on imported whole wheat from Canada for further processing in Australia including for stockfeed end-use, an animal disease agent was identified as a pathogen of biosecurity concern if it had potential to cause:

- a disease of, or infection in, susceptible animal species which is capable of producing adverse consequences in Australia.

In addition, to be included in the identification process, the disease or infection caused by the animal pathogen must:

- be present in Canada
- be exotic to Australia (serotypes or strains considered exotic to Australia may meet this criterion), or if present, is a nationally notifiable animal disease or subject to official control or eradication
- have potential to contaminate the imported whole grain and be transmitted to susceptible animals in Australia that are exposed to the product.

The following list contains the animal diseases of biosecurity concern identified in this review:

- Bovine tuberculosis
- Brucellosis
- Chronic wasting disease
- Avian influenza
- Infectious bursal disease
- Maedi-visna
- Newcastle disease
- Swine enteric coronavirus diseases
- Scrapie

The last reported Bovine spongiform encephalopathy (mad cow disease) case in Canada was in February 2015. It was not considered a potential contaminant of whole wheat from Canada, considering the product, processing and competent authority controls in Canada.

4.3 Review of animal biosecurity risks

This review identifies pathways through which one or more of the identified diseases of animal biosecurity concern associated with imported whole wheat from Canada could enter and establish in Australia i.e. bulk wheat grains sourced from the Canadian Prairies and exported through the port of Vancouver for processing in Australia under an approved arrangement. Under this arrangement, the imported whole wheat will be transported from the port of entry and processed under biosecurity control into stockfeed for direct feeding of livestock.

Processing systems in Canada and in Australia contribute to managing the risk posed by contamination with pathogens of animal biosecurity concern. Spillage of imported bulk wheat and associated admixtures during unloading, and transport and storage activities prior to processing provide opportunities for the entry and establishment of exotic animal diseases, and should therefore be managed.

A summary of the potential biosecurity risk posed by the diseases of animal biosecurity concern retained for further review is presented below.

4.4 Diseases of animal biosecurity concern

4.4.1 Bovine tuberculosis

Bovine tuberculosis (bovine TB) is a chronic infectious bacterial disease affecting mainly cattle. The disease is nationally notifiable in Australia (Department of Agriculture 2015). The last case of bovine TB in Australia in any animal species was reported in 2002 (AHA 2018).

The causal organism is *Mycobacterium bovis*, which can be transmitted to all warm-blooded vertebrates, including humans (Radostits et al. 2007). In several countries, wildlife reservoirs have been established, such as the brushtail possum in New Zealand and the European badger in Great Britain (Palmer et al. 2012). Bovine TB is an OIE-listed disease.

In considering a potential entry pathway for bovine TB with this commodity, it is noted that:

- Bovine TB is transmitted by direct and indirect exposure. Infected animals and environmental contamination are the major exposure routes.
- Studies of *M. bovis* have shown that survival outside living animals depends on a variety of factors including availability of nutrients, temperature, moisture, exposure to sunlight, pH and natural microflora (Morris, Pfeiffer & Jackson 1994). Under natural weather conditions, across different seasons, small numbers of bacilli have survived up to 12 weeks in a range of substrates such as hay, soil, water and shelled corn with survival inversely related to temperature (Fine et al. 2011; Humblet, Boschiroli & Saegerman 2009). Survival times are also extended when the organism resides in shade or darkness (Duffield & Young 1985).
- In Canada, bovine TB is only known to persist in two wildlife populations: bison herds in and around Wood Buffalo National Park, which straddles the border between Alberta and the Northwest Territories, and elk and deer in and around Riding Mountain National Park of southwestern Manitoba. Wood Buffalo National Park is geographically isolated

from large scale wheat production in Canada; however, production does occur in southwestern Manitoba.

- Sporadic detections also occur in domestic herds. This includes independent incidents in beef cattle from Manitoba in 2008, Alberta in 2016 and in British Colombia in 2011 and 2018 (CFIA 2018). Following such detections, CFIA implements strict disease eradication measures to eliminate the infection from the premises where it was detected, determine the source of infection, and identify and eliminate any spread of infection that may have already occurred (CFIA 2018).

Based on the above, it is unlikely *Mycobacterium bovis* would contaminate grains produced under broad acre production and mechanical harvesting in Canada. Therefore, bovine TB is not considered a potential biosecurity concern of significance at the point of entry of the unprocessed product.

Based on the preceding information, specific risk management measures are not required.

4.4.2 Brucellosis

Brucellosis is an infectious disease caused by a group of closely related bacteria of the Brucella genus (Cem Gul & Erdem 2015). Many of these organisms are zoonotic. Bovine brucellosis, caused by *Brucella abortus*, is characterised by abortion, infertility, decreased milk production and/or lameness. Australia has been free of bovine brucellosis since 1989. Australia is also free from brucellosis caused by *B. melitensis* (never reported) but not *B. suis*, which is endemic in wild pigs in Queensland and also found in the wild pig population of northern NSW (NSW Department of Primary Industries 2017). These three members of the genus are listed by the OIE.

Brucellosis transmission typically occurs through direct contact of urine or reproductive fluids from an infected animal with mucus membranes of a susceptible animal.

In considering a potential entry pathway for brucellosis with this commodity, it is noted that:

- in Canada, brucellosis is only known to be present in two wildlife populations: *B. abortus* in bison herds in and around Wood Buffalo National Park, which straddles the border between Alberta and the Northwest Territories, and *B. suis* type 4 (rangiferine brucellosis) in caribou and reindeer in arctic and sub-arctic Canada. The last known case of brucellosis in Canadian livestock occurred in 1989 (CFIA 2016).
- the disease distribution within Canada is stable
- wildlife reservoirs are located in areas that are geographically isolated from large scale wheat production in Canada.

Based on the preceding information, the contamination of the wheat with brucellosis is very unlikely. Therefore, specific risk management measures for brucellosis are not required.

4.4.3 Infectious bursal disease

Infectious bursal disease (IBD) is a viral disease of poultry which causes immunosuppression in young chicks, and mortality in 3 to 6 week old chickens (van den Berg et al. 2000; Lukert & Saif 2003). Exotic strains of IBD virus (IBDV) are present in Canada (OIE 2018a). Antibodies of IBDV have been found in wild birds; however, there is no evidence of their role in disease transmission (van den Berg et al. 2000).

In considering a potential entry pathway for IBDV with this commodity, it is noted that:

- exotic antigenic variant and very virulent strains of IBDV are known to be present in Canada (Zachar et al 2016; OIE 2018a). Detailed information regarding the pathogenesis and risk to Australian industries from IBDV can be found in the [Generic Import Risk Analysis Report for Chicken Meat (Biosecurity Australia 2008)].
- the main route of transmission is the faecal-oral route. The virus can survive for prolonged periods in faeces and bedding (Benton, Cover, & Rosenberger 1967). Mechanical transmission of virus can occur via faecal contamination of fomites (van den Berg et al. 2000). The virus has been shown to remain infectious for 122 days in a chicken house and 52 days in feed, water and faeces (Benton, Cover, & Rosenberger 1967)
- IBD is primarily a disease of immature chickens
- domestic poultry are unlikely to be in close proximity to commercial wheat production in the Canadian Prairies, and unlikely to contaminate wheat produced on broad acre farms prior to harvest
- any contamination would be mainly due to wild birds, not chickens or turkeys.

Based on the preceding information, and noting that IBD primarily affects young poultry and commercial poultry production is likely to be remote from commercial wheat production, the contamination of the wheat with IBDV is very unlikely. Therefore, specific risk management measures for IBD are not required.

4.4.4 Newcastle disease

Newcastle disease (ND) is caused by virulent strains of avian paramyxovirus 1 (APMV-1) which is synonymous with Newcastle disease virus (NDV). Under the OIE Code, ND is restricted to identification of disease in poultry. However, virulent APMV-1 (NDV) infection in other avian species is also often referred to as ND in literature. Outbreaks of ND in chickens in Great Britain in 1984 occurred either directly or indirectly as a result of spread from diseased pigeons infesting food stores at Liverpool docks (Alexander et al. 1985). It is an OIE listed disease. Australia is free from ND.

In considering a potential entry pathway for virulent strains of NDV with this commodity, it is noted that:

- ND vaccination is widely used in Canadian commercial poultry. Canada is free of ND according to the OIE definition i.e. no clinical disease has been identified in poultry (OIE 2018a). However, wild birds are recognised as reservoirs of NDV and NDV is known to be present in Canadian wild birds, including virulent strains which are endemic in wild cormorants in the United States and Canada (Brown and Bevins 2017; CFIA, 2014)
- the disease is highly contagious and the mode of transmission is via contact with diseased or carrier birds or their excretions.

- the virus is excreted in faeces, and birds can be indirectly infected by inhalation of aerosols or by ingestion of faeces. NDV survival in faeces varies from 8 to 22 days in summer and 26 to 50 days in winter (Frolich, Cortez de Jackel & Selhorst 1992)
- windborne transmission of NDV has been postulated and the virus has been recovered from the air up to 64 metres from infected premises (Hugh-Jones et al. 1973)
- contamination of whole grain with NDV may occur throughout the offshore pathway, including via:
    - wild bird faeces contaminating the whole grain during production and harvesting
    - wild birds accessing the stored grain and contaminating it with faeces
    - transport and offshore processing equipment previously contaminated with wild bird faeces cross-contaminating whole grain destined for Australia.

Based on above, NDV remains a potential concern at the point of entry of thermally unprocessed product.

Post-arrival exposure considerations include:

- Spillage from the consignment during unloading, and storage and transportation of imported contaminated grain or associated foreign material prior to processing in Australia. This may attract, and potentially expose wild birds.
- Inadequately heat processed imported contaminated grain or associated foreign material could potentially be fed directly to domestic poultry in Australia and wild birds could gain access.

An outbreak of ND in an Australian domestic poultry flock and spread to other flocks in Australia would have a moderate impact due to reduced production and subsequent financial losses in the domestic poultry industry (Biosecurity Australia 2008).

Based on the preceding information, to manage the biosecurity risk, measures are required. Cross-contamination controls are necessary to assist in managing this risk and the imported grain should also undergo a thermal treatment sufficient to inactivate NDV during the stockfeed manufacturing process.

Studies have shown that thermal processing equivalent to 8.2 minutes at 70°C would result in a 6 log reduction of NDV (Alexander 1997; Alexander & Manvell 2004).

4.4.5 Avian influenza

Highly pathogenic avian influenza (HPAI) is an exotic disease of domestic and wild birds and an OIE listed disease.

In considering a potential entry pathway for HPAI with this commodity, it is noted that:

- Canada is currently free of highly pathogenic avian influenza according to the OIE definition i.e.no infection has been identified in poultry since 2015, and since 2016 for low pathogenic avian influenza (OIE 2018). However, avian influenza virus is maintained in wild waterfowl. Waterfowl migrating through Canada have been implicated in outbreaks in Canadian poultry (Li et al 2018)

- HPAI is a highly contagious disease of domestic and wild birds that causes high mortality in domestic chickens
- wild birds, particularly wild aquatic birds such as ducks, gulls and shorebirds, provide a reservoir of AI viruses, with asymptomatic enteric infections leading to faecal shedding of virus. H5 and H7 subtypes are found sporadically in ducks, shorebirds and gulls, although other HA types are more commonly isolated from these groups of birds (Sharp et al. 1993; Fouchier et al. 2003; Munster et al. 2005). The virus can also infect humans causing severe illness
- the virus may be shed in faeces and may remain infective for 30-35 days in faeces
- the virus is circulated in waterfowl by the faecal-oral route, with the virus persisting in bodies of water for variable periods of time from 9 to over 100 days (Stallknecht et al. 1990; Brown et al. 2007)
- domestic birds, including poultry, are infected through contact with wild birds, or through faecal contamination of water or feed supplies (Swayne & Suarez 2000). Spread of infection between farms can occur mechanically by the movement of people or fomites, or by aerosols
- contamination of whole grain with HPAI may occur throughout the offshore pathway, including via:
    - wild bird faeces contaminating the whole grain during production and harvesting
    - wild birds accessing and contaminating the stored grain with faeces
    - transport and offshore processing equipment previously contaminated with wild bird faeces cross-contaminating whole grain destined for Australia.

Based on above, HPAI remains a potential concern at the point of entry of the thermally unprocessed product.

Post-arrival exposure considerations include:

- Wild bird exposure due to spillage or dust from the consignment during unloading, storage and transportation of imported contaminated grain or associated foreign material prior to processing in Australia.
- Inadequate heat processing of imported contaminated grain or associated foreign material fed directly to domestic poultry in Australia.

An outbreak of HPAI in an Australian domestic poultry flock and subsequent spread in Australia is considered to have a significant impact due to severe production losses, extensive efforts to control and eradicate the disease, and a considerable financial impact on the domestic poultry industry (Biosecurity Australia 2008). In some circumstances, some strains of AI may be transmitted from infected poultry to humans, causing illness and death.

Based on the preceding information, to manage the biosecurity risk, risk management measures are required. Cross-contamination controls are necessary to assist in managing this risk and the imported grain should also undergo a thermal treatment sufficient to inactivate AI virus during the stockfeed manufacturing process. The department's requirement for heat inactivation of avian influenza viruses in chicken meat for human consumption is a minimum core temperature of 70°C for 1 minute using moist heat in a commercial heating process (Biosecurity Australia 2008).

4.4.6 Maedi-visna

Maedi-Visna Virus (MVV) is an exotic small ruminant lentivirus that causes a progressive degenerative inflammatory disease characterised by prolonged incubation periods. It is an OIE listed disease.

In considering a potential entry pathway for MVV with this commodity, it is noted that:

- MVV has spread throughout Canada since first being identified in the 1970s (Heinrichs et al. 2017)
- MVV has a long incubation period and delayed seroconversion
- the main route of transmission is via colostrum and milk from an infected ewe or doe to its offspring, whilst aerosol transmission serves as an important means of transmission under intensive housing conditions (Pritchard & McConnell 2007)
- other means of horizontal transmission and their epidemiological significance have not been clearly elucidated (OIE 2018b)
- MVV is considered not to survive for more than a few days in the environment (Spickler 2015).

Based on the preceding information, the contamination of the wheat with MVV is unlikely. Therefore, specific risk management measures for MVV are not required.

4.4.7 Swine enteric coronavirus diseases

There are three swine enteric coronavirus disease viruses (SECDv) which are exotic to Australia. These are porcine epidemic diarrhoea (PED), porcine delta coronavirus (PDCo) and transmissible gastroenteritis (TGE; an OIE listed disease), each of which is a serious gastrointestinal disease of pigs. The TGE virus, PED virus and PDCo have been identified relatively recently as causal agents of serious outbreaks of gastrointestinal disease in North America (USDA, 2015). Wild pigs may also be a source of SECDv (Bevins et al. 2018). The main clinical signs include severe diarrhoea, vomiting and weight loss. Morbidity and mortality can reach 100% especially in neonatal piglets (Neumann, Ramirez & Schwartz 2009, OIE 2014, Xu et al, 2018).

In considering a potential entry pathway for SECDv with this commodity, it is noted that:

- PED virus has been reported in Ontario, Quebec, Manitoba, Alberta and Prince Edward Island (CFIA 2017; Government of Alberta 2019). PDCo virus was first reported in Canada in 2014 (Ajayi et al. 2018). TGE is reported as present in Canada (OIE 2018a)
- TGE virus replicates in intestinal enterocytes, causes diarrhoea in young pigs and is present in large amounts in the faeces of infected animals. Shedding of the virus generally persists for up to two weeks after recovery from infection but may persist for up to 10 weeks after infection. However, there are a few reports of virus present in faeces for periods of up to 18 months (Woods & Wesley 1998)

- as with the TGE virus, the PED virus is present in faeces and is usually transmitted orally. Erosion and ulceration of enterocytes results in tissue fluid loss, diarrhoea and dehydration. PDCo in pigs is also enteropathogenic causing an acute infection of the small intestine, severe diarrhoea and/or vomiting and atrophic enteritis, similar to the clinical signs of PED and TGE infections (Jung & Saif 2015)
- survival outside the host is dependent on many factors including substrate, temperature and relative humidity (Dee et al. 2015). Studies have demonstrated survival of PED virus in soybean meal up to 180 days (Dee et al. 2015)
- indirect transmission may occur through contaminated vehicles, personnel, equipment and other grains or stockfeeds (OIE 2014; Dee et al. 2014; USDA 2015)
- contamination of whole grain with SECDv may occur throughout the offshore pathway, including via:
    - wild pigs contaminating the whole grain during production and harvesting
    - wild pigs accessing stored grain on the ground on farm or at storage facilities and contaminating it with faeces
    - transport and offshore processing equipment previously contaminated with pig faeces cross-contaminating whole grain destined for Australia.
- the ability to survive outside the host, enhanced by the protective effects of certain substrates, may allow virus to infect pigs following importation of contaminated wheat into Australia (Dee et al. 2015; Dee et al. 2016).

Based on the above information, SECDv remains a potential concern at the point of entry of the thermally unprocessed product.

Post-arrival exposure considerations include:

- Wild pig exposure due to spillage during unloading, storage and transportation of imported contaminated grain or associated foreign material in Australia.
- Inadequately heat processed imported contaminated grain or associated foreign material fed directly to pigs in Australia, or accessed by wild pigs.

Following initial exposure, SECDv is likely to establish and spread through ingestion of virus-contaminated faeces (Neumann, Ramirez & Schwartz 2009; OIE 2014).

The impact of introduction and spread of SECDv into Australia may cause significant consequences for Australia. Due to Australia's naïve pig herd, morbidity and mortality could reach 100%, with neonatal piglets most at risk (OIE 2014). As a consequence of the introduction of PED and PDCo into the United States in 2013, over eight million pigs died, resulting in a US$1.8 billion total industry economic loss (Kim et al. 2017). Overseas market access and reputational damage are also potential outcomes due to an outbreak in either domestic or wild pigs.

Based on the preceding information, risk management measures are required. Cross-contamination controls are necessary to assist in managing this risk and the imported grain should also undergo a thermal treatment sufficient to inactivate coronaviruses during the stockfeed manufacturing process.

PED virus loses infectivity at temperatures above 60°C; however, the duration of treatment and the log reduction was not reported (OIE 2014). A study by Thomas et al. (2015) showed that heating pig trailers to 71°C for more than 10 minutes was found to be effective in inactivating PED virus. TGE and PDCo viruses could be expected to require similar heat treatment for inactivation.

4.4.8 Transmissible spongiform encephalopathies – Chronic wasting disease and scrapie

Chronic wasting disease (CWD) and scrapie are transmissible spongiform encephalopathies of cervids and sheep and goats respectively, which are exotic to Australia. Scrapie and CWD occur throughout North America.

The causative agents, PrPSC/CWD, are contagious, highly persistent and resistant infectious proteins known as prions (FSANZ 2006). CWD and scrapie cause a progressive, neurodegenerative disease affecting a number of deer species and elk, and sheep and goats respectively (EFSA 2017). Scrapie is an OIE listed disease and reportable in Canada.

In considering a potential entry pathway for CWD and scrapie with this commodity, it is noted that:

- these diseases are transmitted through shedding of prions in faeces, saliva, urine and other bodily fluids and persist for long times in the environment (Miller & Williams 2003, Georgsson et al. 2006, Saunders et al. 2008, Hoover et al. 2017)
- prions are very resistant to inactivation. They are not inactivated by UV, gamma irradiation, autoclaving or alcohol treatment (Sakudo et al. 2011)
- contamination of whole grain with CWD may occur throughout the offshore pathway, including via:
    - wild deer contaminating the whole grain during production and harvesting
    - wild deer accessing and contaminating stored grain on the ground on farm or at storage facilities
    - transport and offshore processing equipment, previously contaminated with CWD infected material, cross-contaminating whole grain destined for Australia.
- contamination of whole grain with scrapie may occur throughout the offshore pathway, including via:
    - sheep and/or goats contaminating the whole grain during production and harvesting
    - sheep and/or goats accessing and contaminating stored grain on the ground on farm or at storage facilities
    - transport and offshore processing equipment, previously contaminated with scrapie infected material, cross-contaminating whole grain destined for Australia.

Based on the above information, CWD and scrapie remain a potential concern at the point of entry of the unprocessed product if the consignment is not adequately contained prior to entry.

Post-arrival exposure considerations for CWD and scrapie include:

- Susceptible species contact due to spillage during unloading, storage and transportation and consumption of imported contaminated grain or associated foreign material by susceptible species in Australia.
- Feeding of imported contaminated grain or associated foreign material to susceptible species in Australia.
- For scrapie, although most infections are established in young lambs and kids during the immediate post-natal period, adult sheep and goats remain susceptible to infection, and ingestion of contaminated grain or foreign material may enable the establishment of this disease.

Establishment and spread of CWD or scrapie in wild or farmed species can only occur through shedding of infectious prions. The infectious dose is relatively low so any exposure presents a risk of establishment of infection in the exposed animal. This may occur by either direct contact with an infected animal or indirect environmental exposure – including through contaminated feed and water.

Long incubation periods of several years would provide for silent shedding and horizontal and vertical spread of scrapie and establishment within the national sheep flock and goat herd prior to detection. A single infected animal could significantly contaminate the environment and spread infection to others in its immediate herd, leading to establishment and spread of the disease in Australia.

Modelling by ABARES has indicated it would take 15 years for Australia to regain its scrapie free status after establishment, which would lead to estimated trade costs of $2.2 billion over 15 years from a sheep meat export ban (Hafi et al. 2017).

The introduction, establishment and spread of CWD in Australia would have significant impacts on the farmed deer industry and the environment due to contamination of areas with wild deer populations. Economic modelling of the impact of CWD in one province in Canada was estimated at between Can $12m and hundreds of millions (Arnot et al. 2009).

Based on the preceding information, risk management measures are required. Although CWD is of greater potential concern at the point of entry relative to scrapie due to the greater potential of wild deer to contaminate whole grain production on farms, the consequences of scrapie are much greater than CWD. Due to the thermal resistance of prions, control measures are needed to minimise the likelihood of contamination prior to export, in particular, during on-farm production and storage. These measures are detailed in the following section, Risk management measures.

5 Risk management measures

The diseases of animal biosecurity concern potentially associated with imported whole wheat from Canada for stockfeed end-use, and identified as requiring specific risk management measures to mitigate the biosecurity risk are: avian influenza, Newcastle disease, swine enteric coronavirus disease viruses (SECDv), chronic wasting disease and scrapie.

Components of the risk management measures for bulk whole wheat consignments from Canada are described below.

5.1 Pre-export requirements

5.1.1 Limits on the type of production at the farm level

The grain is sourced from broad-acre cultivation and has been mechanically harvested.

The grain is sourced from farms that have not used off-farm or commercial organic fertilisers.

For grain that has been stored in grain bags (on the ground under covers) on farm or bunkers at grain terminals, this is only a temporary, short-term measure pending transfer to permanent storage off ground.

These measures are considered sufficient to minimise the likelihood of CWD and scrapie contamination and mitigate the risk with these diseases.

5.1.2 Levels of foreign material

The objectives of this requirement are to ensure that imported wheat must only have low levels of foreign material including soil.

The grain is officially sampled and graded by the Canadian Grain Commission (CGC) during the course of loading and contains:

- no vertebrate animal material (excluding rodent excreta)
- no more than 0.01% of rodent excreta
- no more than 1% of other foreign material (other foreign material means Total Foreign Material, as defined in the Canadian grading table for wheat, excluding vertebrate animal material).

5.1.3 Clean transport units must be used

The objective of this requirement is to minimise cross-contamination by animal pathogens of biosecurity concern.

Grain elevators and storage (including shipping bins) should be certified for cleanliness (free of residues of all previous cargoes and extraneous contaminants (including animal material)) prior to being filled with grain intended for export to Australia.

Transports, specifically rail cars, are certified for cleanliness (free of residues of all previous cargoes and extraneous contaminants (including animal material)).

The ship’s holds intended for exporting whole grain to Australia are certified for cleanliness (free of residues of all previous cargoes and extraneous contaminants (including animal material)).

5.1.4 Off-shore export certification must be provided

The objective of this requirement is to ensure that the pre-export requirements stipulated in the import conditions have been met.

The Canadian Grain Commission (CGC) must provide certification on the foreign material contamination of the wheat with reference to Canadian grain standards to assist in managing the animal biosecurity risk.

5.2 Entry requirements

5.2.1 Import permit required

An import permit issued by the department will be required prior to importation of wheat sourced from the Canadian Prairies. The permit conditions will outline the requirements that must be met to manage biosecurity risks along the domestic import pathway.

5.2.2 On arrival-inspection and verification

The objective of this requirement is to confirm that the consignment meets Australia's certification requirements and import conditions.

On arrival in Australia, the department will undertake a documentation assessment to confirm that entry requirements have been met. Each consignment must be accompanied by:

- supplier declaration confirming that the wheat was grown, harvested, stored and transported in a way that manages risks associated with contamination of grain exports with material of animal origin
- an official or approved third party certification of cleanliness declaration in relation to inspection of transportation units (e.g. railcars, trucks) and the shipping vessel prior to loading (e.g. from truck to railcar, railcar to export terminal and the export terminal hygiene)
- a Canadian Grain Commission certificate indicating a class of spring wheat that contains less then 1% foreign material, which must comprise only this class based on samples drawn during loading of the export vessel. <u>The certification must also verify that the consignment of wheat meets the restrictions relating to contaminant animal material import requirements.</u>

After verifying compliance of documentation against entry conditions, the department will inspect a sample of the grain from the consignment using standard procedures to verify import requirements related to the offshore animal biosecurity risks.

5.3 Grain processing requirements

5.3.1 Processing imported grains under an approved arrangement

The objective of this requirement is to render the wheat non-viable, and to address any animal biosecurity risk posed by foreign material. Imported wheat from the Canadian Prairies must be processed as stipulated by the permit conditions. Wheat imported from the Canadian Prairies must be processed at the department-approved facilities under an approved arrangement to manage any residual biosecurity risks. Only processed goods may be released from biosecurity control.

To mitigate the animal biosecurity risks, all imported grain being processed into stockfeed should undergo thermal processing sufficient to inactivate NDV, AI virus and SECDv.

6 Conclusion

The department considers that animal biosecurity risks associated with bulk wheat sourced from the Canadian Prairies for processing can be effectively managed in accordance with the risk management measures outlined in this document. The department considers that the application of those measures will achieve Australia's ALOP in a least trade-restrictive manner.

7 References

Alexander, DJ, Wilson, GW, Russell, PH, Lister, SA & Parsons, G 1985, 'Newcastle disease outbreaks in fowl in Great Britain during 1984', *The Veterinary Record*, vol. 117, no. 17, pp. 429-34.

Alexander, DJ 1997, *Heat inactivation of Newcastle disease virus (NDV) in homogenised chicken meat*, Contract no. FT0513 between The Commonwealth of Australia and the Veterinary Laboratories Agency, Canberra.

Alexander, DJ & Manvell, RJ 2004, 'Heat inactivation of Newcastle disease virus (strain Herts 33/56) in artificially infected chicken meat homogenate', *Avian Pathology*, vol. 33, no. 2, pp. 222-5.

AHA 2018, *Animal Health in Australia 2017*, Animal Health Australia, Canberra.

Ajayi T, Dara R, Misener M, Pasma T, Moser L and Poljak Z 2018, 'Herd-level Prevalence and Incidence of Porcine Epidemic Diarrhoea Virus (PEDV) and Porcine Deltacoronavirus (PDCoV) in Swine Herds in Ontario, Canada' *Transboundary and Emerging Diseases*, 65.5, 1197–1207

Arnot, C, Laate, E, Unterschultz, J & Adamowicz, W 2009, 'Chronic wasting disease (CWD) potential economic impact on cervid farming in Alberta', *Journal of Toxicology and Environmental Health, Part A*, vol. 72, no. 17-18, pp. 1014-7.

Benton, WJ, Cover, MS & Rosenberger, JK 1967, 'Studies on the transmission of the infectious bursal agent (IBA) of chickens', *Avian Diseases*, vol. 11, no. 3, pp. 430-8.

Brown, VR and Bevins, SN 2017, 'A review of virulent Newcastle disease viruses in the United States and the role of wild birds in viral persistence and spread', *Veterinary Research*, 48:68.

Bevins, SN, Lutman, M, Pedersen, K, Barrett, N, Gidlewski, T, Deliberto, TJ & Franklin, AB 2018, Spillover of Swine Coronaviruses, United States, *Emerging Infectious Diseases*, vol.24, no. 7, pp 1390-1392, available at. .

Biosecurity Australia 2008, *Generic import risk analysis report for chicken meat: final report. Part C - detailed assessments*, Biosecurity Australia, Canberra.

CFIA 2014, *Newcastle Disease Overview*, Government of Canada

CFIA 2016, *Fact Sheet - Brucellosis,* Government of Canada

CFIA 2017, *Porcine epidemic diarrhea (PED) in Canada*, Government of Canada

CFIA 2018, *National Bovine Tuberculosis Eradication Program: Annual Program Report 2017*, Canada Food Inspection Agency Animal Health Directorate.

Cem Gul, H & Erdem, H 2015, 'Brucellosis (Brucella Species)', *in Mandell, Douglas, and Bennett's principles and practice of infectious diseases*, 8th edn, Bennett, JE, Dolin, R & Blaser, MJ (eds), Elsevier, Philadelphia, PA.

Dee, S., Clement, T., Schelkopf, A., Nerem, J., Knudsen, D., Christopher-Hennings, J., & Nelson, E. 2014, 'An evaluation of contaminated complete feed as a vehicle for porcine epidemic diarrhea virus infection of naïve pigs following consumption via natural feeding behavior: proof of concept', *BMC veterinary research*, *10*, 176.

Dee, S, Neill, C, Clement, T, Singrey, A, Christopher-Hennings, J & Nelson, E 2015, 'An evaluation of porcine epidemic diarrhea virus survival in individual feed ingredients in the presence or absence of a liquid antimicrobial', *Porcine Health Management*, vol. 1, no. 1.

Dee, S, Neill, C, Singrey, A, Clement, T, Cochrane, R, Jones, C, Patterson, G, Spronk, G, Christopher-Hennings, J & Nelson, E 2016, 'Modeling the transboundary risk of feed ingredients contaminated with porcine epidemic diarrhea virus', *BMC Veterinary Research*, vol. 12, no. 1.

Department of Agriculture 2015, Importation of Stockfeed and Stockfeed Ingredients – Finalised Risk Management Measures for Transmissible Spongiform Encephalopathies (TSEs) (pdf 1.3mb).

Department of Agriculture 2015, National list of notifiable animal diseases, Canberra.

Duffield, BJ & Young, DA 1985, 'Survival of Mycobacterium bovis in defined environmental conditions', *Veterinary Microbiology*, vol. 10, no. 2, pp. 193-7.

EFSA Panel on Biological Hazards, Ricci, A, Allende, A, Bolton, D, Chemaly, M, Davies, R, Fernández Escámez, PS, Gironés, R, Herman, L, Koutsoumanis, K, Lindqvist, R, Nørrung, B, Robertson, L, Sanaa, M, Skandamis, P, Snary, E, Speybroeck, N, Ter Kuile, B, Threlfall, J, Wahlström, H, Benestad, S, Gavier-Widen, D, Miller, MW, Ru, G, Telling, GC, Tryland, M, Ortiz Pelaez, A & Simmons, M 2017, 'Chronic wasting disease (CWD) in cervids', *EFSA Journal*, vol. 15, no. 1.

Fine, AE, Bolin, CA, Gardiner, JC & Kaneene, JB 2011, 'A study of the persistence of Mycobacterium bovis in the environment under natural weather conditions in Michigan, USA', *Veterinary Medicine International*, vol. 2011.

FSANZ 2006, *Evaluation of the risks to human health from the consumption of food products derived from cervids affected by chronic wasting disease: a scientific evaluation*, Food Standards Australia New Zealand, Canberra.

Fouchier, RA, Olsen, B, Bestebroer, TM, Herst, S, van der Kemp, L, Rimmelzwaan, GF & Osterhaus, AD 2003, 'Influenza A virus surveillance in wild birds in Northern Europe in 1999 and 2000', *Avian Diseases*, vol. 47, no. s3, pp. 857-60.

Frolich, M, Cortez de Jäckel, S & Selhorst, T 1992, 'The tenacity of Newcastle disease virus (LaSota) in the excrement of laying hens in different housing systems' (in German), *Deutsche Tierarztliche Wochenschrift*, vol. 99, no. 12, pp. 494-9. (Abstract only)

Georgsson, G, Sigurdarson, S & Brown, P 2006, 'Infectious agent of sheep scrapie may persist in the environment for at least 16 years', *Journal of General Virology*, vol. 87, no. 12, pp. 3737-40

Government of Alberta 2019, *Porcine epidemic diarrhea – Updates.*

Hafi, A, Eather, J & Garner, G 2017, Economic consequences of a scrapie outbreak in Australia, ABARES research report 17.10, Department of Agriculture, Canberra.

Heinrichs, Rhonda et al. 2017 'Prevalence of Maedi-visna in Saskatchewan sheep', *The Canadian veterinary journal = La revue veterinaire canadienne* vol. 58, 2 pp. 183-186.

Homme, PJ & Easterday, BC 1970, 'Avian influenza virus infections: i. characteristics of Influenza A/Turkey/Wisconsin/1966 virus', *Avian Diseases*, vol. 14, pp. 66-74.

Hoover, CE, Davenport, KA, Henderson, DM, Denkers, ND, Mathiason, CK, Soto, C, Zabel, MD & Hoover, EA 2017, 'Pathways of prion spread during early chronic wasting disease in deer', *Journal of Virology*, vol. 91, no. 10.

Hugh-Jones, M, Allan, WH, Dark, FA & Harper, GJ 1973, 'The evidence for the airborne spread of Newcastle disease', *The Journal of Hygiene*, vol. 71, pp. 325-39.

Humblet, M-F, Boschiroli, ML & Saegerman, C 2009, 'Classification of worldwide bovine tuberculosis risk factors in cattle: a stratified approach', *Veterinary Research*, vol. 40, no. 50, pp. 1-24.

Jung, K & Saif LJ 2015, 'Porcine epidemic diarrhea virus infection: Etiology, epidemiology, pathogenesis and immunoprophylaxis', *The Veterinary Journal*, Volume 204, Issue 2, pp134-143

Kim, Y, Yang, M, Goyal, SM, Cheeran, MC-J & Torremorell, M 2017, 'Evaluation of biosecurity measures to prevent indirect transmission of porcine epidemic diarrhea virus', *BMC Veterinary Research*, vol. 13, no. 1.

Lang, G, Narayan, O, Rouse, BT, Ferguson, AE & Connell, MC 1968, 'A new influenza A virus infection in turkeys: ii. a highly pathogenic variant, A/Turkey/Ontario 7732/66', *The Canadian Veterinary Journal*, vol. 9, no. 7, pp. 151-60.

Lang, G, Rouse, BT, Narayan, O, Ferguson, AE & Connell, MC 1968, 'A new influenza virus infection in turkeys: i. Isolation and characterization of virus 6213', *The Canadian Veterinary Journal*, vol. 9, no. 1, pp. 22-9.

Li, L, Bowman, AS, DeLiberto, TJ, Killian, ML, Krauss, S, Nolting, JM, Torchetti, MK, Ramey, AM, Reeves, AB, Stalknecht, DE, Webby, RJ, Wan, X-F 2018, Genetic evidence supports sporadic and independent introductions of subtype H5 low-pathogenic avian influenza A viruses from wild birds to domestic poultry in North America, *Journal of Virology*, 92:e00913-18.

Lu, H, Castro, AE, Pennick, K, Liu, J, Yang, Q, Dunn, P, Weinstock, D & Henzler, D 2003, 'Survival of avian influenza virus H7N2 in SPF chickens and their environments', *Avian Diseases,* vol. 47, pp. 1015-21.

Lukert, PD & Saif, YM 2003, 'Infectious bursal disease', in *Diseases of poultry*, 11th edn, Saif, YM, Barnes, HJ, Glisson, JR, Fadly, AM, McDougald, LR & Swayne, DE (eds), Iowa State University Press, Ames.

Miller, MW & Williams, ES 2003, 'Horizontal prion transmission in mule deer'*, Nature,* vol. 425, no. 6953, pp. 35-6.

Morris, RS, Pfeiffer, DU & Jackson, R 1994, 'The epidemiology of Mycobacterium bovis infections', *Veterinary Microbiology*, vol. 40, no. 1-2, pp. 153-77.

Moses, HE, Brandly, CA, Jones, EE & Jungherr, EL 1948, 'The isolation and identification of fowl plague virus', *American Journal of Veterinary Research*, vol. 9, pp. 314-28.

Munster, VJ, Wallensten, A, Baas, C, Rimmelzwaan, GF, Schutten, M, Olsen, B, Osterhaus, ADME & Fouchier, RAM 2005, 'Mallards and highly pathogenic avian influenza ancestral viruses, Northern Europe', *Emerging Infectious Diseases*, vol. 11, no. 10, pp. 1545-51.

Neumann, EJ, Ramirez, A & Schwartz, KJ 2009, Transmissible gastroenteritis (TGE), in *Swine disease manual*, 4th, American Association of Swine Veterinarians, Perry, Iowa, USA.

NSW Department of Primary Industries 2017, *Brucellosis (Brucella suis) in dogs*, July 2017, Primefact 6/450, first edition, NSW Government.

OIE 2014, Infection with porcine epidemic diarrhoea virus, World Organisation for Animal Health, Paris.

OIE 2018a, World Animal Health Information Database (WAHIS) Interface, World Organisation for Animal Health, Paris.

OIE 2018b, 'Caprine arthritis/encephalitis and maedi-visna', in *Manual of diagnostic tests and vaccines for terrestrial animals 2018*, World Organisation for Animal Health, Paris.

Palmer, MV, Thacker, TC, Waters, WR, Gortazar, C & Corner, LA 2012, 'Mycobacterium bovis: a model pathogen at the interface of livestock, wildlife, and humans', *Veterinary Medicine International*, vol. 2012.

Pritchard, GC & McConnell, I 2007, 'Maedi-visna', in *Diseases of sheep*, 4th edn, Aitken, ID (ed), Blackwell Science, Ames, Iowa, USA.

Radostits, OM, Gay, CC, Hinchcliff, KW & Constable, PD 2007, *Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pigs and goats*, 10th edn, Saunders Elsevier, Edinburgh.

Sakudo, A, Ano, Y, Onodera, T, Nitta, K, Shintani, H, Ikuta, K & Tanaka, Y 2011, 'Fundamentals of prions and their inactivation (review)', *International Journal of Molecular Medicine*, vol. 27, pp. 483-9.

Saunders, SE, Bartelt-Hunt, SL & Bartz, JC 2008, 'Prions in the environment', *Prion*, vol. 2, no. 4, pp. 162-9.

Sharp, GB, Kawaoka, Y, Wright, SM, Turner, B, Hinshaw, V & Webster, RG 1993, 'Wild ducks are the reservoir for only a limited number of influenza A subtypes', *Epidemiology and Infection*, vol. 110, pp. 161-76.

Spickler, AR 2015, Small ruminant lentiviruses: maedi-visna & caprine arthritis and encephalitis, The Center for Food Security and Public Health, Iowa State University, Ames, Iowa, USA.

Stallknecht, DE, Kearney, MT, Shane, SM & Zwank, PJ 1990, 'Effects of pH, temperature, and salinity on persistence of avian influenza viruses in water', *Avian Diseases*, vol. 34, no. 2, pp. 412-8.

Swayne, DE & Suarez, DL 2000, 'Highly pathogenic avian influenza', *Revue Scientifique et Technique de l'Office International des Epizooties*, vol. 19, no. 2, pp. 463-82.

Thomas PR, Karriker LA, Ramirez A, Zhang J, Ellingson JS, Crawford KK, Bates JL, Hammen KJ and Holtkamp DJ 2015, 'Evaluation of time and temperature sufficient to inactivate porcine epidemic diarrhea virus in swine feces on metal surfaces', *Journal of Swine Health and Production*, vol. 23, no.2, pp. 84-90.

USDA 2015*, Swine enteric coronavirus introduction to the United States: root cause investigation report*, United States Department of Agriculture, Animal and Plant Health Inspection Service, Washington, DC

Van den Berg, TP, Eterradossi, N, Toquin, D & Meulemans, G 2000, 'Infectious bursal disease (Gumboro disease)'*, Revue Scientifique et Technique de l'Office International des Epizooties,* vol. 19, no. 2, pp. 527-43.

Woods RD & Wesley RD 1998, 'Transmissible Gastroenteritis Coronavirus Carrier Sow'. In: Enjuanes, L, Siddell, SG, Spaan, W (eds), 'Coronaviruses and Arteriviruses', *Advances in Experimental Medicine and Biology*, vol 440. Springer, Boston, MA

Xu, Z, Zhong, H, Zhou, Q, Du, Y, Chen, L, Zhang, Y, Xue, C & Cao, Y 2018, 'A highly pathogenic strain of porcine deltacoronavirus caused watery diarrhea in newborn piglets', *Virologica Sinica*, vol. 33, no. 2, pp. 131-41.

Zachar, T., Popowich, S., Goodhope, B., Knezacek, T., Ojkic, D., Willson, P, Ahmed, KA and Gomis, S 2016, 'A 5-year study of the incidence and economic impact of variant infectious bursal disease viruses on broiler production in Saskatchewan, Canada', *Canadian journal of veterinary research*, vol. 80, 4, 255-261.

8 Version history

The following table details the published date and amendment details for this document.

Version	Date	Amendment details
1.0	26 August 2019	First publication of this report
2.0	11 February 2020	Removed reference to specific grade names to allow for the import of any Canadian spring wheat class that has low levels of foreign material.