Australian Government

Department of Agriculture, Fisheries and Forestry

Draft non-regulated analysis of existing policy for Californian table grapes to Western Australia

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Submissions
This draft analysis has been issued to give all interested parties an opportunity to comment and draw attention to any scientific, technical, or other gaps in the data, misinterpretations and errors. Any comments should be submitted to the Department of Agriculture, Fisheries and Forestry within the comment period stated in the related Biosecurity Advice on the website. The draft analysis will then be revised as necessary to take account of the comments received and a final document prepared.

Comments on the draft analysis should be submitted to:

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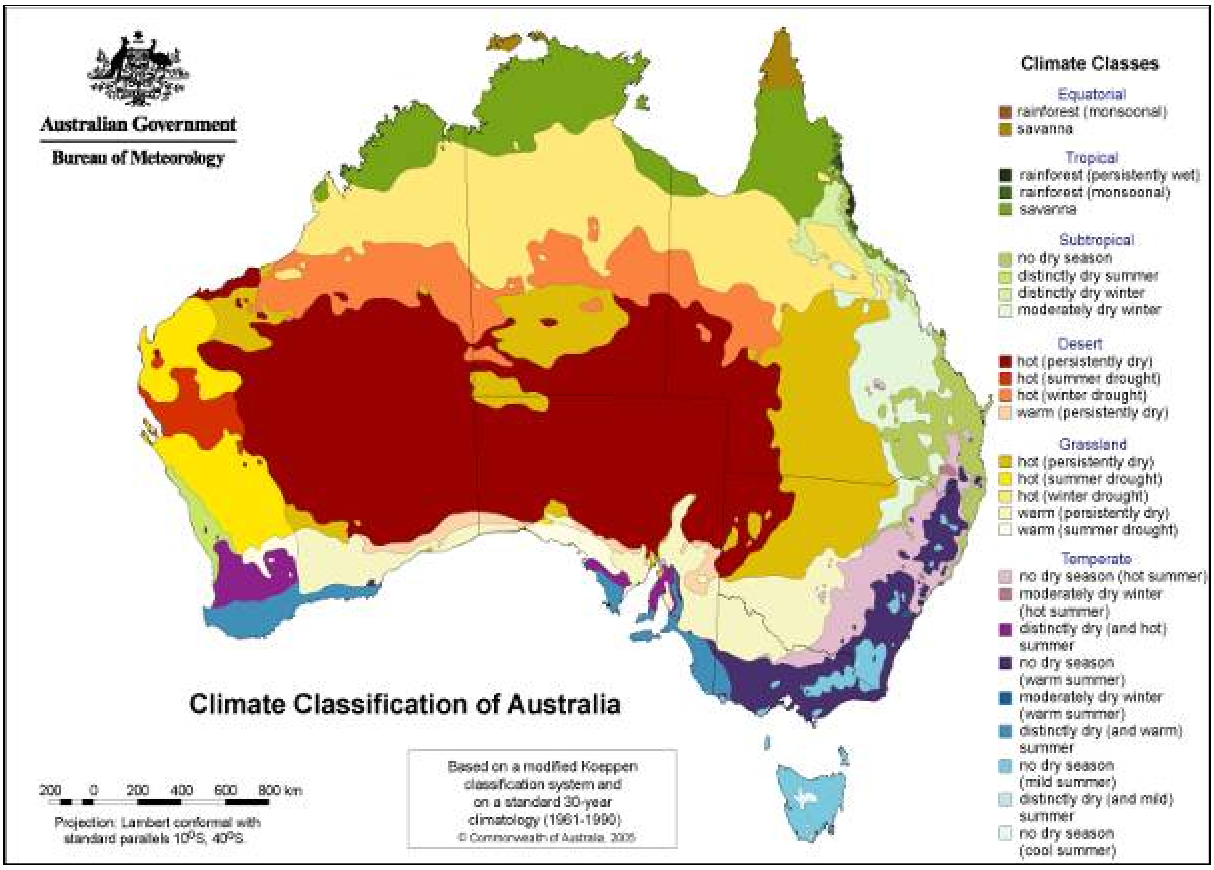

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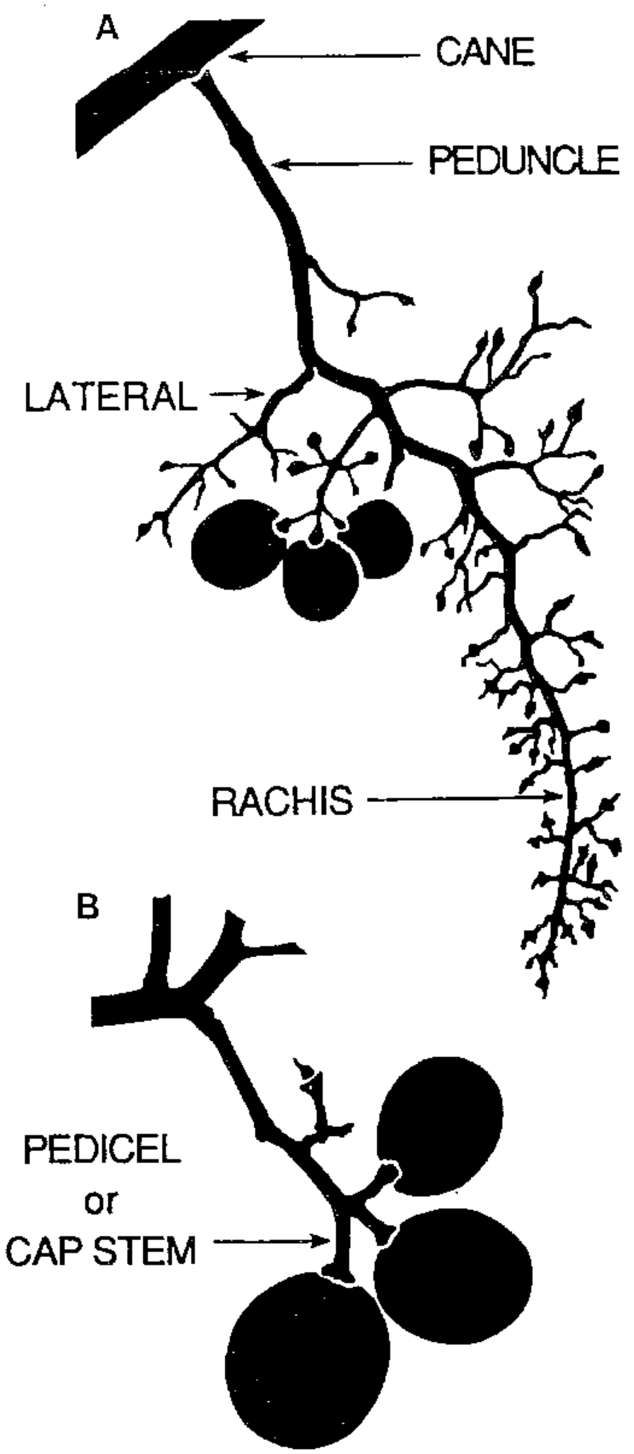

Source: (Pratt 1988)

Figure 3 – Diagram of table grape bunch or cluster
Part A: main parts of a table grape bunch or cluster
Part B: detail of the berry attachment

Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
ALOP	Appropriate level of protection
AQIS	Australian Quarantine and Inspection Service
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DAFWA	Western Australian Government Department of Agriculture and Food
DSEWPC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
EP	Existing policy
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practice
GHP	Good Handling Practices
ICON	Import conditions database
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standard for Phytosanitary Measures
NSW	New South Wales
NPPO	National Plant Protection Organisation
NT	Northern Territory
OIE	World organisation for animal health
OPI	Offshore preshipment inspection
PRA	Pest risk analysis
Qld	Queensland
SA	South Australia
SO_2/CO_2	Sulfur dioxide plus carbon dioxide fumigation treatment
SOP	Standard Operating Procedure
SPS	Sanitary and Phytosanitary
SSOP	Sanitation Standard Operation Procedure
Tas.	Tasmania
USDA-APHIS	United States Department of Agriculture - Animal and Plant Health Inspection Service
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Abbreviations of units

Term or abbreviation	Definition
ºC	Degree Celsius
ha	Hectare
cm	Centimetre
g	Gram
kg	Kilogram
km	Kilometre
m	Metre
mm	Millimetre
s	Second

Summary

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) has prepared this draft report to assess the proposal by the United States of America (USA), to extend market access for table grapes from California to Western Australia.

Australia has permitted entry of table grapes from California into all other Australian states and territories since 2002, provided they meet Australian quarantine requirements.

The draft report considers pests of regional concern to Western Australia.

This draft report proposes that the importation of table grapes from California be permitted into Western Australia, subject to a range of quarantine conditions.

This draft report identifies pests that require biosecurity measures to manage risks to a very low level in order to achieve Australia's appropriate level of protection (ALOP).

This draft report proposes that the biosecurity measures already used for imports of table grapes from California to all other states and territories of Australia be used to manage pest risks for entry to Western Australia. These measures will reduce the risk associated with the importation of table grapes from California into Western Australia to achieve Australia's ALOP. The pests identified as requiring biosecurity measures for entry to all other Australian states and territories under the existing policy for Californian table grapes are also quarantine pests for Western Australia.

One additional pest was identified in this draft report that also requires biosecurity measures, the harlequin ladybird (*Harmonia axyridis*). The draft report proposes to manage the harlequin ladybird through visual inspection and remedial action (if found).

In conducting this review, DAFF has taken the following into consideration:

- previous conditions established and used since 2002, for the importation of table grapes to all other Australian states and territories
- other current policies for the importation of table grapes to Australia
- any additional information available through the literature since 2002
- feedback from consultation relevant to the assessment of the import risks.

This draft report contains details of the risk assessments for pests of quarantine concern and any proposed biosecurity measures so that interested parties can provide comments and submissions to DAFF within the consultation time period.

1 Introduction

1.1 Australia's biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests[1] 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.

The risk analysis process is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the risks that could be associated with proposals to import new products into Australia. If the risks are found to exceed Australia's appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to an acceptable level. But, if it is not possible to reduce the risks to an acceptable level, then no trade will be allowed.

Successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is expressed in terms of Australia's ALOP, which reflects community expectations through government policy and is currently described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia's risk analyses are undertaken by DAFF using technical and scientific experts in relevant fields, and involve consultation with stakeholders at various stages during the process.

DAFF's assessment of risk may take the form of an IRA (import risk analysis), a non-regulated analysis of existing policy or technical advice.

Further information about Australia's biosecurity framework is provided in Appendix C of this analysis and in the *Import Risk Analysis Handbook 2011* located on the DAFF website www.daff.gov.au.

1.2 This non-regulated analysis of existing policy

1.2.1 Background

The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) formally requested to extend market access for fresh table grapes from California to include Western Australia in May 2005.

On 29 March 2012, DAFF formally announced the commencement of this import risk analysis, advising that it would be progressed as a non-regulated analysis of existing policy.

[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products.

1.2.2 Scope

This review presents an assessment of biosecurity risks associated with commercially produced table grapes (*Vitis vinifera* L.) from the Californian counties of Fresno, Kern, Kings, Madera, Riverside and Tulare, free from trash, for human consumption in Western Australia.

In this review, table grapes are defined as table grape bunches or clusters, which include the peduncles, rachises, laterals, pedicels and berries (Pratt 1988) but not other plant parts (see figure 3).

In the pest risk assessment chapter of this draft report (Chapter 4), the pest risk analysis (PRA) area is defined as the state of Western Australia. The likelihoods of entry, establishment and spread and the consequence that pests may cause have been assessed for Western Australia.

This review covers all commercially produced table grapes from the six approved counties in the state of California that are currently permitted entry to the rest of Australia.

1.2.3 Existing policy

International policy

Import policy exists for table grapes imported into all other Australian states and territories from: California (AQIS 1999; AQIS 2000a; AQIS 2000b; Biosecurity Australia 2002; Biosecurity Australia 2003; Biosecurity Australia 2006); Chile (Biosecurity Australia 2005); New Zealand (AQIS 2012); the People's Republic of China (Biosecurity Australia 2011a); and Korea (Biosecurity Australia 2011b).

The import requirements for these commodity pathways can be found at DAFF's import conditions database: http://www.aqis.gov.au/icon.

Current import conditions for Californian table grapes require a combination of risk management measures and operational systems that reduce the risk associated with the importation of table grapes from California into all other Australian states and territories to achieve Australia's ALOP, specifically:

- permitted entry into Australia only from six approved counties in California: Fresno, Kern, Kings, Madera, Riverside and Tulare
- fumigation of all packed table grapes with a mixture of sulfur dioxide (SO_2) and carbon dioxide (CO_2) for grape phylloxera (*Daktulosphaira vitifoliae*) and regulated non-plant pests that are of concern to human health in Australia: the black widow spider (*Latrodectus mactans*); and two species of yellow sac spider (*Cheiracanthium inclusum* and *C. mildei*)
- fumigation of all packed table grapes with a a mixture of sulfur dioxide (SO_2) and carbon dioxide (CO_2) followed by 6 days cold treatment with a pulp temperature of -0.50°C ± 0.50°C or below for spotted wing drosophila (*Drosophila suzukii*)
- pre-export phytosanitary inspection and certification by the USDA-APHIS, offshore preshipment inspection (OPI) or on arrival inspection, remedial action if required, and clearance by DAFF

- suspension of all exports upon a detection of a live glassy-winged sharpshooter (GWSS) during DAFF inspection until the problem is investigated. If a dead GWSS is found during inspection, an investigation will be conducted to evaluate the relationship of GWSS to the table grape pathway
- a supporting operational system to maintain and verify the phytosanitary status of consignments. DAFF will verify that the required biosecurity measures have been applied.

Domestic arrangements

The Commonwealth Government is responsible for regulating the movement of plants and plant products into and out of Australia. However, the state and territory governments are responsible for plant health controls within Australia. Legislation relating to resource management or plant health may be used by state or territory government agencies to control interstate movement of plants or their products.

Currently, the importation of grape fruit, seeds and plants into Western Australia from any source is prohibited due to the absence of grape phylloxera (*Daktulosphaira vitifoliae*), grapevine fanleaf virus and phomopsis cane and leaf spot (*Phomopsis viticola*) in that state (DAFWA 2013). Machinery previously used in the growing or processing of grapes is also prohibited unless it satisfies quarantine requirements that include heat treatment and washing.

On 15 September 2011, the Western Australian Government Department of Agriculture and Food (DAFWA) announced the formal commencement of a pest risk analysis considering the importation of fresh table grapes into Western Australia. That process is still underway.

1.2.4 Contaminating pests

In addition to the pests of fresh table grapes from California that are assessed in this non-regulated analysis, there are other organisms that may arrive with the imported commodity. These organisms could include pests of other crops or predators and parasitoids of other arthropods. DAFF considers these organisms to be contaminating pests that could pose sanitary and phytosanitary risks. These risks are addressed by existing procedures including fumigation; a 600 unit inspection of all consignments; and investigation of any pest that may be of quarantine concern to Australia.

The risk of contaminating weed seeds is also addressed by the procedures detailed in Chapter 5.3.

1.2.5 Consultation

On 29 March 2012, DAFF notified stakeholders in Biosecurity Advice 2012/06 of the formal commencement of a non-regulated analysis of existing policy to consider a proposal from APHIS to extend the importation of fresh table grapes from approved Californian counties into Western Australia.

DAFF has consulted with DAFWA during the preparation of this draft analysis.

1.2.6 Next Steps

This draft analysis gives stakeholders the opportunity to comment and draw attention to any scientific, technical, or other gaps in the data, misinterpretations and errors.

DAFF will consider submissions received on the draft analysis and may consult informally with stakeholders. DAFF will revise the draft analysis as appropriate. DAFF will then prepare a final document, taking into account stakeholder comments.

The final document will be published on the DAFF website along with notice advising stakeholders of the release. DAFF will also notify the proposer, the registered stakeholders and the WTO Secretariat about the release of the final document. The conditions proposed in the final document will be the basis of any import permits issued.

2 Method for pest risk analysis

This chapter sets out the method used for the pest risk analysis (PRA) in this review. DAFF has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2007) and ISPM 11: *Pest risk analysis for quarantine pests, including analysis of environmental risks and living modified organisms* (FAO 2004) that have been developed under the SPS Agreement (WTO 1995).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it' (FAO 2012). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2012).

Quarantine risk consists of two major components: the probability of a pest entering, establishing and spreading in Australia from imports; and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that, on arrival in Australia, DAFF will verify that the consignment received is as described on the commercial documents and its integrity has been maintained.

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2012).

A glossary of the terms used is provided at the back of this analysis.

The PRA was conducted in the following three consecutive stages: initiation, pest risk assessment and pest risk management.

2.1 Stage 1: Initiation

Initiation identifies the pest(s) and pathway(s) that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

Appendix A of this analysis lists the pests and diseases with the potential to be associated with exported table grapes produced using commercial production and packing procedures. The pests associated with the crop and the exported commodity were tabulated from information from DAFF's existing policy on Californian table grapes, a domestic pest list provided by DAFWA and literature and database searches.

For this analysis, the 'PRA area' is defined as the state of Western Australia.

The existing policy for Californian table grapes to the rest of Australia includes measures for quarantine pests. Pests identified in the pest categorisation in this review as pests of quarantine concern for Western Australia that are already identified as quarantine pests for the rest of Australia and for which biosecurity measures are in place for trade in Californian table grapes were not reassessed in the pest risk assessment. A judgement was made to apply the current quarantine measures for Californian table grapes to the rest of Australia to pests of quarantine concern identified in the pest categorisation for Western Australia. These pests are identified in the pest categorisation.

2.2 Stage 2: Pest risk assessment

A pest risk assessment (for quarantine pests) is: 'the evaluation of the probability of the introduction and spread of a pest and of the likelihood of associated potential economic consequences' (FAO 2012).

For pests that have been considered by DAFF in previous pest risk assessments for other commodities or other source areas, the previous assessment was used in this review. The likelihood of importation, and sometimes the likelihood of distribution, of the pest on the commodity was reassessed, but the likelihood of establishsment and spread and the consequences that those pests may cause were not reassessed as these relate specifically to events that would occur in Western Australia and are independent of the importation pathway. This method is indicated in pest risk assessments where this has been applied.

In this review, the pest risk assessments were divided into the following interrelated processes:

2.2.1 Pest categorisation

Pest categorisation identifies which pests with the potential to be on the commodity are pests of quarantine concern for Western Australia and require pest risk assessment.

The pests identified in Stage 1 were categorised using the following primary elements to identify the pests of quarantine concern for the commodity being assessed:

- identity of the pest
- presence or absence in the PRA area and the rest of Australia
- regulatory status
- potential for establishment and spread in the PRA area
- potential for economic consequences (including environmental consequences) in the PRA area.

The results of pest categorisation for the pests considered in this PRA are set out in columns 4-7 in Appendix A. The steps in the categorisation process are considered sequentially, with the assessment terminating with a 'Yes' in column 4 or the first 'No' in columns 5 or 6. The pests of quarantine concern identified during pest categorisation were carried forward for pest risk assessment and are listed in **Error! Reference source not found.**.

2.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2004). A summary of this process is given below, followed by a description of the qualitative methodology used in this risk analysis.

Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Western Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host. It is based on pathway scenarios depicting necessary steps in the sourcing of the commodity for export, its processing, transport and storage, its use in Western Australia and the generation and disposal of waste. In particular, the ability of the pest to survive is considered for each of these various stages.

The probability of entry estimates for the quarantine pests for a commodity are based on the use of the existing commercial production, packaging and shipping practices of the exporting country. Details of the existing commercial production practices for the commodity are set out in Chapter 3. These practices are taken into consideration by DAFF when estimating the probability of entry.

For the purpose of considering the probability of entry, DAFF divides this step into two components:

- **Probability of importation**: the probability that a pest will arrive in Western Australia when a given commodity is imported.
- **Probability of distribution**: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that would be associated with the commodity
- mode of trade (e.g. bulk, packed)
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the lifecycle of the pest
- vulnerability of the life-stages of the pest during transport or storage
- incidence of the pest likely to be associated with a consignment
- commercial procedures (e.g. refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Western Australia.

Factors considered in the probability of distribution include:

- commercial procedures (e.g. refrigeration) applied to consignments during distribution in Western Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host

- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (e.g. for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2012). In order to estimate the probability of establishment of a pest, reliable biological information (lifecycle, host range, epidemiology, survival, etc.) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

Factors considered in the probability of establishment in the PRA area include:

- availability of hosts, alternative hosts and vectors
- suitability of the environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Probability of spread

Spread is defined as ‘the expansion of the geographical distribution of a pest within an area’ (FAO 2012). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the probability of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread.

Factors considered in the probability of spread include:

- suitability of the natural and/or managed environment for natural spread of the pest
- presence of natural barriers
- potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning qualitative likelihoods for the probability of entry, establishment and spread

In its qualitative PRAs, DAFF uses the term ‘likelihood’ for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 2.1). Descriptive definitions for these descriptors are given in Table 2.1. The standardised likelihood descriptors provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 2.1 – Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition
High	The event would be very likely to occur
Moderate	The event would occur with an even probability
Low	The event would be unlikely to occur
Very low	The event would be very unlikely to occur
Extremely low	The event would be extremely unlikely to occur
Negligible	The event would almost certainly not occur

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 2.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the probability of importation is assigned a likelihood of ‘low’ and the probability of distribution is assigned a likelihood of ‘moderate’, then they are combined to give a likelihood of ‘low’ for the probability of entry. The likelihood for the probability of entry is then combined with the likelihood assigned to the probability of establishment (e.g. ‘high’) to give a likelihood for the probability of entry and establishment of ‘low’. The likelihood for the probability of entry and establishment is then combined with the likelihood assigned to the probability of spread (e.g. ‘very low’) to give the overall likelihood for the probability of entry, establishment and spread of ‘very low’. A working example is provided below;

P [importation] x *P* [distribution] = *P* [**entry**] e.g. **low x moderate = low**

P [entry] x *P* [establishment] = *P* [**EE**] e.g. **low x high = low**

P [**EE**] x [spread] = ***P* [EES]** e.g. **low x very low = very low**

Table 2.2 – Matrix of rules for combining qualitative likelihoods

	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

DAFF normally considers the likelihood of entry on the basis of the estimated volume of one year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year's volume of trade is being considered. This difference reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

The use of a one year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on DAFF method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection.

In assessing the volume of trade in this PRA, DAFF assumed that a substantial volume of trade will occur. This is based on the historical trade that has occurred in table grapes from California to the rest of Australia since 2002. The estimated volume is given in Chapter 3.

2.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the likely consequences if the pests or disease agents were to enter, establish and spread in Western Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2012) and ISPM 11 (FAO 2004).

Direct pest effects are considered in the context of the effects on:

- plant life or health
- other aspects of the environment.

Indirect pest effects are considered in the context of the effects on:

- eradication, control, etc.
- domestic trade
- international trade
- environment.

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

Local: an aggregate of households or enterprises (a rural community, a town or a local government area).

District: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as ‘Far North Queensland’).

Regional: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).

National: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequence at each of these levels was described using four categories, defined as:

Indiscernible: pest impact unlikely to be noticeable.

Minor significance: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion’s intrinsic value. Effects would generally be reversible.

Significant: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.

Major significance: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic ‘value’ of non-commercial criteria.

- The estimates of the magnitude of the potential consequences over the four geographic levels were translated into a qualitative impact score (A-G) using Table 2.3.
- For example, a consequence with a magnitude of ‘significant’ at the ‘district’ level will have a consequence impact score of D.

Table 2.3 – Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic scales

		Geographic scale			
		Local	District	Region	Nation
Magnitude	Indiscernible	A	A	A	A
	Minor significance	B	C	D	E
	Significant	C	D	E	F
	Major significance	D	E	F	G

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 2.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

Table 2.4 – Decision rules for determining the overall consequence rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequence rating
1	Any criterion has an impact of 'G'; or more than one criterion has an impact of 'F'; or a single criterion has an impact of 'F' and each remaining criterion an 'E'.	Extreme
2	A single criterion has an impact of 'F'; or all criteria have an impact of 'E'.	High
3	One or more criteria have an impact of 'E'; or all criteria have an impact of 'D'.	Moderate
4	One or more criteria have an impact of 'D'; or all criteria have an impact of 'C'.	Low
5	One or more criteria have an impact of 'C'; or all criteria have an impact of 'B'.	Very Low
6	One or more but not all criteria have an impact of 'B', and all remaining criteria have an impact of 'A'.	Negligible

2.2.4 Estimation of the unrestricted risk

Once the above assessments are completed, the unrestricted risk can be determined for each pest or groups of pests. This is determined by using a risk estimation matrix (Table 2.5) to combine the estimates of the probability of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequence.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (e.g. low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'low' likelihood combined with 'high' consequences, is not the same as a 'high' likelihood combined with 'low' consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'moderate', whereas, the latter would be rated as a 'low' unrestricted risk.

Table 2.5 – Risk estimation matrix

Likelihood of pest entry, establishment and spread						
High	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	Very low risk	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Very low risk
	Negligible	**Very low**	**Low**	**Moderate**	**High**	**Extreme**
	Consequences of pest entry, establishment and spread					

2.2.5 Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero. The band of cells in Table 2.5 marked 'very low risk' represents Australia's ALOP.

2.3 Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing biosecurity measures to manage risks to achieve Australia's ALOP, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate exceeds Australia's ALOP, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve Australia's ALOP. The effectiveness of any proposed biosecurity measures (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure it reduces the restricted risk for the relevant pest or pests to meet Australia's ALOP.

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the probability of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments – e.g., inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop – e.g., treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest – e.g., pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways – e.g., consider natural spread, measures for human travellers and their baggage, cleaning or disinfestations of contaminated machinery
- options within the importing country – e.g., surveillance and eradication programs
- prohibition of commodities – if no satisfactory measure can be found.

Risk management measures are identified for each quarantine pest where the risk exceeds Australia's ALOP. These are presented in the pest risk management chapter of this analysis (Chapter 5).

3 California's commercial production practices for table grapes

This chapter provides information on the pre-harvest, harvest and post-harvest practices in California for the production of fresh table grapes for export. The export capability of California is also outlined.

3.1 Assumptions used in estimating unrestricted risk

Production and processing procedures described in this chapter are standard commercial production practices for table grapes in California. DAFF officers and contractors have visited table grape production areas, before and after the importation of table grapes from California into the rest of Australia commenced in 2002, to observe or verify commercial production practices related to pest management in vineyards and packinghouses, and during storage and transportation. The most recent visit took place in June 2012.

In estimating the likelihood of pest introduction, it was assumed that the pre-harvest, harvest and post-harvest production practices for table grapes, as described in this chapter, are implemented for all areas and for all grape cultivars within the scope of this analysis.

3.2 Climate in production areas

Californian table grapes are permitted access into Australia only from the Californian counties of Fresno, Kern, Madera, Kings, Tulare and Riverside (AQIS 2012), which are located in the southern half of the state (see Figure 4).

Figure 4 – Map of California showing counties and their boundaries

Source: http://www.digital-topo-maps.com/county-map/california.shtml

The majority of Californian table grape production occurs in warm, dry inland valleys, with about 85 percent of production occurring in the southern San Joaquin Valley, including Fresno, Kern, Kings, Madera and Tulare counties, and about 14 percent in the Coachella Valley, including Riverside County (USDA 1999).

The San Joaquin Valley has an arid-to-semiarid climate with hot summers and mild winters (USGS 2011). Fresno County, for example, experiences high temperatures and sunshine hours with little rainfall throughout summer and the period following grape berry ripening (Gladstones 1992). From June to October, Fresno has a total average rainfall of 22 mm and an average maximum temperature of 33°C (NCDC 2008). However, the climate is milder during early spring, with a total average rainfall of 81 mm and an average maximum temperature of 21.5°C between March–April (during bud burst) (World Climate 2005). The average total rainfall from April to May (during bloom) is 39 mm and the average maximum temperature is 26°C (World Climate 2005). Fresno's dry, hot weather and low rainfall, provide good conditions for table grape and drying grape production. The counties of Madera, Kings, Kern, and Tulare experience similar average temperatures to those of Fresno from May to December, although Riverside County experiences a slightly higher average temperature for the same months (University of California Cooperative Extension 2012).

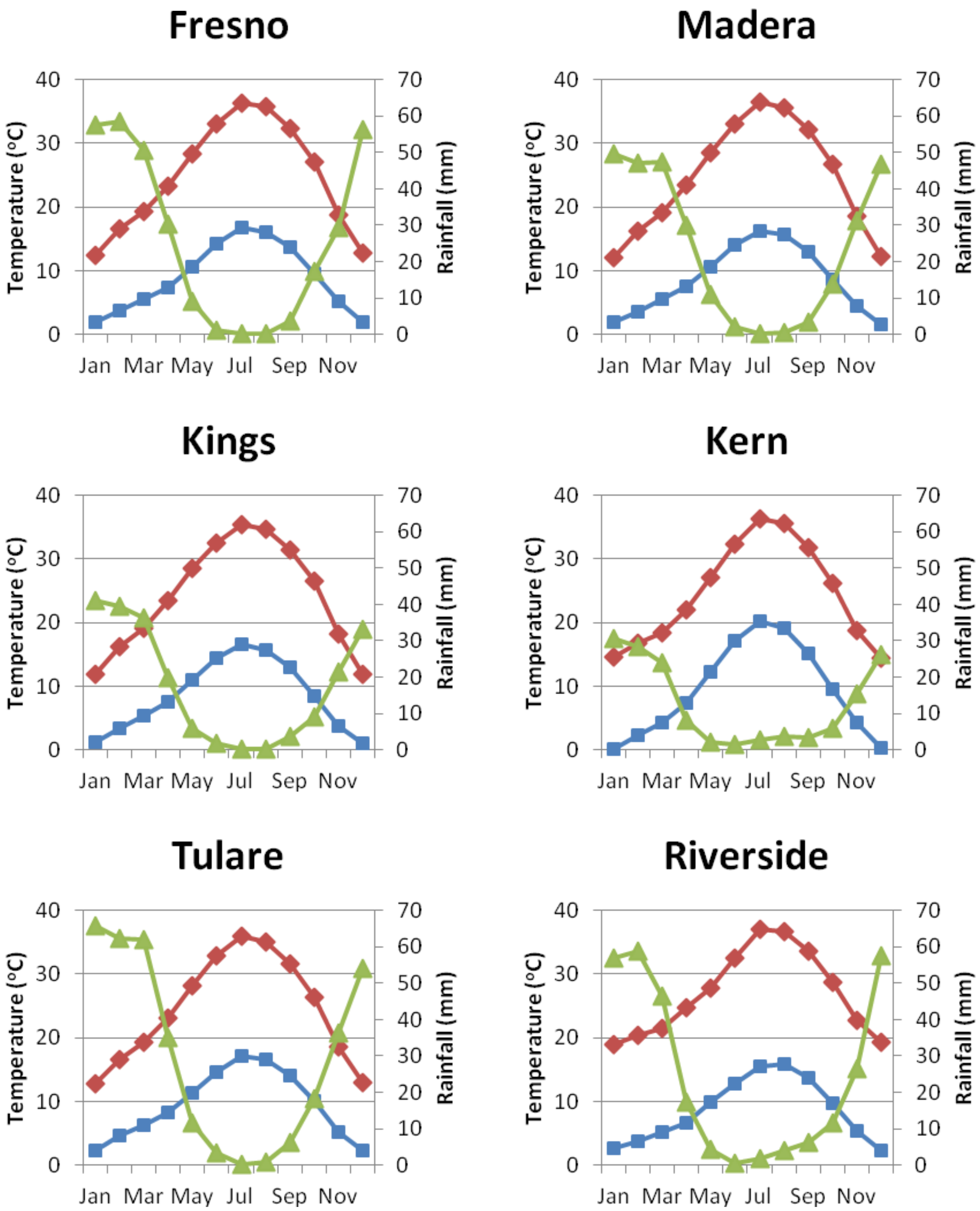

Figure 5 – Mean maximum (—♦—) and minimum (—■—) temperatures and mean rainfall (—▲—) for the Californian table grape-producing counties of Fresno, Madera, Kings, Kern, Tulare and Riverside (World Climate 2005).

3.3 Pre-harvest

3.3.1 Cultivars

Grapes have been cultivated in California for over two centuries (California table grape Commission 2012a). Grape production began to boom in California after 1839 when the first commercial table grape vineyard was planted in Los Angeles (California table grape Commission 2012b). There are now over 70 varieties of table grapes grown in California (California table grape Commission 2012b).

The major varieties of table grape by area planted are Flame Seedless, Crimson Seedless, Red Globe and Sugraone (Table 3.1).

Table 3.1 – Growing area for major table grape varieties in California in 2011 (CDFA 2012a).

Major varieties	Growing area (ha) in 2011
Autumn King	1,021
Autumn Royal	1,813
Crimson Seedless	5,388
Flame Seedless	7,645
Perlette	611
Princess	1,360
Red Globe	4,638
Ruby Seedless	1,217
Scarlet Royal	1,279
Sugraone	2,036
Summer Royal	380
Other varieties	7,899
All varieties	**35,287**

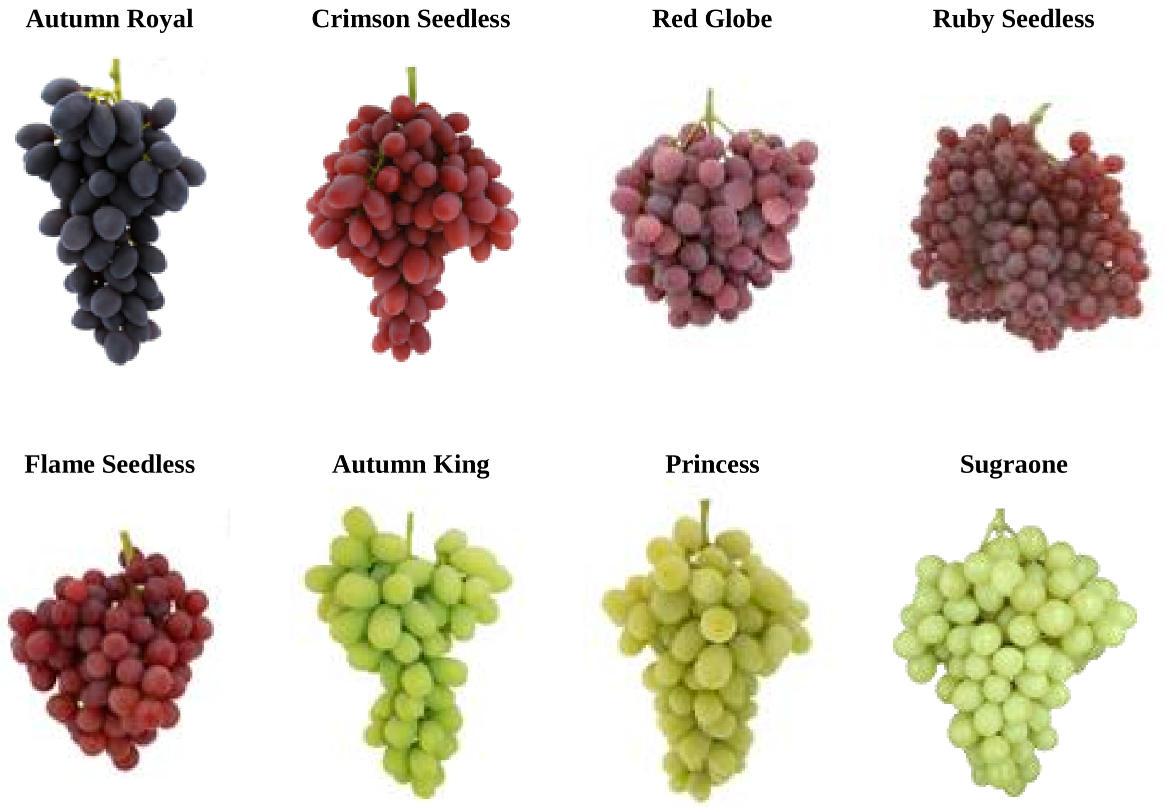

Figure 6 – Popular table grape varieties grown in California (California table grape Commission 2012c)

3.3.2 Cultivation practices

Planting

Appropriate site preparation is conducted prior to planting in spring (Peacock *et al.* 1994). Many popular varieties including Autumn Royal and Crimson Seedless adapt to a wide range of soil types and conditions, although moderate vigour sites may be preferred to limit excessive vegetative growth (Dokoozlian *et al.* 2000a; Dokoozlian *et al.* 2000b). Irrigation and nitrogen fertilisation are also controlled to limit extreme canopy growth (Dokoozlian *et al.* 2000b). Cultivars may be grafted onto rootstocks, with Harmony and Freedom being the most commonly used rootstock for table grape production in the San Joaquin Valley (Dokoozlian *et al.* 2000a). Some cultivars are frequently spaced 2.1 to 2.4 metres between vines and 3.7 metres between rows, with in-row spacing being reduced to 1.8 metres if vine vigour is expected to be moderate (Dokoozlian *et al.* 2000a; Dokoozlian *et al.* 2000b).

Trellis systems

The ‘T’ trellis system has been the standard set-up used over the past 60 years with only minor modifications made through time (Peacock *et al.* 1994). Due to its simplicity and effectiveness, ‘T’ trellis systems with a single crossarm and two or three foliage support wires have become the industry norm for table grape producers throughout California (Peacock *et al.* 1994). The set-up for the ‘T’ trellis system normally involves a 0.9 to 1.2 metre crossarm

(2 to 5 wires) arranged at the top of a 2.1 metre stake, driven into the ground to a depth of approximately 60 cm (Peacock *et al.* 1994). Other systems including the 'Y' and the Gable trellis set-ups have also been used in Californian vineyards (Peacock *et al.* 1994).

Pruning

Throughout the first year, vineyards in the San Joaquin Valley are allowed to grow unhindered for maximum leaf area and root system development (Christensen 1999). Vines are pruned back to two buds at the end of the growing season (Christensen 1999). In California, vines are either cane pruned or spur pruned (University of California 2008a). Cane pruning involves cutting back shoots from the previous season's growth to one or two buds to produce the following season's canes (Olmstead 2007). Spur pruning involves cutting back spurs along a permanently trained cordon (Olmstead 2007).

In California, some table grape cultivars, such as Autumn Royal, are most productive under a quadrilateral cordon system with spur pruning (Dokoozlian *et al.* 2000a). Other cultivars, such as Crimson Seedless, may produce adequate yields under either a cane pruning system or a quadrilateral cordon/spur pruning system (Dokoozlian *et al.* 2000b).

Irrigation

Irrigation is applied to Californian grapevines to ensure berries grow to a satisfactory size, to provide enough leaf area for healthy vine growth, and for the development of a canopy that provides sufficient shade to minimise sunburn to berries (Williams 2012). Irrigation requirements for table grapes in the San Joaquin Valley typically range from 450 to 500 mm between bud break and harvest (Williams 2012). Slightly higher volumes of water use are required in the Coachella region as a result of higher evaporation rates (Williams 2012).

3.3.3 Pest management

A year round checklist is used to ensure pest management covers all stages of table grape growth. Table 3.2 details the chemicals used, the timing of application and the pests targeted throughout California.

Table 3.2 – Integrated pest and disease management for Californian table grapes

Lifecycle stage	IPM activity	Example treatment options
Delayed dormant	• Monitor vines for mealybugs, European lecanium scale, spider mites, cutworm and manage if necessary • Place pheromone traps for omnivorous leafroller and sticky traps for glassy-winged sharpshooter	• Imidacloprid 7–14 fl oz/acre; insecticidal soaps; spinosad 1.25–2.5 oz/acre
Budbreak	• Continue monitoring vines for mealybugs, European lecanium scale, spider mites, cutworm and manage if necessary • Monitor vines for powdery mildew and treat if necessary • Consider treating for phomopsis if rain is forecast • Check traps for omnivorous leafroller and glassy-winged sharpshooter • Survey weeds and form management plan	• Imidacloprid 7–14 fl oz/acre; insecticidal soaps; narrow range oil; spinosad 1.25–2.5 oz/acre • Tebuconazole 4 oz/acre; *Bacillus pumilis* 2–4 qt/acre • Kresoxim-methyl 3.2–4.8 oz/acre; mancozeb; ziram; 3–4 lb/acre
Rapid-shoot growth	• Monitor leafhoppers • Place pheromone traps for mealybugs • Continue checking traps for omnivorous leafroller and glassy-winged sharpshooter • Continue monitoring vines for powdery mildew and manage if necessary • Monitor for diseases including bot canker, eutypa dieback, measles and Pierce's disease • Check for wilting caused by Botrytis shoot blight and branch and twig borer • Monitor vines for spider mites, western grape, skeletonizer, leafrollers and other pests	• Remove basal leaves or lateral shoots; imidacloprid 7–14 fl oz/acre • Tebuconazole 4 oz/acre; azoxystrobin 11–15.4 fl oz/acre; *Bacillus pumilis* 2–4 qt/acre • Canker removal, vine removal, cultural practices to maintain vine vigour, and some fungicide applications may be used
Bloom to veraison	• Monitor for western flower thrips and manage if necessary • Monitor leafhoppers, spider mites, mealybugs, European fruit lecanium scale, Botrytis bunch rot, powdery mildew and for other pest and disease damage • Continue monitoring traps for vine mealybug, omnivorous leafroller and glassy-winged sharpshooters • Check for summer rot, Botrytis bunch rot and leafhopper populations	• Spinosad 1.25–2.5 oz/acre; narrow range oil 1–2 gal/acre • Imidacloprid 7–14 fl oz/acre; narrow range oil; and other appropriate pesticides • Remove basal leaves and lateral shoots in the fruit zone at berry set
Veraison	• Monitor for pests and check traps, as above • Check for bird damage	• Manage with netting or scare devices
Harvest	• Check traps for glassy-winged sharpshooter and continue managing birds	
Postharvest	• Continue monitoring mealybugs, scale and western grapeleaf skeletonizer, and continue checking traps	
Dormant	• Prune vines, remove dried grape clusters and survey weeds	

Source: University of California (2012b)

3.4 Harvesting and handling procedures

Timing of harvest is largely determined by the fruit's appearance, flavour, texture and sugar-acid ratio. Table grapes are harvested when they are ready to be consumed as they do not ripen after they have been picked (Rosenstock 2007). To determine the appropriate time to harvest, growers monitor the percentage colouration in the clusters and quantify soluble solid levels in a random selection of berries (Rosenstock 2007). In California, a soluble solids concentration of 14 to 17.5 per cent is normally used to identify fruit which are ready for harvest (Crisosto and Smilanick 2004). A minimum colour requirement is also applied to red and black table grape varieties to ensure adequate colour in the cluster prior to harvest (Crisosto and Smilanick 2004).

The majority of Californian table grapes are packed in the field, with few being shed packed (Crisosto and Smilanick 2004). Field packed grapes are commonly picked and placed into a picking container (Crisosto and Smilanick 2004). The cluster is trimmed to remove any defective fruit, including sunburnt, decayed, undersized, cracked or irregular-shaped berries (Rosenstock 2007). Defective clusters are either completely discarded or included in low grade category (Rosenstock 2007). Defective clusters may be too compact to examine the interior, filled with shot berries, too small, have an excess of defective berries, or have inadequate colouring (Rosenstock 2007). The picking container is then moved to a packer working in a portable stand in the avenue between vineyard blocks (Crisosto and Smilanick 2004). Packed containers are subject to quality inspection and weight checking (Crisosto and Smilanick 2004). The packer places the grape bunches into boxes. After packing, grapes are arranged onto pallets and sent to packing sheds and/or treatment facilities.

3.5 Post-harvest

After harvest, fruit is pre-cooled to remove field head, reduce respiration, slow growth of decay, and to minimise water loss (Rosenstock 2007). Pre-cooling commences as soon as possible. Once the grapes have been pre-cooled, pallets are placed in a storage room until transportation occurs (Crisosto and Smilanick 2004). Under current export conditions, table grapes destined for the Australian market are fumigated with a combination sulfur dioxide (SO_2) and carbon dioxide (CO_2) treatment before they are cooled. This is because the fumigation treatment must occur at 15.6°C (60°F) or greater. After fumigation the table grapes are then cooled to undergo at least 6 continuous days of cold treatment at a pulp temperature of –0.50°C ± 0.50°C. After cold treatment they may then be moved into storage until they are transported for export.

Optimum refrigeration conditions for table grapes in storage are between -1 and 0 °C with relative humidity levels of 90 to 95 percent (Crisosto and Smilanick 2004). It is recommended that the pulp temperature of the berries should range from -0.5 to 0 ^{o}C during post-harvest storage (Crisosto and Smilanick 2004).

Optimum storage conditions for table grapes in transit range from -1 to -0.5 ^{o}C with relative humidity of 90-95% (Welby and McGregor 2004). Under these conditions, grapes may have an approximate storage life of 2-6 months (Welby and McGregor 2004). Figure 7 summarises the post-harvest packing house, storage and distribution steps for Californian table grapes. Table grapes destined for export to Australia are subject to the conditions detailed in Chapter 5.1.2.

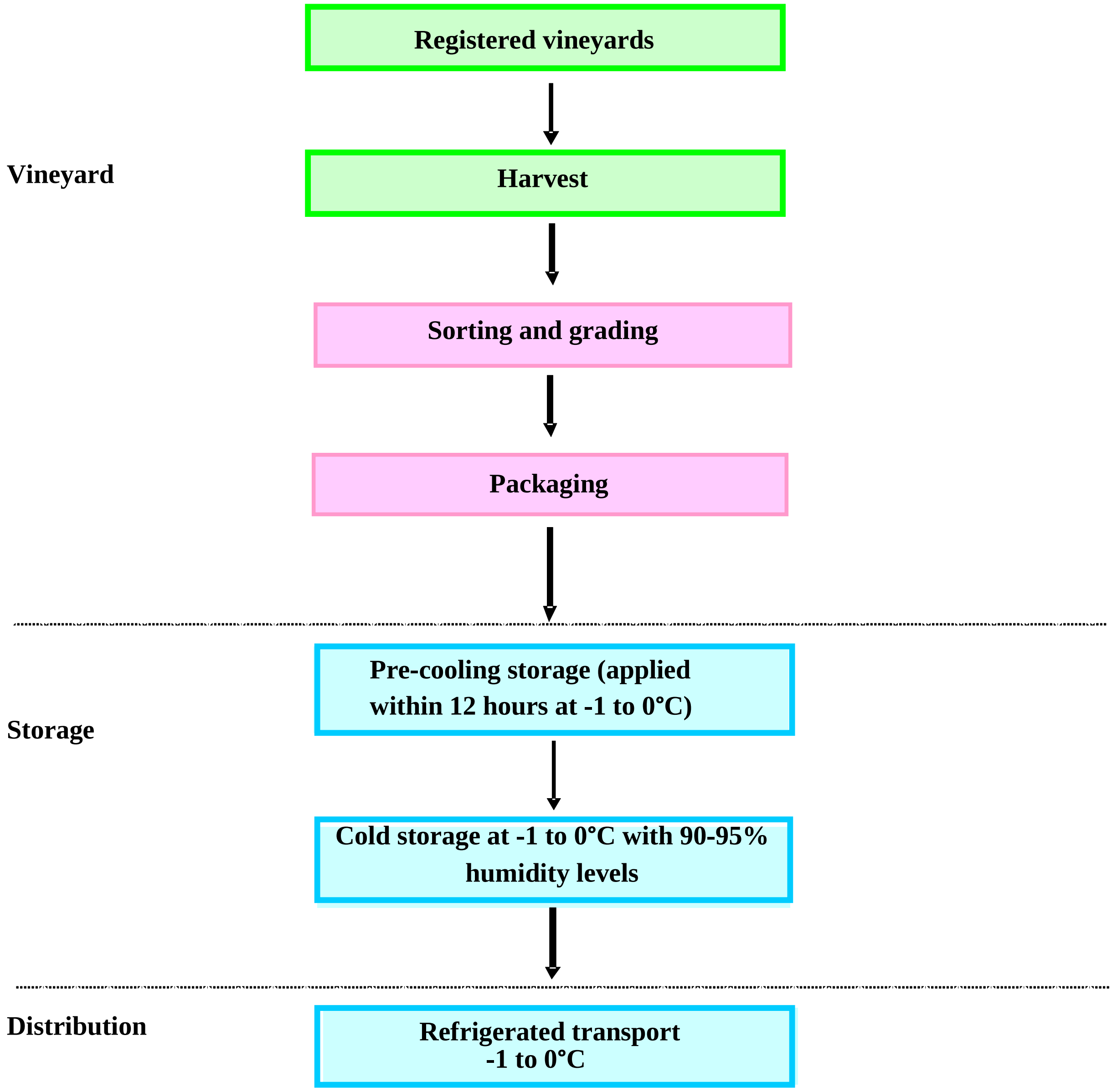

Figure 7 – Summary of vineyard and post-harvest packing house, storage and distribution steps for Californian table grapes

3.6 Commercial production and export information

3.6.1 Production statistics

California is the largest producer of table grapes in the USA. The majority of Californian table grapes are produced in the San Joaquin Valley, with most production occurring in Kern, Tulare and Fresno counties (USDA 2010a). In 2011, Kern had approximately 15,500 ha of bearing and non-bearing vines, Tulare had over 10,000 ha and Fresno had approximately 5,000 ha (CDFA 2012a). Riverside County has the largest table grape plantings outside the San Joaquin Valley, with approximately 2,800 ha of bearing and non-bearing vines (CDFA 2012a).

In 2010, California had over 34,000 bearing hectares of table grape vines. The California Department of Food and Agriculture (CDFA 2012a) reported production of over 900,000 tonnes of grapes with a value of US$385.6 million (Table 3.3). Whilst production of table grapes in California steadily increased between 2006 and 2010, the prices for fresh grapes declined contributing to a lower value of production compared to previous years (Table 3.3).

Table 3.3 – Production statistics for table grapes in California from 2000 to 2010

Year	Production (tonnes)	Value of production (US$M)
2000	702,161	437.4
2001	646,823	435.2
2002	674,038	457.6
2003	664,059	407.6
2004	698,532	535.0
2005	791,065	385.1
2006	650,452	643.8
2007	717,583	622.9
2008	882,691	394.5
2009	792,880	406.0
2010	914,442	385.6

Source: California Department of Food and Agriculture (CDFA 2012a)

Export statistics

The USA is the second largest exporter of table grapes in the world after Chile (USDA 2010a). California is the top export state, followed by New Jersey, New York and Pennsylvania (USDA 2010a). Approximately 35 per cent of the USA's table grape crop is exported (USDA 2011). In 2009, the United States Department of Agriculture reported that the USA exported 303,000 tonnes of table grapes valued at US$586 million to 86 countries (USDA 2010a). Canada was the largest importer, taking 33 per cent of the crop, followed by Hong Kong (11 per cent) and Australia (8 per cent) (Table 3.4;(USDA 2010a). Other major export markets include the Philippines, Indonesia, Taiwan, Mexico, the United Kingdom, Malaysia, New Zealand, Thailand and Vietnam (USDA 2010a). Table 3.4 summarises table grape exports from the USA to its main markets for selected years over the period 2005 to 2009 as reported by the United States Department of Agriculture (2010a).

Table 3.4 – Fresh table grape exports from the USA to major markets 2005 to 2009 (US$ millions)

			(US$ millions)			% share
Country	**2005**	**2006**	**2007**	**2008**	**2009**	**2009**
Canada	158	150	185	169	194	33%
Hong Kong	44	43	45	59	63	11%
Australia	16	16	34	47	48	8%
Philippines	11	12	15	18	24	4%
Indonesia	15	11	17	26	24	4%
Taiwan	26	17	20	24	21	4%
Mexico	51	49	51	60	19	3%
United Kingdom	13	12	17	23	19	3%
Malaysia	63	40	20	16	15	3%
New Zealand	8	8	13	13	14	2%
Thailand	10	10	12	15	13	2%
Vietnam	5	5	7	9	12	2%
Other	120	124	116	130	120	20%
Total	540	497	552	609	586	100%

Source: United States Department of Agriculture (2010a)

Volume of trade to Australia and Western Australia

Californian table grapes have been imported into Australia, excluding Western Australia, since 2002. Export volumes have increased since that time; however they have somewhat stabilised after 2007, although there are still year-to-year fluctuations (Table 3.5). This data has been used to estimate possible trade volumes to Western Australia for consideration in the pest risk assessment in Chapter 4.

In 2012, based on the resident population at the June quarter, the population of Western Australia was around 12 per cent of the combined population of the other states and territories of Australia (2,430,300 and 20,253,300 respectively) (ABS 2012). If trade volumes to the other states and territories could be expected to fluctuate around 11,500 tonnes per year, based on trade volumes since 2007, then it is assumed that the volume exported to Western Australia could be about 1,400 tonnes per year (12% of 11,500 tonnes).

Table 3.5 – Imports of Californian table grapes to Australia (excluding Western Australia)

Year	Volume (tonnes)
2002	921
2003	1043
2004	3909
2005	4198
2006	4314
2007	10889
2008	14787
2009	15898
2010	5762
2011	10571

Source: (TradeMap Australia 2011)

Export and harvest season

In California, the table grape season begins around May with the earliest varieties being Perlette, Flame Seedless and Sugraone. Flame Seedless has a very long season in California usually lasting until around December, whereas Perlette and Flame Seedless varieties last only until August (Pollack and Perez 2007). Thomson Seedless also has a long season in California starting in June and ending in January (Pollack and Perez 2007). Red Globe is available from July through January, and Ruby Seedless and Crimson Seedless from August through January. Calmeria is available only from September, but lasts through to January of the following year (Pollack and Perez 2007).

Since exports of fresh table grapes from California to Australia began in 2002, the export season to Australia has been from June to November (with one exceptional year where consignments were also shipped in December).

4 Pest risk assessments for pests of quarantine concern

Pests of quarantine concern associated with table grapes from California to Western Australia were identified in the pest categorisation process (Appendix A). This chapter assesses the probability of the entry, establishment and spread of these pests and the associated potential economic, including environmental, consequences.

This review builds on previous policy for table grapes from California to the rest of Australia (AQIS 1999; AQIS 2000a; AQIS 2000b; Biosecurity Australia 2002; Biosecurity Australia 2003; Biosecurity Australia 2006).

Pest categorisation identified 14 pests of quarantine concern associated with table grapes from California to Western Australia that do not have risk management measures in the existing policy for Californian table grapes to other Australian states and territories. Table 4.1 identifies these pests, and full details of the pest categorisation are given in Appendix A. Additional pest data are given in Appendix B.

No pest risk assessments were conducted for those pests with risk management measures already in place under the existing policy for Californian table grapes to the rest of Australia. Any existing measures for those pests will be applied to imports to Western Australia.

Assessments of risks associated with the 14 pests of quarantine concern are presented in this chapter. Pests are listed or grouped according to their taxonomic classification, consistent with Appendix A and Appendix B.

For each pest, the PRA area is defined as the state of Western Australia. The likelihood ratings given for entry, establishment and spread and the associated consequences are for Western Australia.

Pest risk assessments were completed to determine whether the risk posed by each pest exceeds Australia's ALOP and thus whether biosecurity measures are required to manage the risk.

For some of the 14 pests identified, pest risk assessments have already been completed for other commodities or other source countries. For these pests, the likelihood of importation and/or the likelihood of distribution may be reassessed due to the differences in the commodity and growing region assessed. The likelihood of establishment and spread and the consequences the pests may cause have been based on the outcomes from the previous assessment. If previous policy has been considered, this will be stated in the introduction for the pest.

Table 4.1 – Pests of quarantine concern for table grapes from California identified in the draft review but which do not have risk management measures in the existing policy for Californian table grapes into Australia

Pest	Common name
Harmonia axyridis	Harlequin ladybug
Lygus hesperus	Western plant bug
Lygus lineolaris	Tarnished plant bug
Parthenolecanium corni	European fruit lecanium scale
Pseudococcus calceolariae	Citrophilus mealybug
Marmara gulosa	Citrus peel miner
Phomopsis viticola	Phomopsis cane and leaf spot
Strawberry latent ringspot virus	
Grapevine fanleaf virus	
Tomato ringspot virus	
Grapevine yellow speckle viroid 1	
Grapevine yellow speckle viroid 2	
Hop stunt viroid	
Citrus exocortis viroid	

In the following pest risk assessments DAFF considered several matters that were common for most pests and pathogens. These included the possibility that:

- imported Californian table grapes will contain seeds and that those seeds may germinate
- consumers will discard Californian table grapes in environments suitable for pest or pathogen distribution to a host or for seed germination in the case of seed transmitted pathogens (including household compost)
- a seedling from a Californian table grape seed will survive and establish and that a pathogen of quarantine concern may infect that seedling.

California exports both seeded and seedless table grape varieties to Australia. DAFF assumes that some viable grapevine seed from fruit consumed by the public will be discarded into natural and unmanaged environments as well as household composts. However, out of the top fourteen varieties of table grapes grown in California, only one variety, Red Globe, has seeded berries (California table grape Commission 2012d). Red Globe represents the third top variety by volume shipped from California (Anonymous 2011). As such, some seeded table grapes are expected to be exported from California to Australia, however the majority of table grapes are likely to be seedless varieties which have no risk of seed transmission of pathogens.

In general, grapevines are grown from vegetatively propagated cuttings that are grafted onto rootstock or, less commonly, self-rooted (Zohary 1996). Vineyards are not established using vines propagated from seed as these vines are likely to produce inferior berries and are unlikely to be true to type after genetic segregation (Zohary 1996). This aspect of grapevine propagation, along with the relatively long time taken to grow a productive vine from seed, will likely deter members of the public from deliberately growing grapevines from the seed of imported fruit (Olmo 1976). The wide availability of grafted vines will also reduce the incentive to grow vines from seed.

The proportion of grapevine seed that germinates depends on the cultivar, seed maturity, storage, stratification and planting conditions (Doijode 2001). Most grapevine seed is dormant and will not germinate unless it has been stratified. Successful stratification is usually achieved by storing seed at 0–5 °C for two months or longer (Ellis *et al.* 1985; Doijode 2001). Low germination rates of seed from fresh untreated berries or room temperature stored seed has been reported in the literature, although longer storage periods after ripening positively correlated with germination rates (Scott and Ink 1950; Singh 1961).

The timing of exports of Californian table grapes to Australia is another important consideration because discarded seed may be stratified by low temperatures in winter. Although table grapes are harvested in California from May to January (Pollack and Perez 2007), exports to Australia occur between June and November. This coincides with winter, when seed are more likely to stratify naturally in low temperatures (in some parts of Australia) and spring, when conditions are more favourable for growth of seedlings.

Germination of some untreated seed is reported to be slow and some seedlings grown from untreated seed are stunted (Scott and Ink 1950; Mamarov *et al.* 1958). However, grapevine seedlings sometimes occur in vineyards (Office of the Gene Technology Regulator 2003). In Europe, volunteer grapevines grow as weeds in small numbers. Most of these weedy vines are probably rootstocks that have escaped vegetatively or have grown from seed, although some may be escaped cultivars of grapevine that have grown from seed (Zohary 1996; Arrigo and Arnold 2007; Ocete *et al.* 2008).

Grapevine is not a common weed in Australia (Office of the Gene Technology Regulator 2003), but there are reports of grapevine growing as a weed on roadsides and in disturbed areas in NSW, Victoria and Western Australia (Richardson *et al.* 2006) and vines have been found near established vineyards and water-courses (Conn 2010). Grapevine has been recorded as naturalised in Western Australia (Conn 2010) and thus climatic conditions are suitable for the establishment of wild grapevines in some parts of Western Australia.

There is some risk of consumers discarding grape seed into household compost piles. One study which investigated food-related behaviours of Australians found that half of respondents composted their food waste often (Lea and Worsley 2008), but the proportion of grape seeds that are discarded as compost is not known. If conditions were right, grapevine seed could germinate, but as discussed, untreated seed has variable rates of germination. Given that most Californian table grapes are seedless, the risk of a Californian table grape seed germinating in a household compost pile is low.

The likelihood that table grape waste may be discarded close to other suitable hosts for the pests and pathogens concerned was also considered. Most households in Australia do not grow table grapes; the highest proportion occurs in Western Australia, South Australia and the Australian Capital Territory with about 1 in 10 private dwellings growing grapes (Cross and Taylor 1996). Other suitable hosts may be present in backyards, but this depends on the pest or pathogen considered and is discussed, when relevant, in the pest risk assessments below.

Given the available evidence, DAFF considers that some waste from imported table grapes will be disposed of in household compost or other natural or unmanaged environments. There is a low likelihood that this will be adjacent to a suitable host for the quarantine pests and pathogens considered. The biology of each pest and pathogen will determine how close a suitable host needs to be for distribution to occur. Also, a very small proportion of seed from imported table grapes may germinate when table grapes are discarded in compost or somewhere such as on a road side. A seedling may establish given that grapevines are known to grow wild in some parts of Australia. But given the barriers to successful seed germination discussed above, and the fact that only some Californian table grapes contain seeds, this would not be likely to occur.

4.1 Harlequin ladybird [Coleoptera: Coccinellidae]

Harmonia axyridis EP

The Harlequin ladybird is not known to occur in Western Australia and is a pest of quarantine concern for that state. It is also considered to be absent from the rest of Australia.

Harmonia axyridis is a beetle from the Coccinellidae family and is a voracious predator of plant pests, especially of aphids but also of other soft bodied insects. Its native range includes China, Japan and eastern Russia but it has since become established in Europe and the Americas following its introduction as a biocontrol agent. Its current wide distribution is indicative of the invasiveness of this species and it is now recorded from the USA, Canada and Mexico (Koch *et al.* 2006), Argentina and Brazil in South America (de Almeida and da Silva 2002), and throughout Western Europe, Scandinavia and Great Britain (Roy and Roy 2008; Brown *et al.* 2008). It is also spreading eastwards, and is now present in Poland, Serbia, Hungary, Romania, Slovakia and Ukraine (EPPO 2009a).

During the 1960s to the 1990s, the United States Department of Agriculture attempted to establish *H. axyridis* to control agricultural pests, particularly of pecans and apples (Potter *et al.* 2005). However, some scientisits believe that the current infestations in the USA are a result of the unintentional introduction of beetles from a Japanese freighter in New Orleans (Potter *et al.* 2005). Since its establishment in North America, it has become the dominant ladybird species in much of the USA and Canada (Kenis *et al.* 2008) and inhabits ornamental and agricultural crops throughout the USA (Potter *et al.* 2005). It is currently reported from much of the continental USA with the exception of Montana, Wyoming and parts of the southwest (Koch 2003).

In addition to being a pest of commercial fruit production, it is known as a human nuisance, is threatening native biodiversity in some areas and it has also become of significant concern in wine production, where beetles may be crushed along with grapes during processing. When crushed, the beetles release a foul smell that taints the wine, adversely affects its taste, and has caused millions of dollars in losses to the wine industry in the eastern USA and southern Canada (Galvan *et al.* 2006). There have been anecdotal accounts that approximately 5% of wines have been affected in some areas (Kovach 2004).

The risk scenario of concern for *H. axyridis* is the presence of adults and potentially larvae and pupae within bunches of table grapes from California.

Harmonia axyridis was assessed in the existing import policy for table grapes from the People's Republic of China (Biosecurity Australia 2011a). The assessment presented here builds on this previous assessment.

The probability of distribution, establishment and spread of *H. axyridis* in Western Australia and the consequences it may cause will be comparable for table grapes imported from any country as these probabilities relate specifically to events that occur in Western Australia and are independent of the importation pathway. Furthermore, the timing of imports from California and China overlap as they are both in the Northern Hemisphere. Accordingly, there is no need to reassess these components, and the risk ratings for distribution, establishment, spread and consequences as set out for *H. axyridis* in the import risk analysis report for table grapes from the People's Republic of China (Biosecurity Australia 2011a) will be adopted for this assessment.

4.1.1 Likelihood of entry

The likelihood of entry is considered in two parts, the likelihood of importation and the likelihood of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *Harmonia axyridis* will arrive in Western Australia with the importation of table grapes from California is: **HIGH**.

Supporting information for this assessment is provided below:

- Since its introduction into North America, *Harmonia axyridis* population levels have dramatically increased and it is now the dominant ladybird species in the USA and Canada (Kenis *et al.* 2008).
- *Harmonia axyridis* is often reported as a pest of fruit production in North America (Kenis *et al.* 2008); feeding has been reported on grapes, apples peaches, and raspberries (Kovach 2004).
- Larvae complete their development on plants where aphids, their primary food source, are abundant (Potter *et al.* 2005).
- As aphids become scarce in late summer and autumn, the ladybirds become attracted to ripening grapes as a late-season food source (Roy and Roy 2008). The beetles tend to aggregate on grape clusters just prior to harvest and some beetles may remain within the bunch following harvest (Galvan *et al.* 2006). As a result, it can be difficult to separate this pest from the grapes (Roy and Roy 2008).
- *Harmonia axyridis* is generally reported as a contaminant pest and feeds only on berries which have been previously damaged by other insects, birds, diseases or from 'splitting' (Galvan *et al.* 2006; Kenis *et al.* 2008). However, there are also accounts from growers that undamaged fruit can be affected (Kovach 2004), which suggests that adult beetles are associated with fruit that is not damaged.
- Females have been reported to produce up to 3819 eggs (25.1 eggs/day) under laboratory conditions but typically oviposit batches of around 20-30 eggs at a time (Koch 2003) on leaves or stems of host plants (Biosecurity Australia 2011a). Given the potential high fecundity of this pest and its use as a biocontrol agent, relatively large numbers of *H. axyridis* are potentially available at the time of harvest.
- Although some control strategies have been implemented or are currently being studied to manage *H. axyridis* populations in commercial fruit production, these are limited given the role of *H. axyridis* as a beneficial insect in commercial orchards.
- Adults typically live for 30 to 90 days but can live up to 3 years (Koch 2003) and are likely to survive transit times to Western Australia following harvest.

- Watanabe (2002) reported on the cold tolerance of *H. axyridis* in overwintering adults. Although some mortality is experienced at sub-freezing temperatures, more than 90% of males and females survived winter ambient temperatures in Japan, with temperatures often recorded below zero. The lowest ambient temperature recorded was -3.5°C. Watanabe (2002) also reported on seasonal changes in cold hardiness of *H. axyridis*, where adults moderate levels of cryoprotective agents in response to climatic cues to better enable winter survival. Table grapes are harvested in the warmer summer months; although beetles are unlikely to have accumulated peak levels of cryoprotective substances, the cold temperatures used to treat, store and transport table grapes for export are unlikely to kill all *H. axyridis* if they are present.

The wide distribution and abundance of *H. axyridis* in California (and the USA), its association with grape bunches, its longevitiy and its cold tolerance support a likelihood estimate for importation of 'high'.

Probability of distribution

The probability of distribution for *Harmonia axyridis* in Western Australia is being based on the assessment for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The rating from that assessment was: **HIGH**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *Harmonia axyridis* will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **HIGH**.

4.1.2 Probability of establishment and spread

As indicated above, the probability of establishment and of spread for *Harmonia axyridis* is being based on the assessment for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment are:

Probability of establishment:	**HIGH**
Probability of spread:	**HIGH**

4.1.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *Harmonia axyridis* will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **HIGH**.

4.1.4 Consequences

The consequences of the establishment *Harmonia axyridis* in Australia have been estimated previously for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**C**	Minor significance at the district level
Any other aspects of the environment	**D**	Significant at the district level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**E**	Significant at the regional level
International trade	**D**	Significant at the district level
Environment	**E**	Significant at the regional level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**E**', the overall consequences are estimated to be **MODERATE**.

4.1.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *Harmonia axyridis*	
Overall probability of entry, establishment and spread	High
Consequences	Moderate
Unrestricted risk	Moderate

As indicated, the unrestricted risk estimate for *Harmonia axyridis* has been assessed as 'moderate', which is above Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.2 Plant bugs [Hemiptera: Miridae]

Lygus hesperus EP and *Lygus lineolaris* EP

Lygus hesperus (western plant bug) and *Lygus lineolaris* (tarnished plant bug) are not present in Western Australia and are therefore pests of quarantine concern for that state. The biology and taxonomy of these two species are considered sufficiently similar to justify combining them into a single assessment. In this assessment, the term 'plant bugs' is used to refer to these two species unless otherwise specified.

The family Miridae includes a large number of species, most of which feed on plants. Mirids are also referred to as plant bugs and are characterised as generalist plant feeding insects that use needle-like mouthparts to extract plant juices from their hosts at all stages of their life, from nymph to adult (University of Missouri 2000; CABI 2011). They may feed upon the fruit of their hosts as well as other reproductive plant parts such as flowers and buds (CABI 2011).

Plant bugs overwinter as adults in dead plants, leaf litter/plant debris and uncultivated areas outside the orchard (CABI 2011; Bentley *et al.* 2012a). During spring, females will lay eggs in a wide variety of plants that hatch into nymphs that undergo a number of nymphal phases (instars) before becoming adults. Adults are very active and mobile with a short life cycle, which for the *L. lineolaris* is around 30 days with 2–5 generations per year (CABI 2011). Within California, there have been reports of up to ten overlapping generations in a year for some plant bug species (Bentley *et al.* 2012a).

Plant bugs lay eggs and feed on both commercial and weedy host plants. The presence of weeds is an important factor that influences the number of plant bugs that may be found in a commercial crop, so control of weeds is usually recommended (CABI 2011).

The risk scenario of concern for *L. hesperus* and *L. lineolaris* is the presence of eggs in the imported commodity. As plant bugs are highly mobile and easily disturbed, it is unlikely that nymphal or adult plant bugs would remain associated with imported table grapes.

Lygus hesperus and *L. lineolaris* have been assessed in the existing import policy for stone fruit from the United States (Biosecurity Australia 2010). The assessment of *L. hesperus* and *L. lineolaris* presented here builds on this previous assessment.

Differences in the host status between table grapes and stone fruit for *L. hesperus* and *L. lineolaris* make it necessary to assess the likelihood that *L. hesperus* and *L. lineolaris* will be imported into Western Australia with table grapes from California.

The probability of distribution, establishment and spread of *L. hesperus* and *L. lineolaris* in Western Australia and the consequences they may cause will be comparable for any commodity from which these species are imported into Western Australia, as these probabilities relate specifically to events that occur in Western Australia and are independent of the importation pathway. Furthermore, the risk scenario of concern is the presence of eggs on fruit and DAFF considers the likelihood of distribution of eggs to be comparable between stone fruit and table grapes. Accordingly, there is no need to reassess these components, and the risk ratings for distribution, establishment, spread and consequences, as set out for *L. hesperus* and *L. lineolaris* in the existing import policy for stone fruit from the United States (Biosecurity Australia 2010), will be adopted for this assessment.

4.2.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *L. hesperus* and *L. lineolaris* will arrive in Western Australia with the importation of table grapes from California is: **VERY LOW**.

Supporting information for this assessment is provided below:

- Both *L. hesperus* and *L. lineolaris* are widely distributed across North America. *Lygus hesperus* is predominantly reported in the west of North America, ranging from southern British Columbia to northern Mexico (Zhou *et al.* 2012). In the western United States, it is reported as the dominant plant bug species in a complex that includes *L. elisus, L. shulli* and *L. lineolaris* (Zhou *et al.* 2012). *Lygus lineolaris* was originally recorded from the eastern United States but has since been reported to be one of the most widely distributed plant bug species in North America (Summers 2001; Mueller *et al.* 2012).

- Both species are highly polyphagous with *L. lineolaris* reported to feed on more than 385 host plant species (Young 1986) and *L. hesperus* from over 100 plant species (Godfrey 2000; Zhou *et al.* 2012).
- In California, plant bugs are considered major pests of cotton, fruit, vegetable and seed crops (Godfrey 2000). *Lygus hesperus* is a key pest of several agricultural crops in California, particularly in the San Joaquin Valley (Godfrey 2000). Its principal hosts include cotton, strawberry, alfalfa and dry beans (Godfrey 2000). *Lygus lineolaris* is also reported from California (Mueller *et al.* 2012) and is mainly a pest of apples, carrots, cherries, cotton, lima beans, seed alfalfa, green beans, soybeans, peaches, pears, strawberries, tomatoes and nursery stock (Dixon 2009), although infestation of grapes is also known (Bostanian *et al.* 2003; Fleury *et al.* 2006; Fleury *et al.* 2010). Despite its polyphagy, *L. lineolaris* mostly feeds on young apples and weeds (Fleury *et al.* 2010).
- Plant bugs are associated with grapevines in the field. There have been reports of *L. lineolaris* in vineyards of Pennsylvania and in southwestern Quebec, Canada (Bostanian *et al.* 2003; Fleury *et al.* 2010). Adults feed on reproductive parts of their host plant (i.e. buds or flowers) or rapidly growing meristematic tissues (Bostanian *et al.* 2003). Grapevines continuously produce meristematic tissues (as they flower throughout the growing season) which provides new substrates for *L. lineolaris* generations to feed continuously throughout the season (Fleury *et al.* 2006; Fleury *et al.* 2010).
- Laboratory studies have shown that adults of *L. lineolaris* are capable of feeding on all phenological stages of grapevines (Fleury *et al.* 2006). Most feeding in the berry development stages of grapevine growth occurs in the grape bunch on the upper part of the pedicel (Fleury *et al.* 2006).
- Although eggs may be laid into fruit from around mid May until late in the season, females preferentially deposit eggs in stems, leaf parts and flowers of orchard weeds such as *Amaranthus* spp. (pigweed), *Brassica* spp. (wild mustard), *Capsella bursa-pastoris* (shepherd's-purse), *Centaurea solstitialis* (yellow starthistle), *Chenopodium album* (lambsquarters), *Hemizonia* spp. (tarweed), *Melilotus officinalis* (sweet clover), *Raphanus raphanistrum* (wild radish), *Salsola tragus* (Russian thistle), and *Vicia* spp. (vetch) (Anthon 1993; Fleury *et al.* 2010; CABI 2011; Caprile *et al.* 2011). For *L. hesperus*, winter and early spring weeds serve as a reservoir and provide a link to summer crops in the Central Valley of California (Godfrey 2000).
- It is noted that nymphs are not commonly seen in orchards, suggesting that eggs are preferentially laid into other hosts. The availability and sequence of flowering in weedy hosts is thought to be a critical factor in their population dynamics (CABI 2011). The presence of adult plant bugs in orchards is linked to the drying up of primary host material around the orchard, at which time the adults migrate to the irrigated areas (Bentley *et al.* 2012a).
- Adult and nymphal plant bugs are highly mobile and easily disturbed. Adults of *L. lineolaris* can easily and rapidly move between crops, and have been shown to fly over 12km in 12h, and 5km without interruption (Fleury *et al.* 2010). The process of

harvesting table grapes is likely to disturb or dislodge any plant bugs associated with the fruit, but if any eggs are present, they may not be affected.

- Unless fruit damage or other symptoms of infestation are obvious, fruit infested with eggs would not be expected to be removed by harvest and post-harvest quality assurance operations, particularly given the enclosed nature of table grape bunches.
- Plant bugs overwinter as adults beneath weeds, on the orchard floor or in bordering uncultivated areas (Anthon 1993). *Lygus lineolaris* overwinters as diapausing adults beneath plant litter (Fleury *et al.* 2006) and resumes activity in spring when temperatures are greater than 8°C (Anthon 1993; Bostanian *et al.* 2003).
- Eggs are the life stage expected to be associated with the imported commodity. It has been shown that eggs can survive temperatures of 10°C for 15 days without any notable level of mortality (Snodgrass and McWilliams 1992). However, there is no evidence that eggs exposed to the colder temperatures – such as those experienced during in-transit cold storage under commercial conditions – would result in significant mortality.

The high mobility of adults, limited reports citing infestation of table grapes and the predominant association of eggs and nymphs with weedy hosts support a likelihood estimate for importation of 'very low'.

Probability of distribution

The probability of distribution for *L. hesperus* and *L. lineolaris* is being based on the assessment for stone fruit from the United States (Biosecurity Australia 2010). That assessment used the same methodology as described in Chapter 2 of this report. The rating from the previous assessment was: **MODERATE**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *L. hesperus* and *L. lineolaris* will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **VERY LOW**.

4.2.2 Probability of establishment and spread

The probability of establishment and of spread for *L. hesperus* and *L. lineolaris* is being based on the assessment for stone fruit from the United States (Biosecurity Australia 2010). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment were:

Probability of establishment: **HIGH**

Probability of spread: **MODERATE**

4.2.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *L. hesperus* and *L. lineolaris* will enter Western Australia as a result of trade in table grapes from the United States, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.2.4 Consequences

The consequences of the establishment *L. hesperus* and *L. lineolaris* in Western Australia have been estimated previously for stone fruit from the United State (Biosecurity Australia 2010). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**E**	Significant at the regional level
Other aspects of the environment	**B**	Minor significance at the local level
Eradication, control etc.	**D**	Significant at the district level
Domestic trade	**C**	Significant at the local level
International trade	**C**	Significant at the local level
Environment	**B**	Minor significance at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are ‘E’, the overall consequences are estimated to be **MODERATE**.

4.2.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *L. hesperus* and *L. lineolaris*	
Overall probability of entry, establishment and spread	Very low
Consequences	Moderate
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for *L. hesperus* and *L. lineolaris* has been assessed as ‘very low’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.3 European fruit lecanium scale [Hemiptera:Coccidae]

Parthenolecanium corni EP

Parthenolecanium corni is not present in the state of Western Australia and is therefore a pest of quarantine concern for that state. It is present in Victoria, Tasmania (Plant Health Australia 2001; CSIRO 2005) and New South Wales (CSIRO 2005).

Parthenolecanium corni is divided into two sub species, *P. corni* ssp. *corni* and *P. corni* ssp. *apuliae* (Ben-Dov *et al.* 2010). *Parthenolecanium corni corni* has a wide geographic distribution, being found extensively across the Palaearctic, Nearctic, Neotropical, Oriental and Australasian regions, while *P. corni apuliae* is found exclusively on grapevines in Italy (Ben-Dov *et al.* 2010). To date, research of this scale has only been conducted to species (*P. corni*) level. Due to the comparatively narrow distribution of *P. corni apuliae,* the remainder of this assessment assumes research to be based on *P. corni corni* and will use *P. corni* interchangeably with this sub-species.

Parthenolecanium corni belongs to the soft scale insect family Coccidae (Ben-Dov *et al.* 2010). Soft scales are small, often inconspicuous and are covered with a wax secretion that provides protection (Smith *et al.* 2012). There are three life stages: egg, nymph and adult. The life cycle of female *P. corni* includes an egg stage, two nymph stages and an adult stage (David'yan 2009). Adult females are small (3–6.5 mm long, 2.0–4.0 mm in width and 4.0 mm in height) (David'yan 2009) and covered in a shiny brown, leathery domed shell (Bentley *et al.* 2009). The male scale has one egg stage, four nymph stages and an adult stage which is winged (David'yan 2009). Adult male scales have a short life span and are rarely observed (Smith *et al.* 2012). Adult males are 1.7 mm long (David'yan 2009).

In Californian vineyards, *P. corni* overwinter as second instar nymphs, moulting to the third instar stage in early spring, then developing into adult females that start laying eggs in April and May (Bentley *et al.* 2009). Females lay between 1000–3000 eggs under their body (David'yan 2009), which shrinks against the outer body wall to house the eggs (Flaherty *et al.* 1992). Eggs hatch from May to July (Flaherty *et al.* 1992) (in the northern hemisphere). The emerging crawlers (first instar nymphs) move to grapevine shoots and leaves, and moult to second instars from June to July (Bentley *et al.* 2009). Second instar nymphs move back to the woody part of the vine in late summer where they overwinter, re-emerging in the following spring to become third instars and mature into egg laying females (Bentley *et al.* 2009). There is generally only one generation each year in California, although there can be two generations in north coast vineyards (Bentley *et al.* 2009).

Scales cause major problems in agricultural and ornamental ecosystems and are commonly transported on plant materials (Miller *et al.* 2007). Due to their small size and habit of feeding in concealed areas, they are frequently an invasive species causing billions of dollars in damage annually in the USA (Miller *et al.* 2007). Soft scales, such as *P. corni*, are serious pests especially as invasive species (Miller *et al.* 2007). In the USA there are 42 introduced species of soft scales and 41 of them are pests (Miller *et al.* 2007).

Parthenolecanium corni damages plants through direct feeding damage (CABI 2011). Severe infestations can stunt vine growth (Bentley *et al.* 2009) and cause twig and limb death (Virginia Tech 2012). However, sooty mould growth is a more common problem associated with *P. corni* infestations (Virginia Tech 2012). *P. corni* excretes honeydew as it feeds, which serves as a substrate for sooty mould growth (CABI 2011). This results in blackened areas on leaves and fruit, which can reduce photosynthetic capacity and the marketability of produce (CABI 2011).

The risk scenario of concern for *P. corni* is that imported bunches of table grapes from California may contain adult females, eggs and nymphs.

Parthenolecanium corni has been assessed in the existing import policies for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and the People's Republic of China (Biosecurity Australia 2011a). These reports based their assessment on the existing import policy for table grapes from Chile (Biosecurity Australia 2005). The assessment of *P. corni* presented here builds on these previous assessments.

The probability of distribution, establishment and spread of *P. corni* in Western Australia and the consequences they may cause will be based on the assessments in the reports for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and table grapes from the People's Republic of China (Biosecurity Australia 2011a). The table grape harvest and export periods in Korea and China overlap those in California as they are all in the northern hemisphere and imports to Australia would occur at about the same time of year. For this reason, DAFF considers the likelihood estimates given in the reports for table grapes from Korea and China for distribution, establishment and spread and consequences to be equivalent to table grapes imported from California. Furthermore, these stages relate specifically to events that occur in Australia and are independent of the importation pathway.

The risk ratings for distribution, establishment, spread and consequences as set out for *P. corni* in the reports for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and table grapes from the People's Republic of China (Biosecurity Australia 2011a) have been adopted for this assessment.

4.3.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *Parthenolecanium corni* will arrive in Western Australia with the importation of table grapes from California is: **MODERATE**.

Supporting information for this assessment is provided below:

- *Parthenolecanium corni* occurs in the USA, including in California (Golino *et al.* 2002; Ben-Dov *et al.* 2010) where it is sometimes abundant (Dreistadt *et al.* 2007). It is a pest of grapevine in California (Bentley *et al.* 2009). This suggests that it is likely to be associated with the pathway.
- On grapevine, adult females are generally found on shoots or wood less than three years old (Flaherty *et al.* 1992). Flaherty *et al*. (1992) state that they may also be found on grape bunches, but no further comment is made. The crawlers move to grapevine shoots, and moult to second instars from June to July and the second instar nymphs don't move back to the woody part of the vine until late summer, where they overwinter (Bentley *et al.* 2009). Eggs, nymphs and adults could be present on table grape bunches when exports to Australia occur (June to November), but *Parthenolecanium corni* seem to be mainly the associated with shoots and wood (Flaherty *et al.* 1992).
- Due to the small size of adults, nymphs and eggs, it may be difficult to detect them in grape bunches, especially at low population levels. Additionally, the shape and colour of adult females varies according to age and host plant, which may make detection more difficult. As such, table grape sorting, grading and packing processes may not remove them effectively from the export pathway.
- *Parthenolecanium corni* overwinters under grapevine bark as second instar nymphs (Bentley *et al.* 2009). The ability to overwinter may demonstrate an ability to tolerate cold storage during transport of table grapes from California to Western Australia.

The small size of the eggs, nymphs and adults; sessile nature of most life stages; cold tolerance; and reported abundance of this pest suggest that there may be a high risk of importation, but the importation likelihood is reduced because *Parthenolecanium corni* are mainly associated with shoots and wood and not grape bunches. This supports a likelihood estimate for importation of 'moderate'.

Probability of distribution

The probability of distribution for *Parthenolecanium corni* is being based on the assessment for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and table grapes from the People's Republic of China (Biosecurity Australia 2011a). Those assessments used the same methodology as described in Chapter 2 of this report. The distrubution rating from these previous assessments was: **LOW**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *Parthenolecanium corni* will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.3.2 Probability of establishment and spread

As indicated above, the probability of establishment and of spread for *Parthenolecanium corni* is being based on the assessment for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and table grapes from the People's Republic of China (Biosecurity Australia 2011a). Those assessments used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessments are presented below:

Probability of establishment:	**HIGH**
Probability of spread:	**MODERATE**

4.3.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *Parthenolecanium corni* will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **LOW**.

4.3.4 Consequences

The consequences of the establishment *Parthenolecanium corni* in Western Australia have been estimated previously for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and table grapes from the People's Republic of China (Biosecurity Australia 2011a). Those assessments used the same methodology as described in Chapter 2 of this report. The ratings from those assessments can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from these analyses is provided below:

Plant life or health	**D**	Significant at the district level
Any other aspects of the environment	**B**	Minor significance at the local level
Eradication, control, etc.	**D**	Significant at the district level

Domestic trade	**C**	Minor significance at the district level
International trade	**C**	Minor significance at the district level
Environment	**B**	Minor significance at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**D**', the overall consequences are estimated to be **LOW**.

4.3.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *Parthenolecanium corni*	
Overall probability of entry, establishment and spread	Low
Consequences	Low
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for *Parthenolecanium corni* has been assessed as 'very low', which achieves Australia's ALOP. Therefore, no specific risk management measures are required for this pest.

4.4 Citrophilus mealybug [Hemiptera: Pseudococcidae]

Pseudococcus calceolariae EP

Pseudococcus calceolariae (citrophilus mealybug) is not present in Western Australia and is a pest of quarantine concern for that state.

Pseudococcus calceolariae belongs to the mealybug family Pseudococcidae which consists of small, soft-bodied insects that are covered with a mealy wax secretion (Charles *et al.* 2000). Mealybugs can rapidly increase to large numbers and cause significant damage by extracting plant sap, excreting toxic salivary compounds, and secreting honeydew which serves as a substrate for the development of sooty moulds (El-Sayed *et al.* 2010; RBG 2012b). *Pseudococcus calceolariae* is native to Australia (RBG 2012b) and is a serious pest of citrus in South Australia (Smith *et al.* 1997; Gullan 2000) and a minor pest of citrus in Victoria and New South Wales (Gullan 2000).

Eggs are laid in a cottony sack containing up to 500 eggs (Smith *et al.* 1997). Female mealybugs develop from an egg through three nymphal (instar) stages before undergoing a third moult into the adult form (Smith *et al.* 1997). Adult females are slow moving, oval-shaped and 3-4 mm long (Smith *et al.* 1997). Males develop from eggs through first and second instar stages, form pupa, and undergo a third and fourth moult into small, winged adults with long tail filaments (Smith *et al.* 1997). Females, prior to egg laying, and males, after the second instar stage, stop feeding and find protected locations under vegetation or bark (CABI 2011). In Australia, the lifecycle takes around 2 months in summer and 3-4 months in winter (Smith *et al.* 1997).

The risk scenario of concern for *P. calceolariae* is the presence of nymphs or adults on table grapes from California.

Pseudococcus calceolariae has been assessed in the existing import policies for table grapes from Chile (Biosecurity Australia 2005). The commercial production practices in Chile and California are similar, and although table grapes are harvested at different times of year, this mealybug does not overwinter and the risk of distribution is comparable for table grapes from both regions being imported to Australia at any time of year. The wide climatic variation across Australia means that conditions are suitable for entry, establishment and spread somewhere in Australia all year round. Furtheremore, the probability of distribution, establishment and spread of *P. calceolariae* in Australia and the consequences it may cause will be comparable for table grapes imported into Australia from any country as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to reassess these components, and the risk ratings for distribution, establishment, spread and consequences, as set out for *P. calceolariae* in the final import risk analysis report for table grapes from Chile (Biosecurity Australia 2005) will be used for this assessment.

4.4.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *P. calceolariae* will arrive in Western Australia with the importation of table grapes from California: **LOW**.

Supporting information for this assessment is provided below:

- *Pseudococcus calceolariae* is present in the state of California (Smith *et al*. 1997; Waterhouse and Sands 2001; Daane *et al.* 2008; Ben-Dov *et al*. 2010). It was first detected in California in 1913 and had become a serious pest by 1928. Effective control of the pest was achieved when two parasitoids, *Coccophagus gurneyi* and *Tetracnemoidea brevicornis*, were introduced from the Sydney area (Waterhouse and Sands 2001). Although these parasitoids reduced the pest to low numbers (Waterhouse and Sands 2001), it is still considered to be a pest of citrus in California (Grafton-Cardwell *et al.* 2012) and could therefore be present on table grapes grown in California.
- *Pseudococcus calceolariae* has a wide host range, infesting plants belonging to 40 families, including grapevine (Ben-Dov *et al*. 2010).
- Although *P. calceolariae* is present in the USA and is a pest of citrus in California (Grafton-Cardwell *et al.* 2012), it is reported to be rarely found in North American vineyards (Daane *et al*. 2011).
- Juvenile and adult stages of *P. calceolariae* seek out fruit and sheltered sites (Smith *et al.* 1997). On grapevine, mealybugs are most prevalent in dense canopies and tend to be located in sheltered positions such as the underside of leaves, inside curled leaves, between bud scales, under bark, and inside grape bunches (Furness and Charles 1994). If *P. calceolariae* are present in sheltered locations inside grape bunches, such as between touching fruit, they are likely to be overlooked during pre-export sorting and packing processes.
- Although native to eastern Australia (Smith *et al*. 1997; RBG 2012b), *P. calceolariae* has invasively spread and now has a world-wide distribution due to trade in plants and plant products.

The presence of this pest in California, its association with grapevines and its cryptic nature are moderated by low pest prevalence in California and infrequent detections in North American vineyards. This support a likelihood estimate for importation of 'low'.

Probability of distribution

The probability of distribution for *P. calceolariae* is being based on the assessment for table grapes from Chile (Biosecurity Australia 2005). That assessment used the same methodology as described in Chapter 2 of this report. The rating from the previous assessment was **MODERATE**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *P. calceolariae* will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.4.2 Probability of establishment and spread

The probability of establishment and of spread for *P. calceolariae* is being based on the assessment for table grapes from Chile (Biosecurity Australia 2005). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessment are:

Probability of establishment:	**HIGH**
Probability of spread:	**HIGH**

4.4.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *P. calceolariae* will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **LOW**.

4.4.4 Consequences

The consequences of the establishment *P. calceolariae* in Western Australia have been estimated previously for table grapes from Chile (Biosecurity Australia 2005). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**D**	Significant at the district level
Any other aspects of the environment	**A**	Indiscernible at the local level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**D**	Minor significance at the regional level
International trade	**D**	Minor significance at the regional level

Environment	**A**	Indiscernible at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are **'D'**, the overall consequences are estimated to be **LOW**.

4.4.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *Pseudococcus calceolariae*	
Overall probability of entry, establishment and spread	Low
Consequences	Low
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for *P. calceolariae* has been assessed as 'very low', which achieves Australia's ALOP. Therefore, no specific risk management measures are required for this pest.

4.5 Citrus peelminer [Lepidoptera: Gracillariidae]

Marmara gulosa

Marmara gulosa is not recorded from Western Australia and so is a pest of quarantine concern for that state.

Marmara gulosa is a moth native to the southwestern USA and has become an economic pest in California, Arizona, Cuba and Mexico (Guillén *et al.* 2001; Jones 2001). It was first misidentified as *M. salictella* on the young twigs of willow in the Atlantic states but was subsequently described as *M. gulosa* (Guillén *et al.* 2001). It probably initially attacked willow, but has undergone a host shift to various plants not native to the USA including citrus and oleander (Jones 2001).

In California, *M. gulosa* was first reported on citrus in 1917 and as a sporadic pest up until the 1970s (Kirkland 2009). High populations were recorded from the Coachella Valley in the mid 1980s and mid 1990s, and in 1999 *M. gulosa* was reported from the southern San Joaquin Valley with high infestations apparent by 2000 (Kirkland 2009). It is recorded throughout southern and central California, including desert areas (Jones 2001; Grafton-Cardwell *et al.* 2008).

Marmara gulosa is a highly polyphagous pest which is reported to feed on hosts from up to 31 plant families including fruit and vegetable crops; ornamentals; and weeds (Grafton-Cardwell 2002; Kirkland 2009). In commercial production, it is primarily a pest of citrus, especially grapefruit and navel oranges; however, infestations have been observed on cotton, cowpeas, eggplant, grape, capsicum, plum, pumpkin and zucchini (Stelinski 2007).

In the San Joaquin Valley citrus, table grapes and nursery stock have been most affected by *M. gulosa* (Grafton-Cardwell *et al.* 2003). It has been found heavily infesting table grapes, in which it attacked stems and fruit of varieties with large berries (Grafton-Cardwell *et al.*

2003). It has also been reported on petioles, tendrils and bunch rachises (Eichlin and Kinnee 2001).

Larvae of *M. gulosa* cause economic damage by feeding on the upper epidermal layers of the fruit, creating a silvery white serpentine surface mine (Kirkland 2009). Under high pest pressures, mining of leaves is observed also (Grafton-Cardwell *et al.* 2012). Fruit damage is considered cosmetic but the occurrence of a single mine can render the fruit unacceptable for sale (Grafton-Cardwell *et al.* 2012). In citrus, it can cause from 5 to 80% loss of marketable fruit in susceptible varieties (Grafton-Cardwell *et al.* 2012). An outbreak of *M. gulosa* in the Coachella Valley in 1995 caused 80-90% marketable fruit losses in some areas (Stelinski 2007).

The risk scenario of concern for *M. gulosa* is the presence of eggs, larvae or adults within bunches of imported table grapes.

4.5.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *Marmara gulosa* will arrive in Western Australia with the importation of table grapes from California is: **MODERATE**.

Supporting information for this assessment is provided below:

- *Marmara gulosa* is native to the USA and has become an economically important pest in California, particularly of citrus in the Coachella and San Joaquin Valleys (Stelinski 2007; Grafton-Cardwell *et al.* 2012).
- Anecdotal evidence suggest that *M. gulosa* has entered California from Mexico on shipments of citrus and caused outbreaks of the pest in California (Kirkland 2009). This suggests that the pest can be spread through trade of horticultural products, although this was not on table grapes
- Often, *M. gulosa* populations build in grape or cotton crops and disperse into neighbouring citrus orchards when the fruit begins to senesce (Grafton-Cardwell *et al.* 2003).
- On grapes, infestation has been reported on the stem, petiole, tendril, bunch rachis and berries (Eichlin and Kinnee 2001; Grafton-Cardwell *et al.* 2003).
- In California, citrus, table grapes and nursery stock have been most affected by *M. gulosa*; and in 2001 citrus and table grape shipments from California were rejected by trading partners due to interceptions of *M. gulosa* (Grafton-Cardwell *et al.* 2003).
- Eggs are deposited on stems and fruits and the larvae feed on the upper epidermal layers of fruit (Grafton-Cardwell *et al.* 2008). Eggs can be present on grape bunches and go undetected.
- The mining caused by *M. gulosa* larvae blemishes the surface of fruit (Grafton-Cardwell *et al.* 2008). Where symptoms of infestation are obvious, these fruit would likely be culled during standard harvest and post-harvest quality assurance procedures as well as be detected during routine in-field pre-harvest surveillance programs. Where the damage is not visible from the outside of the bunch, it may go undetected.
- Just before pupating, the larvae leave their mines and spin a cocoon on a twig, leaf, bark crevice, amongst trash on the ground or fruit where they pupate(Kerns *et al.* 2004; Grafton-Cardwell *et al.* 2008). Cocoons are decoarated with small white silk

balls, which makes them conspicuous (Grafton-Cardwell *et al.* 2008); if present on grape bunches they are likely to be detected unless they are secreted within the bunch.

- In the San Joaquin Valley, there may be 7 generations per year (Grafton-Cardwell *et al.* 2008) although up to 13 generations are also reported (Jones 2001). Development continues throughout the year and no overwintering stage is observed (Grafton-Cardwell *et al.* 2008). When plants such as citrus are dormant, the pest probably survives on adjacent plants in gardens, road side plantings and natural areas. Oleander, which is common in California, is an alternative host for this pest (Guillén *et al.* 2001) from which *M. gulosa* may invade orchards.
- Under laboratory conditions, average fecundity was reported as 48.5 eggs per female with an average of 4.5 eggs laid per day (Guillén *et al.* 2001). But females are reported to lay between 10 and 50 eggs generally (Kerns *et al.* 2004). Given the potential fecundity and multiple generations, *M. gulosa* are likely to be present at the time of harvest in all life stages.
- In 2001 shipments of table grapes from the San Joaquin Valley were rejected by foreign countries due to infestation with *M. gulosa* (Grafton-Cardwell *et al.* 2003).
- The eggs are only 0.41 mm long and 0.28 mm wide (Guillén *et al.* 2001), and may be difficult to detect on a grape bunch.
- Development is temperature-dependent and can range from two to four weeks (Kirkland 2009). O'Neal et al. (2011) reported that temperatures of 17^{o}C and 21^{o}C resulted in around 70% mortality, but required 27 and 49 days respectively to achieve this level of mortality. Similarly, the authors reported that at 17^{o}C or 33^{o}C, *M. gulosa* experienced greater than 10% mortality during the egg, first larval instar and second larval instar stages. Transport of table grapes from California to Australia is predominantly by air freight and the time taken from harvest to retail sale can be less than two weeks. Although some mortality to egg and larval stages may be experienced during cold treatment storage and transport, it is possible that viable *M. gulosa* eggs, larvae, pupae or adults could arrive in Western Australia if they are present on table grape bunches when packed in California. Where table grapes are shipped by sea freight, taking up to 3 weeks (or 4-5 weeks including post-harvest and on-arrival processing), the longer transit period could result in a higher mortality rate but would not likely preclude the potential import of viable *M. gulosa* life stages.

The presence of the pest in California throughout the year, its demonstrated association with table grape bunches, adult longevity and probable history of spread into California on citrus from Mexico are moderated by the conspicuous nature of the larval damage and cocoons, and lack of any official detection records during inspection of table grapes from California into eastern Australia. This supports a likelihood estimate for importation of 'moderate'.

Probability of distribution

The likelihood that *Marmara gulosa* will be distributed within Western Australia in a viable state as a result of the processing, sale or disposal of table grapes from California and subsequently transfer to a susceptible part of a host is: **HIGH**.

Supporting information for this assessment is provided below:

- Any eggs, larvae or pupae present on table grapes imported from California would be distributed with the commodity to destination points. Following pupation, adults are capable of independent flight and could potentially locate a suitable host from markets, repacking facilities, retailers, during transportation, or wherever they are taken by consumers. However, a review of the literature did not indicate what the dispersal range of adult *M. gulosa* moths is.

- The entire life cycle takes around 30 days for completion (Kerns *et al.* 2004), although development is temperature-dependent and can range from two to four weeks (Kirkland 2009). Larvae pass through 4-5 instar stages which each require around 3 days for completion (Kerns *et al.* 2004). Adult females survive for an average of 10.9 days and males 9.3 days (Guillén *et al.* 2001). This suggests that they could be distributed alive on table grapes after introduction.
- *Marmara gulosa* is highly polyphagous and feeds on a range of fruit and vegetable crops, ornamentals and weeds in up to 31 plant families (Grafton-Cardwell 2002; Kirkland 2009). Grafton-Cardwell *et al.* (2002) documented 67 hosts based on observations from infestations in Fresno, Tulare and Kern counties and Kirkland (2009) reported a host plant list of 69 species. The species is also considered to have shifted from willow to plants such as citrus and oleander (Jones 2001) indicating an ability to expand its host plant range in new environments.
- As discussed in the introduction to this chapter, consumers may discard the waste from Californian table grapes onto household compost piles. Given that the adults of this pest can fly, there is some risk that adults could distribute to a suitable host via this pathway. However, the proportion of table grape bunch waste going to household compost is low. Consumers may also discard waste onto roadsides or other uncontrolled environments, where distribution to suitable hosts could occur.

This pest has a wide host range, the adults can fly and their life cycle can take up to around 30 days. This supports a likelihood risk estimate for distribution of 'high'.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *Marmara gulosa* will enter Western Australia as a result of trade in table grapes from the California and be distributed in a viable state to a susceptible host is: **MODERATE**.

4.5.2 Probability of establishment

The likelihood that *Marmara gulosa* will establish within Western Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction is: **HIGH**.

Supporting information for this assessment is provided below:

- The wide host range of *M. gulosa* suggests that it is likely, if the pest has been distributed to a suitable part of a host plant, that the host would be suitable for egg laying and larval development. As indicated, this species has probably shifted from native hosts such as willow to plants such as citrus and oleander (Jones 2001). It may be able to move to other hosts in new environments.
- *Marmara gulosa* is native to southern USA and has been reported from California, Texas, Arizona, Florida, Northern Mexico and Cuba (Stelinski 2007). Many of the areas where *M. gulosa* has been reported share similar climates to parts of Western Australia. It is likely that warmer areas in Western Australia would be suitable for the establishment of this species.

- *Marmara gulosa* can have up to 13 generations per year (Jones 2001). On average, females lay between 10 and 50 eggs (Kerns *et al.* 2004). The generation time varies from two to four weeks (Kirkland 2009), although it generally takes about 30 days (Kerns *et al.* 2004). Given the fecundity of females, a population could establish from a single gravid female. In addition, the rapid generation times would favour the establishment of *M. gulosa* in Western Australia should it be introduced.
- There are currently only limited biological and cultural control measures available to manage *M. gulosa*. Chemical coverage can be incomplete due to: *M. gulosa* entering an orchard or vineyard in waves; fruit expanding rapidly leaving untreated surfaces for egg deposition; eggs being preferentially laid on low lying internal fruit; and the limited ability to penetrate inside the mines of larvae (Grafton-Cardwell *et al.* 2003; Grafton-Cardwell *et al.* 2012). Biological control has shown some success with the native eulophid wasp (*Cirrospilus coachellae*) in the Coachella Valley, but the wasp is unable to survive the colder winters in northern regions such as the San Joaquin Valley (Stelinski 2007; Grafton-Cardwell *et al.* 2012) and efforts to establish it there have been unsuccessful (Grafton-Cardwell *et al.* 2008). If *M. gulosa* was introduced, it is unlikely that suitable controls could be applied in urban areas. Also, existing IPM strategies applied in rural and horticultural areas are unlikely to be effective in limiting the establishment of this pest in Western Australia.

The wide host range, current geographic distribution, high reproductive potential, and limited effectiveness of current control methods support a likelihood estimate for establishment of 'high'.

4.5.3 Probability of spread

The likelihood that *Marmara gulosa* will spread within Western Australia, based on a comparison of factors in the source and destination areas that affect the expansion of the geographic distribution of the pest is: **MODERATE**.

Supporting information for this assessment is provided below:

- The polyphagous nature of *M. gulosa* would enable it to locate suitable hosts in new areas and facilitate the spread of this pest should it be introduced and become established. It may also be able to spread to new hosts as probably occurred in California with the shift from willow to citrus (Jones 2001).
- The current geographic distribution of *M. gulosa* includes California, Texas, Arizona, Florida, northern Mexico and Cuba (Stelinski 2007). Many of these areas share similar climates to parts of Western Australia and *M. gulosa* could spread through areas with a suitable climate; probably warmer regions of Western Australia.
- The first collections of *M. gulosa* in the USA were made in 1915 from California according to Jones (2001) and 1917 according to Kirkland (2009). Only sporadic occurrences were reported in California up to the mid 1990s and *M. gulosa* was considered a minor pest of citrus in the San Joaquin Valley (Grafton-Cardwell *et al.* 2003; Kirkland 2009). Since that time, *M. gulosa* has rapidly spread throughout the San Joaquin Valley and to additional regions of California and the USA, infesting not only citrus, but a wide range of hosts that it had previously only rarely attacked (Grafton-Cardwell *et al.* 2003). This change coincides with shipments of citrus fruit from northern Mexico in response to shortages in fruit production in California in the late 1990s (Kirkland 2009). Although *M. gulosa* has managed to spread throughout California, the limited and disparate spread of *M. gulosa* in the USA and the Americas

suggest there may be additional factors outside of pest management practices that impede the widespread dispersal of this pest, particularly across the southern states of the USA which may relate to host availability and climate.

- *Marmara gulosa* adult moths are capable of independent flight and could disperse locally. Natural barriers such as deserts, mountains or large areas where hosts are not present would limit its ability to disperse between some areas. The long distances between production areas in Australia may reduce the likelihood that *M. gulosa* would disperse unaided from one agricultural region to another.
- Long distance spread would probably rely on facilitated distribution with commodities or conveyances. The small size of eggs and larvae could enable the spread of *M. gulosa* to new areas undetected. However, where obvious symptoms of infestation are apparent, interstate control measures may restrict spread in a commercial context.
- The potential fecundity of gravid females, many generations per year and potential persistence year round, would favour the spread of *M. gulosa* in Western Australia.

The wide host range, possible history of spread on Mexican citrus, capacity for flight, and high fecundity are moderated by the history of limited spread of outbreaks in south western parts of the USA. This supports a likelihood estimate for spread of ‘moderate’.

4.5.4 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of ‘rules’ are shown in Table 2.2.

The likelihood that *Marmara gulosa* will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **LOW**.

4.5.5 Consequences

The consequences of the establishment of *Marmara gulosa* in Western Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are ‘D’, the overall consequences are estimated to be **LOW**.

Reasoning for these ratings is provided below:

Criterion	Estimate and rationale
Direct	
Plant life or health	**D – Significant at the district level** • *Marmara gulosa* can cause direct damage to crops in the form of mines on the surface of fruit. Although the presence of mines causes only a cosmetic effect and does not damage the internal flesh, it can render fruit unmarketable in some crops. Mining damage can also cause secondary infections such as bunch rot in table grapes (Kirkland 2009). Whilst the damage is cosmetic and the interior fruit flesh remains unaffected, the presence of a single mine can render the fruit unmarketable in some commodities such as citrus (Grafton-Cardwell *et al.* 2008; Grafton-Cardwell *et al.* 2012). • In citrus, significant economic impacts have been recorded in the USA, with up to 80-90% losses on marketable fruit reported in some varieties (Jones 2001; Stelinski 2007). Susceptible citrus varieties can experience damage in the range of 5-80% with other varieties rarely incurring losses of more than 3% (Grafton-Cardwell *et al.* 2012). *Marmara gulosa* is rarely considered an economic problem with other hosts (Grafton-Cardwell *et al.* 2012). • In contrast to citrus, larval mining in crops such as cotton or grapes can cause little to no economic damage (Grafton-Cardwell *et al.* 2008). • There are currently only limited biological and cultural control measures available to manage *M. gulosa* populations. Chemical coverage can be incomplete due to: numerous generations of *M. gulosa* entering an orchard or vineyard in waves; fruit expanding rapidly leaving untreated surfaces for egg deposition; eggs being preferentially laid on low lying internal fruit; and the limited ability to penetrate inside the mines and kill larvae (Grafton-Cardwell *et al.* 2003; Grafton-Cardwell *et al.* 2012). Biological control has shown some success, particularly with the native eulophid wasp (*Cirrospilus coachellae*) in the Coachella Valley, but it is unable to survive the colder winters in northern regions such as the San Joaquin Valley (Stelinski 2007; Grafton-Cardwell *et al.* 2012) and efforts to establish it there have been unsuccessful (Grafton-Cardwell *et al.* 2008).
Other aspects of the environment	**A – Indiscernible at the district level** • There are no documented direct impacts of *M. gulosa* on any other aspect of the environment. Their introduction into a new environment may lead to competition for resources with native species, but there is no documented history of this occurring. • The potential for some impact on plant health suggests that there may be impacts on amenity plants and ecological communities, but as stated, this has not been documented.
Indirect	
Eradication, control etc.	**D – Significant at the district level** • Current pest management practices and biological control activities have had only limited success in controlling *M. gulosa* in the USA. Additional control programs may be required to minimise the impact of *M. gulosa* on host plants. • Existing domestic programs may provide some effectiveness for some hosts such as in cases where broad spectrum pesticide applications are utilised. However, this may not be the case for all hosts, particularly where specific integrated pest management programs are in place. In addition, potential biological control species may not be present in Western Australia. • Existing IPM programs may be disrupted because of the need to re-introduce or increase the use of certain pesticides. This may result in increased production costs which may be incurred by the producer.
Domestic trade	**D – Significant at the district level** • The presence of *M. gulosa* in commercial production areas may have a significant effect at the district level due to any resulting interstate trade restrictions on potentially a wide range of commodities. These restrictions may lead to either a loss of markets or require additional measures to facilitate ongoing trade.
International trade	**C – Significant at the local level** • The presence of *M. gulosa* in commercial production areas of a range of commodities that are hosts may limit access to overseas markets where *M. gulosa* is absent.
Environmental and non-commercial	**B – Minor at the local level** • While existing pest management practices may contain *M. gulosa*, additional pesticide applications and other control activities would be required to manage *M. gulosa* on susceptible crops. Any additional insecticide usage may affect the environment.

4.5.6 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *Marmara gulosa*	
Overall probability of entry, establishment and spread	Low
Consequences	Low
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for *Marmara gulosa* has been assessed as ‘very low’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.6 Phomopsis cane and leaf spot [Diaporthales: Diaporthaceae]

Phomopsis viticola [EP]

Phomopsis viticola is not present in the state of Western Australia and is a pest of quarantine concern for that state.

Phomopsis cane and leaf spot, or dead arm, is caused by the fungus *Phomopsis viticola* and is an important disease in several viticultural regions of the world (Nair *et al.* 1994), especially where rain following bud break keeps grapevines wet for several days (Hewitt and Pearson 1988). *Phomopsis viticola* is established in New South Wales, Queensland, South Australia, Tasmania and Victoria (Mostert *et al.* 2001; Plant Health Australia 2001) but is not known to be present in Western Australia.

Phomopsis viticola infects leaves, young shoots, rachises, petioles and fruit (Hewitt and Pearson 1988). Grapevines are susceptible throughout the growing season. After infection of juvenile fruit, symptoms do not appear until the fruit matures. On the fruit, the early symptoms are browning and shrivelling (Ellis and Erincik 2005). On rachises, the symptoms are chlorotic spots with dark centres (Hewitt and Pearson 1988). These spots enlarge to form dark brown streaks and blotches that turn black (Hewitt and Pearson 1988). Rachises may become brittle from numerous infections and break, resulting in loss of fruit (Hewitt and Pearson 1988). Pycnidia are subepidermal. Yellowish spore masses are exuded and then the berries shrivel and mummify (Gubler and Leavitt 1992). *Phomopsis viticola* conidia are splash dispersed and usually spread only short distances, i.e. within a vine or adjacent vines. Long distance spread is usually by movement of infected or contaminated propagation material (Hewitt and Pearson 1988).

There has been considerable confusion around the taxonomy of Phomopsis disease in grapevines, particularly as a number of species of *Phomopsis* have been isolated (Melanson *et al.* 2002). Previous taxonomic classifications have relied solely on host association, symptom expression, morphological features, mycelia growth and in vitro sporulation (Melanson *et al.* 2002; Van Niekerk *et al.* 2005; Schilder *et al.* 2005; Udayanga *et al.* 2011). A number of putative species of *Phomopsis* on grapevine have been characterised. Based on sequencing of the ITS1 and ITS2 regions of the nuclear ribosomal DNA internal transcribed spacers, the Australian *P. viticola* isolate clusters with *P. viticola* isolates from other regions of the world, including the USA (Mostert *et al.* 2001).

Phomopsis viticola was assessed in the existing policies for table grapes from the People's Republic of China (Biosecurity Australia 2011a), table grapes from the Republic of Korea (Biosecurity Australia 2011b), and table grapes from Chile (Biosecurity Australia 2005). The assessment presented here builds on these previous assessments.

Assessments for table grapes from the Republic of Korea (Biosecurity Australia 2011b) and the People's Republic of China (Biosecurity Australia 2011a) found the probability of importation to be high and the probability of distribution to be low for those countries. Assessment for table grapes from Chile (Biosecurity Australia 2005) found the probability of importation to be low and the probability of distribution to be very low. Because the risk ratings for *P. viticola* on table grapes from these three countries differ, DAFF considers that new assessments should be made for the probabilities of importation and distribution for *P. viticola* with table grapes from California. All three previous assessments contain information applicable to California and no one assessment can be said to be more relevant in this case.

The probability of establishment and spread of *P. viticola* in Australia and the consequences it may cause will be comparable for table grapes sourced from any area and imported into Australia, as these probabilities relate only to events that occur in Australia. The ratings given for establishment, spread and consequences in the reports for table grapes from Korea, China and Chile are also the same, unlike the ratings for importation and distribution. Accordingly, there is no need to reassess these components and the previous ratings will be adopted for this assessment.

This assessment is a contemporary review of the scientific literature that builds on the evidence given in previous assessments. It includes sources used in those previous assessments and any new evidence which has emerged about the biology of phomopsis leaf and cane spot. Consideration has also been given to data obtained from ten years of trade of Californian table grapes into other Australian states and territories.

The risk scenario of concern for *Phomopsis viticola* is the presence of the fungus on mature bunches of grapes.

4.6.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that *P. viticola* will arrive in Western Australia with the importation of table grapes from California is: **LOW**.

Supporting information for this assessment is provided below:

Association of the pathogen with the crop

- Phomopsis cane and leaf spot disease of grape is common in viticultural regions around the world including the USA (Mostert *et al.* 2001; Nita 2005; Nita *et al.* 2006). In California, the disease was first reported near Sacramento in 1935 and has since been consistently present in the Central Valley (Cucuzza and Sall 1982). It is most prevalent in the northern grape growing regions of the North Coast and the northern San Joaquin Valley where spring rains are common (Gubler *et al.* 2009).
- Despite the application of both calendar-based and predictive warning system spraying regimes, Phomopsis cane and leaf spot disease can be prevalent in many vineyards where

climatic conditions are suitable (Anco *et al.* 2012). However, predictive systems can result in significantly less disease incidence and severity (Nita *et al.* 2006) and Pscheidt and Pearson (1989b) noted that spray applications during bloom significantly reduced fruit rot and rachis lesions in New York.

- *Phomopsis viticola* can infect most parts of a grapevine including the shoots, leaves, rachises and fruits, with young immature tissues being most susceptible (Erincik *et al.* 2001; Nita *et al.* 2006). Phomopsis cane and leaf spot infection can cause breaking of the shoots, stunting, dieback, reduced vigour, reduced bunch set, and fruit rot (Van Niekerk *et al.* 2005). Leaf symptoms include small irregular or round pale green to yellow spots with dark centres (Nita 2005). On canes and rachises, brown to black necrotic irregular shaped lesions develop, causing girdling which weakens the plant and can cause premature fruit drop(Rawnsley *et al.* 2004; Nita 2005).
- Symptoms of cane and leaf infection are usually observed from the first through third internode or leaf (Erincik *et al.* 2001). Cane infections can result in some damage and are likely the primary source of inoculums (Erincik *et al.* 2001). Symptoms are rarely observed on parts of the plant that develop late in the season, suggesting that maybe these tissues do not tend to carry viable inoculum and/or the timing coincides with unfavourable weather conditions (Erincik *et al.* 2001). This highlights the importance of early season infections in the disease pathogenesis (Erincik *et al.* 2001). The significance of late-season infection of the rachis and berries under natural field conditions remains unknown (Erincik *et al.* 2001).
- Rawnsley and Wicks (2002) report that at least 10 hours of rain in combination with low temperatures are necessary for spore production and an additional 8-10 hours of moist conditions are required for infection.
- Erincik *et al.* (2003) observed that 7.4h of wetness was required for leaf infection at 18°C and noted similar results by previous authors.
- Temperature limits for infection range from 5 to 35°C and the optimum temperature for leaf and cane infection was reported between 16°C and 20°C(Erincik *et al.* 2003). Rawnsley and Wicks (2002) report that the optimum temperature for spore germination and fungal growth is 23°C. Variance in the reported optimum values may be accounted for by differences in cultivar and/or pathogen isolate(s) used (Erincik *et al.* 2003).
- In the field, the incidence and severity of disease caused by *P. viticola* is strongly influenced by weather conditions, inoculum density and host growth stage (Rawnsley and Wicks 2002; Erincik *et al.* 2003). Importantly, the occurrence of early-season infections in combination with prolonged rain periods and low temperatures early in the season favour disease development (Rawnsley and Wicks 2002; Erincik *et al.* 2003). It is suggested that the fungus is predominantly active at lower temperatures (Erincik *et al.* 2003), again highlighting the significance of early-season infections in the pathogenesis of the disease before summertime temperatures increase. Further, disease development tends to be more prominent in spring when higher inoculums levels are present and are in close proximity to susceptible young tissues (Nita *et al.* 2006).
- Some regions of California experience a hot and dry climate which may not be favourable for the development of Phomopsis cane and leaf spot disease, particularly fruit infection. Access for Californian table grapes into Australia is permitted only from the counties of Fresno, Kern, Kings, Madera, Riverside and Tulare (AQIS 2012), which are located in the southern half of the state.

- Gladstones (1992) notes that the county of Fresno, California experiences high temperatures and sunshine hours with little rainfall throughout the whole summer and the period following ripening. For Fresno, the total average rainfall from June to October is 22.3 mm and the average maximum temperature for the same period is 32.9°C (NCDC 2008). However, during early spring, Fresno has a milder climate where total rainfall during bud burst (March–April) is 80.8 mm on average and the average maximum temperature is 21.3°C (NCDC 2008). These early spring conditions indicate that in some years, vegetative tissue infection could be supported when temperature and duration of wetness are suitable for pycinidia formation and sporulation.
- The weather records for the counties with existing market access to Australia was reviewed for the period 2009-2012. This included temperature and precipitation data from a selection of weather stations. The counties of Madera, Kings, Kern, Fresno and Tulare experience similar average temperatures from May to December, although Riverside County, which is located in the very south of California, experiences a slightly higher average temperature for the same months (World Climate 2005). Average precipitation is similar for all counties from May to September, although Tulare County was slightly higher at 22.5 mm (World Climate 2005). However, from October through to December (late autumn to early winter), more precipitation is encountered across the export counties, ranging from 47.4 to 108.4 mm (World Climate 2005).
- There are indications from the literature that *P. viticola* is present in some of the exporting counties. From surveys of 166 vineyards across 21 counties in California, Úrbez-Torres *et al.* (2006) reported *P. viticola* as the most commonly isolated pathogen from cankers taken from trunks, cordons and spurs in Fresno and Tulare counties, with isolations also noted from Madera, Kern and Riverside counties. However, *P. viticola* is more prevalent on the north coast of California and the northern San Joaquin Valley and is economically important during wet years when spring rains are common (Gubler *et al.* 2009; Bay *et al.* 2010). Gubler and Leavitt note in Flaherty *et al.* (1992) that it has been recorded to infect canes and leaves in the most northerly export counties of California after heavy and prolonged rainfall in late March to April.
- A number of studies have reviewed the occurrence of Phomopsis cane and leaf spot disease in the eastern USA. Nita *et al.* (Nita *et al.* 2008) surveyed vineyards in Ohio over a three year period and reported a relatively high disease incidence which ranged from 4-86% and with a mean incidence of 48%. Critically, it is important to note that Ohio is located in the north eastern US and experiences cooler and wetter conditions than the relatively arid climate of Fresno, Madera, Kings, Kern, Tulare and Riverside counties. By way of example, Wooster (Ohio) has a continental climate and during bud burst (April-May), total rainfall is 177 mm on average, and the average maximum temperature is 17.6°C. From June to October total rainfall is 431 mm on average and the average maximum temperature is 23.7°C (World Climate 2005). Accordingly, the conditions in Ohio are likely to be far more conducive to Phomopsis cane and leaf spot disease. Whilst *P. viticola* has been found in the Californian export counties, environmental conditions are far less favourable for disease development, particularly on the fruit.

Association of the pathogen with the commodity pathway

- *Phomopsis viticola* can infect most parts of the vine including rachises and fruits, with young immature tissues being most susceptible (Erincik *et al.* 2001; Nita *et al.* 2006). Berry infection is favoured by 20-30 hour wetting periods and high humidity during bloom (Rawnsley and Wicks 2002; Nita *et al.* 2008).

- Mostert *et al.* (2000) showed that *P. viticola* mainly colonised the node and internode tissues of grapevine in South Africa. Of the 51 isolates obtained across nodes, internodes, leaf and leaf petiole, tendril and bunch peduncle, 48 were isolated from the nodes and internodes, two from the leaf petiole and one from the leaf (Mostert *et al.* 2000). The grape cluster was not included in this study as no berry rot had been observed in South Africa.
- Where berry infection occurs, infection of the pedicel or rachis in cool climates is most likely to cause yield loss (Rawnsley and Wicks 2002). From a lesion, the infection advances into the berry from the pedicel and pycnidia are produced in the epidermis of the fruit (Rawnsley and Wicks 2002).
- Pscheidt and Pearson (1989b) reviewed historical data for the western New York grape region from the years 1958 and 1986 to determine which years Phomopsis fruit rot occurred. Based on that review, fruit rot was only observed in 1972, 1984 and 1986. These periods of infection were linked to above average rainfall experienced during the two week period of bloom. In the year of 1972, Hurricane Agnes hit the state during bloom (Pscheidt and Pearson 1989b) and for the years 1984 and 1986, significant rainfalls (>130 mm) were recorded over a two week period around the time of bloom (Pscheidt and Pearson 1989b).
- Pscheidt and Pearson (1989a) investigated the effect of cultivation practices on the occurrence of Phomopsis cane and leaf spot disease in both experimental and commercial vineyards from various locations in New York. One of the sites, Fredonia, experiences a total rainfall of 159 mm on average during bloom (May-June) and an average maximum temperature of 22°C for the same period (World Climate 2005). In those trials, the authors reported the number of berries with symptoms of fruit rot at up to 4.7%. However, for one year in particular, 1986, disease development was high due to heavy rains from budbreak until bloom, totalling 238.5 mm (1989a). In addition, there was significant cane wetness (up to 37.7 hours) that coincided with low temperatures (10.9°C to 20.2°C).
- Anco *et al.* (2012) reported on the temporal sporulation potential of *P. viticola* on grape shoots, canes and rachises at a research vineyard in Wooster, Ohio. Climate data for Wooster, Ohio shows that during bloom (May-June), total rainfall is 193 mm on average and the average maximum temperature is 23°C (World Climate 2005). The authors found that the sporulation potential on rachises peaked around mid-May, but that sporulation was not apparent prior to spring or after bloom. This study shows that rachis material can carry viable inoculums however, it is important to note that: these vineyards experienced high levels of naturally occurring Phomopsis cane and leaf spot disease; the vines were inoculated with a wild-type *P. viticola* at 10^7 α-conidia on the shoots and inflorescences until runoff; overhead irrigation was utilised to supplement natural rainfall to ensure sufficient wetness periods; and, sampled tissues were incubated in chambers at 100% relative humidity to maintain free water on samples.
- The climatic averages for both New York and Ohio, where fruit rot has been shown, indicate that conditions in many years are theoretically likely to support rachis and berry infections. In practice, it appears that environmental conditions (temperature and wetness duration) are appropriate for the development of Phomopsis fruit rot only in very limited circumstances. This relatively low incidence of fruit rot in states with climates far more conducive to Phomopsis cane and leaf spot disease than in the exporting counties of

California, suggests more arid environments will support a significantly lower incidence of Phomopsis cane and leaf spot disease, and that fruit infection is unlikely to occur.

- In Australia, the first occurrence of bunch rot by *P. viticola* was reported during surveys of the Hastings Valley located in northern coastal New South Wales during the period of 2004-2006 (Savocchia *et al.* 2007). Hastings Valley has a coastal climate which is more suitable for the development of Phomopsis cane and leaf spot than the counties in the southern San Joaquin Valley.
- The weather in the counties in California approved to export to Australia is very dry during bloom and would limit vegetative tissue infection. In Fresno, the average total rainfall during bloom (April-May) is 39.2 mm and the average maximum temperature is 25.8°C (World Climate 2005). In considering the higher total rainfalls and average maximum temperatures in the eastern USA (e.g. New York and Ohio) where fruit infections are practically low to nil in years of average rainfall (Pscheidt and Pearson 1989b), the climate in the export counties of California is significantly drier and are typically not conducive to fruit rot. This is supported by the lack of reports of fruit infection from export counties (lower Central Valley and Coachella Valley) and the rest of California where fruit infection is considered to occur only occasionally (Flaherty *et al.* 1992), with the disease considered only to be economically important along the north coast and in the north of the San Joaquin Valley during wet years (Bay *et al.* 2010).
- When bunches do become infected in California during wet years, symptoms are localised with only isolated bunches affected on any one vine (Flaherty *et al.* 1992). This is consistent with reports from Rawnsley and Wicks (2002) which also notes that fruit symptoms tend not to be extensive and infected bunches are generally limited to a single vine (Rawnsley and Wicks 2002). Similarly, Nita (2005) investigated the spatial distribution of Phomopsis cane and leaf spot disease in Ohio vineyards and showed that where disease occurred, it tended to only spread within a single vine, with spread between vines rarely occurring. Accordingly, there is a limited potential for undetected or asymptomatic fruit rots to spread to other grape bunches.
- Rachis lesions develop after inoculation at 12.7 cm of shoot growth or at bloom and the rachis remains susceptible to infection from bud break until bloom (Erincik *et al.* 2001). The infection of late season developing tissues is less prevalent. Pscheidt and Pearson (1989b) showed that under laboratory conditions, inoculated berries were less susceptible to infection and colonisation as the berries mature from pea-size to the fully ripe stage.
- For the period 2007-2009, approximately 39,000 tonnes of fresh grapes were imported into Australia from California (USITC 2013). In 2010 alone, over 400,000 berries (or over 100,000 bunches) were inspected by DAFF inspectors during offshore preshipment inspections (OPIs) (USDA 2010b). There are no recorded detections of *P. viticola* on table grapes from California during OPIs for trade into eastern Australia since the commencement of trade in 2002. The lack of detection of fruit or bunch rots, or *P. viticola*, on table grapes from California supports the case that the climatic conditions in the exporting counties of California limits the incidence of *P. viticola* infection and Phomopsis cane and leaf spot disease.

Ability of the pest to survive harvesting, packing, transport and storage conditions

- Infection of the rachis generally develops within 3 to 4 weeks of inoculation and is considered to be an important phase of the disease (Erincik *et al.* 2001). Lesions that develop on the rachises can result in premature withering of the cluster stem and the infected clusters that survive until harvest will often produce poor quality fruit or fall from the vine before harvest (Erincik *et al.* 2001; Anco *et al.* 2011). The likely rapid and obvious symptom development on rachises would allow for affected bunches to be removed during quality assurance procedures and affected fruit culled before, during and after harvest.

- Berry infections can remain latent in green fruit until close to harvest (Erincik *et al.* 2001) and cluster symptoms generally show as the fruit begins to ripen (Schilder *et al.* 2005). Infected rachises become necrotic and affected berries become shrivelled with detectable pycnidia, rotting and fruit falling to the ground (Schilder *et al.* 2005; Nita *et al.* 2006).
- *Phomopsis viticola* overwinters as mycelia in the woody parts of infected canes, spurs, pruned shoots and dormant buds, or as immature pycnidia in the cortex of diseased vine canes, suggesting these are likely important sites for winter survival (Mostert *et al.* 2000; Rawnsley and Wicks 2002; Nita 2005; Nita *et al.* 2006). Although it is unknown how well *P. viticola* could overwinter on rachises or berries, it is likely that cold storage and transportation conditions would not significantly impact on the survival of *P. viticola* associated with infected rachis or cluster material.
- The long distance spread of *P. viticola* to new areas has largely been attributed to the movement of propagation material (budwood, cane cuttings and nursery stock) and contaminated vineyard equipment (Rawnsley and Wicks 2002; Clarke *et al.* 2004) rather than fresh fruit.
- There is one report of *P. viticola* on grapes from South Africa into Lithuania intercepted during visual inspection procedures for the period 2003-2004 (Raudoniene and Lugauskas 2005). However, no further details are provided in relation to the number of interception events.

Conclusion on probability of importation

The information presented indicates that *P. viticola* is predominantly associated with vegetative tissues in cool wet seasons in temperate climates. Mature tissues are more resistant to infection and bunch infection occurs at economic levels only when very wet periods (>130mm of precipitation) coincide with blooming. While *P. viticola* is known from California, it is typically only an economic issue to the north of the export counties currently permitted to export to Australia. The hot and arid climate of the Californian export counties lowers the incidence of Phomopsis cane and leaf spot disease and the likelihood of bunch rot infection is even lower. Where seasons with abnormally high wet periods occur and temperatures are suitable for the development of fruit rot, symptoms are typically observed prior to harvest, are localised and would generally be associated with a high incidence of disease on the vegetative tissues. Under these circumstances, infected bunches would not meet commercial requirements and would be culled during quality assurance operations. The poor climate for bunch rot infection is supported by the lack of detection of *P. viticola* bunch rots during 10 years of phytosanitary inspection during the trade of Californian table grapes into eastern Australia. Accordingly, the evidence supports a likelihood estimate for importation of ‘low’.

Probability of distribution

The likelihood that *P. viticola* will be distributed within Western Australia in a viable state as a result of the processing, sale or disposal of table grapes from California and subsequently transfer to a susceptible part of a host is: **VERY LOW**.

Supporting information for this assessment is provided below:

Distribution of the imported commodity in the PRA area

- Distribution of the commodity would be for retail sale as the intended use of the commodity is human consumption. Fungi present on the surface of fruit could potentially be distributed via wholesale and retail trade and waste material would also be generated.
- Table grape bunches with any obvious symptoms of infection would be unmarketable and would not be sold within Western Australia. Fruit without symptoms, or with only minor symptoms, could still be distributed for sale.
- Most of the bunch will be eaten but the rachises will remain and would be discarded as waste. Waste generated through retail and food service industry distribution pathways is likely to be disposed of in municipal tips and would therefore pose little risk of exposure to a suitable host.
- Consumer generated waste could result in small quantities of fruit waste being discarded in urban, rural and natural localities including domestic composts, along roadsides or in other environments. There is some potential for consumer waste being discarded near commercially grown, household or wild host plants.
- In the PRA area, the majority of the population lives in the Perth metropolitan area and the majority of imported grapes would be distributed there. Therefore, most of the waste generated would be managed through metropolitan disposal facilities.
- Some waste could enter the environment via composts. Composting will either bury the rachis, preventing any spore dispersal, or eventually cause discarded material to rot. Only discarded material that remains uncovered and does not degrade or dessicate is likely to produce spores.

Availability of hosts

- *Phomopsis viticola* has a restricted host range which includes *Vitis* spp. (*Vitis vinifera*, *Vitis rupestris*, *Vitis aestivalis*, *Vitis labrusca*, *Vitus rotundifolia*) and *Parthenocissus quinquefolia* (Virginia creeper)(Punithalingam 1964; Galet and Morton 1988). There is a report of *P. viticola* being isolated from *Vaccinium* spp. but not being pathogenic (Espinoza *et al.* 2008). The restricted host range limits the likelihood that imported bunches infected with *P. viticola* will be distributed to a location near a suitable host.
- *Vitis* spp. hosts (for both table and wine grapes) are grown commercially and domestically in Western Australia. Also, a number of *Vitis* spp. are recorded as weeds in Australia (Randall 2007) and could be potential wild hosts in Western Australia. Domestic garden plantings, both maintained and abandoned, occur in Perth and in most Western Australian towns and by many farmhouses.
- Approximately 300 Western Australian commercial table grape vineyards were reported from near the Western Australian coast in 2006, extending from the Gascoyne region (Carnarvon) to the South-West region (Harvey, Donnybrook, Margaret River and Busselton) (DAWA 2006b). With respect to wine grape production, the main vineyards span from Gingin just north of Perth, extending through the south-west and across to the Porungurup's near Mount Baker (DAFWA 2006).

Risks from by-products and waste

- The primary inoculum sources for *P. viticola* in vineyards are the canes and dormant buds (Erincik *et al.* 2001; Rawnsley and Wicks 2002; Nita 2005) and Mostert *et al*. (2000)

showed that *P. viticola* most often colonised the node and internode tissues. These plant parts, rather than rachises and berries, are important in the maintenance of viable populations which can then result in new infections (Erincik *et al.* 2001; Rawnsley and Wicks 2002; Nita 2005).

- Most species of *Phomopsis* are considered to be hemibiotrophic, subsisting on living tissues for parts of its life cycle and becoming nectrotrophic at least for the latent phase of infection (Udayanga *et al.* 2011). *Phomopsis* species can also grow saprophytically on synthetic media (Punithalingam 1964) although this is not representative of field conditions. The ability to grow nectrotrophically, and potentially saprophytically, would allow *P. viticola* to remain in a viable state on discarded table grape bunches.
- As presented in the probability of importation, Anco *et al.* (2012) demonstrated the potential for the rachis and fruit cluster, when attached to the plant, to maintain viable *P. viticola* over winter and produce conidium in spring (Anco *et al.* 2012). However, the vineyards included in the study: experienced high levels of naturally occurring Phomopsis cane and leaf spot disease; had shoots and inflorescences that were inoculated with wild-type *P. viticola* at 10^7 α-conidia until runoff; used overhead irrigation to ensure sufficient wetting periods; and, had the isolations incubated in chambers at 23°C for 14 days at 100% humidity to maintain free water on the samples. It is unclear to what degree any life stages of *P. viticola* living saprophytically on imported bunches could survive and sporulate at sufficient inoculum pressures to initiate new infections on susceptible host tissues under natural conditions. But, it is likely to be less than the experimental conditions adopted by Anco *et al.* (2012).
- Once a bunch is detached from the plant it starts to lose moisture. Waste material discarded into the environment would continue to desiccate and additional external moisture may be required for *P. viticola* to produce pycindia and then sporulate.
- Discarded bunches would be colonised by specialist saprophytic fungi and bacteria that would compete with *P. viticola* for suitable substrate.
- Table grapes from the USA are imported into Australia from June through to November (Australian winter to early summer). Any *P. viticola* present on imported table grapes would need suitable material to survive on until conditions were appropriate for re-sporulation and continuation of the disease cycle. Early season imported fruit infected with *P. viticola* could sporulate during winter when rainfall is suitable, although winter temperatures may limit the ability of the fungus to infect a new host. Alternatively, infected grape bunches would need to survive until spring when temperatures are warmer but rainfall is decreasing.
- Anco *et al.* (2012) reported that *P. viticola* sporulation occurred from bud break until shortly after the end of bloom, at which time its ability to sporulate ceased. Depending on the timing of importation, this window would limit the ability of *P. viticola* to survive until suitable climatic conditions allowed conidia production.

Ability of the pest to move from the pathway to a suitable host

- Natural spread is limited and occurs via the growth of mycelium from diseased to healthy parts of the vine (Rawnsley and Wicks 2002) and via rain splashed conidia. Since imported grape bunches are detached and subject to desiccation and saprophytic competition, the likelihood of mycelial growth infecting new host material is considered negligible. Conidia are considered the only plausible means of dispersal.

- *Phomopsis viticola* requires suitable periods of moisture and temperature to produce pycnidia and then conidia. Rawnsley and Wicks (2002) report that at least 10 hours of rain in combination with low temperatures are necessary for spore production.
- Nita (2005) conducted a spatial distribution analysis of Phomopsis cane and leaf spot disease in Ohio vineyards, and under favourable climatic conditions, showed aggregation at the vine level, with dissemination between vines within the same row or across rows occurring in only a few situations. The ability of disease to spread within a single vine, but not across multiple vines, indicates that *P. viticola* has a limited ability to spread naturally, even in close proximity to host material. In this study, the primary source of inoculum was on older canes well above ground level (Nita 2005). Older canes are located near the main trunk, with 2-3m spacing typically between vines and rows (Nita 2005). Given that natural spread occurs via rain splashed conidia, the spacing of 2-3m between vines and rows suggests that the fungus would have only a limited ability to spread from vine-to-vine.
- As the natural spread of *P. viticola* is almost limited to within a vine and rarely occurs between vines (Nita 2005), infected grape berries or rachises must be discarded in very close proximity to a susceptible host for the fungus to move from imported material to a new host.
- Anco *et al.* (2012) reported that *P. viticola* sporulation occurred from bud break until shortly after the end of bloom, after which time its ability to sporulate ceased. Depending on the timing of importation, this window would limit the ability of *P. viticola* to survive until suitable climatic conditions allowed conidia production.
- No studies have demonstrated that insect vectors are important in the epidemiology of the disease. The spread of water-borne spores by insects onto young vine foliage and bunches has been reported but no data was presented to support the claim (Emmett *et al.* 1992). The spatial distribution of Phomopsis cane and leaf spot disease in the study conducted by Nita (2005) would have included any effect of insects on the dispersal of conidia. The limited dispersal recorded in this study was from source inoculum that was located on cane tissue above ground height and would maximise rain splash dispersal. If infected table grape bunches imported from the USA were disposed into the PRA environment, most likely at ground level, they would need to be located in very close proximity to a susceptible host to allow any conidia produced the chance to transfer to a new host.

Ability of the pest to initiate infection of a suitable host

- *Phomopsis viticola* is considered to be monocyclic and infections primarily occur early in the growing season (Erincik *et al.* 2003; Anco *et al.* 2012).
- Rawnsley and Wicks (2002) report that at least 10 hours of rain, in combination with low temperatures, are necessary for spore production and then an additional 8-10 hours of moist conditions are required for infection.
- After conidia have been successfully produced and transferred to a new host, suitable infection sites need to be available.
- Table grapes from California are imported into Australia from June through to November. Precipitation in Western Australia could be favourable for Phomopsis distribution early in the import season but host plants are dormant at that time and susceptible young tissues

would not likely be available for infection and temperatures may be too low for new infections to occur. It is likely that infected grape bunches would need to survive until spring when climatic conditions are suitable and susceptible young grape tissues are available to be infected. At this time, suitable temperatures and extended periods of free moisture would be needed for conidia production and to allow spores to germinate and initiate an infection.

- It is unclear from the literature what minimum inoculum loads are required for infection. Under natural conditions, a critical mass of spores would be needed to ensure sufficient inoculum was available so that the probability of spores distributing to a susceptible host tissue was high enough for infection to occur. Cucuzza and Sall (1982) found that disease severity was a function of inoculum load (pycnidia/cm^2). However, in one year of their study, they observed more than a twofold increase in disease severity despite only half the inoculum load. Cucuzza and Sall (1982) cited rainfall patterns as a potential causal factor to account for the difference. A number of authors, cited throughout this pest risk assessment, report on the importance of temperature, humidity, total rainfall and sufficient wetting periods as critical factors for *Phomopsis* infection and disease development. Although it is theoretically possible that a single conidium present on imported table grapes could initiate an infection, in practice, many environmental factors affect the likelihood that *P. viticola* will infect, and cause disease on, new host tissues.
- Field experiments have shown that dispersal can occur from infected cane material detached from the vine (1989a). Infected canes ranging in weight from approximately 200–900 grams were bundled and suspended above vines prior to bud burst. Each bundle produced between 1721–3773 pycnidia under field conditions, and then post sporulation, new vine growth was sampled directly below the infected canes. In this experiment disease incidence on sampled new growth ranged from approximately 2 – 40% (Pscheidt and Pearson 1989a).
- The experiment by Pscheidt and Pearson (1989a) shows that even when large inoculum sources are produced in the field, directly above susceptible host tissue, the majority of sampled tissue was not infected (based on incubation for 60 hours at 22°C). The ability of *P. viticola* to disperse from an infected rachis, most likely below a host, to receptive host tissue would be considerably less. It is important to note that these field experiments were conducted in New York vineyards during significant bloom rains with sufficient cane wetness and suitable low temperatures. Therefore, should any viable conidia produced on infected table grape bunches be transferred to susceptible host material, it is likely that there is a relatively lower chance of initiating an infection under the Western Australian climate, which is warmer and drier than that of New York.
- As was presented in the probability of importation, *P. viticola* can infect most parts of the vine including the shoots, leaves, rachises and fruits, with young immature tissues being most susceptible (Erincik *et al.* 2001; Nita *et al.* 2006). However, the late season developing tissues are rarely symptomatic, indicating that climatic conditions are unfavourable during these latter developmental stages, or that these tissues do not tend to carry viable inoculums (Erincik *et al.* 2001). Similarly, Mostert *et al.* (Mostert *et al.* 2000) showed that *P. viticola* preferentially colonised the node and internode tissues. This would suggest that to initiate a new infection, *P. viticola* contaminated imported bunches would need to be transferred to vegetative host tissues early in the growing season.
- Once transferred to suitable host material, appropriate temperatures and moisture would be required to initiate infection in the canes and leaves. Erincik *et al.* (2003) reported that

7.4h of wetness was required for leaf infection at 18°C and that the optimum temperature for leaf and cane infection was between 16°C and 20°C.

- As presented in the introduction to this chapter, seeded table grape varieties imported into Australia could be used by consumers to intentionally grow grapes from seed. Where this is the case, new infections could potentially occur on seedlings through germination of seeds from an infected imported bunch. However, the majority of imported varieties do not have seeds, with seeded varieties accounting for a very small proportion of table grapes grown in California (CDFA 2012b). In addition, the ability of seed to germinate without effective stratification methods can be extremely difficult, but varies with variety. Natural germination can occur to varying degrees depending on the cultivar and length of time since berry ripening, although longer storage periods after ripening are positively correlated with germination rates (Scott and Ink 1950; Singh 1961).
- Ellis *et al*. (1983) reported on the use of a combination stratification treatment (H_2O_2 + GA_3 + pre-chill) in achieving greater germination rates. Potentially, the temperatures encountered during cold treatment, storage and transport could allow for susceptible seeds to become stratified. Conversely, other authors have reported on the difficulties in breaking seed dormancy and generating viable seedlings even when applying a range of available stratification methods. Using seeds collected in the field from 1967-71, Ottenwaelter *et al*. (1974) reported that of 1278 seeds subject to stratification at 2-4°C for 75 days only 17 germinated and of these, only 6 managed to establish seedlings.
- For new infections to initiate on seedlings germinated from imported seeded table grape bunches, a viable infection/conidia on the berry or rachis material would need to remain viable on a suitable substrate; the seed would need to break dormancy and germinate; the germinated seedling would need to survive to a suitable life stage that is susceptible to infection; the fungus would need to remain in close proximity to the emerging seedling and an assisted dispersal method would need to move the fungus onto susceptible host tissue; and climatic conditions (temperature and moisture) would need to be amenable for infection to occur. Given the low predominance of imported seeded table grape varieties, the potential difficulties with effectively growing grape from seed, the requirement for a Phomopsis life stage to remain viable and in close proximity to an emerging seedling and transfer to susceptible host tissue under suitable climatic conditions, this pathway for initiating new infections is likely to be of a very low or negligible risk. Moreover, depending on the time if import, any contaminant fungi may need to survive until the following season when conditions are suitable for growing seedlings.
- The south-western regions of Western Australia experience a temperate climate with warm dry summers, cooler winters and high rainfalls during the winter months and could provide suitable climatic conditions for infection by *P. viticola* and disease development. Aread north of Perth into the Gascoyne region and up to Carnarvon experience more desert and tropical climates with hot summers, warm winters and lower rainfall and would not likely be conducive to the development of Phomopsis cane and leaf spot disease.

Conclusion for the probability of distribution

The evidence presented suggests that the unassisted spread *P. viticola* is very limited and field observations show that transmission, even between vines, occurs in very few circumstances. Long distance spread has largely been attributed to facilitated distribution with propagative material and contaminated machinery. *Phomopsis viticola* has a narrow host range limited practically to *Vitis* spp. The majority of waste would be managed through municipal waste facilities and while some waste could be discarded directly into the environment (e.g. roadsides, composts etc.), infected imported bunches would need to be discarded in very close proximity to commercial or backyard vines, or potentially to wild *Vitis* spp. plants, prior to dessication of the rachis and/or fruit for any chance of distribution. *Phomopsis viticola* is monocyclic and after importation, significant bloom rainfalls, low spring temperatures and susceptible early season green tissues would be required for infection. Depending on the time of import, this may limit the opportunities for infection to occur in the same season. Otherwise, the fungus would need to remain viable until the following year on a suitable overwintering substrate. The evidence presented supports a risk rating of ‘very low’ for the probability of distribution.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that *P. viticola* will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **VERY LOW**.

4.6.2 Probability of establishment and spread

As indicated above, the probability of establishment and of spread for *P. viticola* is being based on the assessment for table grapes from the People’s Republic of China (Biosecurity Australia 2011a), table grapes from the Republic of Korea (Biosecurity Australia 2011b), and table grapes from Chile (Biosecurity Australia 2005). Those assessments used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessments are presented below:

Probability of establishment:	**HIGH**
Probability of spread:	**MODERATE**

4.6.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *P. viticola* will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.6.4 Consequences

The consequences of the establishment *P. viticola* in Western Australia have been estimated previously for table grapes from the People’s Republic of China (Biosecurity Australia 2011a), table grapes from the Republic of Korea (Biosecurity Australia 2011b), and table grapes from Chile (Biosecurity Australia 2005). Those assessments used the same methodology as described in Chapter 2 of this report. The ratings from those assessments can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from these analyses is provided below:

Plant life or health	**C**	Minor significance at the district level

Any other aspects of the environment	**A**	Indiscernible at the local level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**B**	Minor significance at the local level
International trade	**B**	Minor significance at the local level
Environment	**B**	Minor significance at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**D**', the overall consequences are estimated to be **LOW**.

4.6.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for *Phomopsis viticola*	
Overall probability of entry, establishment and spread	Very low
Consequences	Low
Unrestricted risk	Negligible

As indicated, the unrestricted risk estimate for *P. viticola* has been assessed as 'negligible', which achieves Australia's ALOP. Therefore, no specific risk management measures are required for this pest.

4.7 Grapevine fanleaf virus [Comoviridae: Nepovirus]

Grapevine fanleaf virus [EP]

Grapevine fanleaf virus (GFLV) has not been recorded in Western Australia (DAWA 2006a) and is a pest of quarantine concern for that state. It is one of the most significant and widespread viruses of grapevine (CIHEAM 2006). In Australia, it is present in New South Wales (Plant Health Australia 2001), South Australia (Stansbury *et al.* 2000; Habili *et al.* 2001) and Victoria (Habili *et al.* 2001).

GFLV is a member of the Nepovirus genus of the Comoviridae family (Varadi *et al.* 2007). It causes disease in most cultivars of *Vitis vinifera*, including some hybrids as well as in other *Vitis* spp. (Brunt *et al.* 1996a; Martelli *et al.* 2001b; Andret-Link *et al.* 2004; Varadi *et al.* 2007). The virus has also been isolated from bemuda grass, *Chenopodium quinoa* and other weedy species (Izadpanah *et al.* 2003).

The virus is transmitted and disseminated by several mechanisms. It is transmitted through soil between grapevines by the root-feeding ectoparasitic dagger nematodes *Xiphinema index* and *X. italiae* (Brunt *et al.* 1996a; Martelli *et al.* 2001b), and transmission by *X. vuittenezi* has also been suspected but not proven (CIHEAM 2006). *Xiphinema index* has not been detected in Western Australia (Plant Health Australia 2001; Walker 2004; Lantzke 2004; Walker and Stirling 2008), and there are also no detection records for *X. italiae* and *X. vuittenezi* in Western Australia. The virus is also transmitted by grafting and is likely commonly introduced into vineyards and disseminated through infected scion wood and rootstock (Murant 1981; Habili *et al.* 2001; Martelli *et al.* 2001b; Andret-Link *et al.* 2004; CABI 2011). It may be maintained in soil contaminated with viruliferous nematodes or roots (Murant 1981; Martelli *et al.* 2001b). The virus can be transmitted though seed (Mink 1993) and has been detected in endosperm of grape seed (Cory and Hewitt 1968). GFLV may occasionally be transmitted to seedlings of hosts (Martelli *et al.* 2001b); however, there are conflicting reports on seed transmission in grapevine (CIHEAM 2006). The virus can be transmitted through seeds of other hosts, including soybean (CIHEAM 2006).

Severe symptoms occur, although not exclusively, when GFLV co-infects with grapevine yellow speckle viroid 1 or 2 (GYSVd-1, GYSVd-2) (Szychowski *et al.* 1995; Little and Rezaian 2003). GYSV-1 and GYSVd-2 are present in grapes in California (Wolpert *et al.* 1996; Szychowski *et al.* 1998). Both of these viroids are also present in Australia (Koltunow *et al.* 1989) but are not reported from Western Australia (DAWA 2006a).

The risk scenario of concern is the importation of fruit infected with GFLV, germination of infected seed, seed transmission of the virus to those seedlings, and then transmission of GFLV from the seedlings to other grapevines in Western Australia.

GFLV was assessed in the existing import policy for table grapes from the People's Republic of China (Biosecurity Australia 2011a). The assessment of GFLV presented here builds on this previous assessment.

The probability of distribution, establishment and spread of GFLV in Western Australia, and the consequences it may cause, are comparable for table grapes imported from any country into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Furthermore, the table grape season in China and California overlap as they are both in the northern hemisphere and table grapes would be imported from both sources around the same time of year. Accordingly, there is no need to reassess these components, and the risk ratings for distribution, establishment, spread and consequences, as set out for GFLV in the import risk analysis report for table grapes from the People's Republic of China (Biosecurity Australia 2011a) will be adopted for this assessment.

4.7.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that grapevine fanleaf virus will arrive in Western Australia with the importation of table grapes from California is: **HIGH**.

Supporting information for this assessment is provided below:

- GFLV is present in California, where it is a major viticultural problem (University of California 2013c). Golino (1992) reported that in San Joaquin County, California, 25 of the 44 vineyards tested were positive for GFLV-infected vines. GFLV is also present in other viticultural regions of the USA including Washington State (Mekuria *et al.* 2008) and Missouri (Qiu *et al.* 2007).
- Most long distance spread occurs via infected propagation material (BC Ministry of Agriculture 2010). However, GFLV has been found in the endosperm of grape seed (Cory and Hewitt 1968; Mink 1993; Martelli *et al.* 2001b).
- There are over 60 varieties of fresh grapes grown in California, however out of the top fourteen varieties, only one variety, Red Globe, has seeded berries (California table grape Commission 2012d). Red Globe represents the third top variety by volume exported from

California (Anonymous 2011). Although the most popular varieties are seedless, some seeded table grapes would be imported into Western Australia. There is some risk that these could be infected with GFLV.

- The leaves of infected vines may become chlorotic, canes and leaves may grow abnormally, fewer grape bunches may develop, and bunches may be smaller and ripen irregularly (Stansbury *et al.* 2000; Martelli *et al.* 2001b). Some infected fruit and bunches showing symptoms may be culled during harvesting, grading and packing. However some cultivars and rootstocks can show tolerance to infection and display few symptoms (CIHEAM 2006). Some infected, asymptomatic fruit may therefore evade culling processes.

The distribution of the virus in multiple grape growing regions of California, the potential for asymptomatic fruit to carry the virus as well as the importation of at least some seeded grape varieties from California supports a likelihood estimate for importation of ‘high’.

Probability of distribution

The probability of distribution for grapevine fanleaf virus is being based on the assessment for table grapes from the People’s Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The rating from that previous assessment was **MODERATE**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that grapevine fanleaf virus will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **MODERATE**.

4.7.2 Probability of establishment and spread

The probability of establishment and of spread for grapevine fanleaf virus is being based on the assessment for table grapes from the People’s Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessment are:

Probability of establishment:	**LOW**
Probability of spread:	**VERY LOW**

4.7.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that grapevine fanleaf virus will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.7.4 Consequences

The consequences of the establishment grapevine fanleaf virus in Western Australia have been estimated previously for table grapes from the People's Repiblic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**E**	Significant at the regional level
Any other aspects of the environment	**A**	Indiscernible at the local level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**B**	Minor significance at the local level
International trade	**A**	Indiscernible at the local level
Environment	**A**	Indiscernible at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**E**', the overall consequences are estimated to be **MODERATE**.

4.7.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for grapevine fanleaf virus	
Overall probability of entry, establishment and spread	Very low
Consequences	Moderate
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for grapevine fanleaf virus has been assessed as 'very low', which achieves Australia's ALOP. Therefore, no specific risk management measures are required for this pest.

4.8 Strawberry latent ringspot virus [Secoviridae:Unassigned]

Strawberry latent ringspot virus

Strawberry latent ringspot virus (SLRSV) is not present in Western Australia and is a pest of quarantine concern for that state. There is one record of presence for South Australia (CABI-EPPO 1997a), but there are no further records and DAFF considers the pathogen to be absent from Australia.

Strawberry latent ringspot virus (SLRSV) was first described by Lister (1964) from strawberry in Scotland. It is a nematode transmitted virus (Murant 1983) and was thought to be a member of the genus *Nepovirus* like other nematode transmitted viruses. It is now placed in an unassigned genus (Secoviridae) (ICTVdB Management 2010) because sequencing showed that the RNA 2 encodes structural proteins that are not related to any member of the *Comoviridae* (Tzanetakis *et al.* 2006). It is present in California, but is not widespread (Martin *et al.* 2004).

SLRSV has a very wide host range. Experimentally, it was shown to infect 126 out of 167 species tested across 23 families (Murant 1983), but it is known to have hosts in at least 33 plant families (Brunt *et al.* 1996b). Natural transmission occurs via two nematode vectors, *Xiphinema diversicaudatum* (Murant 1983; Adekunle *et al.* 2006) and *X. coxi* (Murant 1983), but these do not occur in Australia (CABI 2011) and they transmit the virus between plants by infesting their roots (CABI 2011). Plant Health Australia (2001) lists three detections of *X. diversicaudatum* in Burnley, Victoria, however these records are from 1963 and *X. diversicaudatum* has since been eradicated from Australia (CABI 2011). SLRSV can be transmitted through grafting (Brunt *et al.* 1996b) and seed, in some species (Dunez 1988) (although not in grapevine (Brunt *et al.* 1996b)). Walkey (1969) demonstrated mechanical transmission experimentally using preparations of ground plant tissue from infected plants, but direct evidence of transmission via contaminated equipment such as pruning tools was not found.

Plant species in which it is known to be seed transmitted are: shepherd's purse, field mint, henbit deadnettle, raspberry, common groundsel, chickweed, quinoa, parsnip, parsley and celery (Brunt *et al.* 1996b).

Infection with SLRSV typically affects the leaves and flowers and can cause a variety of disease symptoms in different plants. In celery it is associated with strap-leaf and stunting (Walkey and Mitchell 1969). In cucumber it causes lesions, stunting and early death (Walkey and Mitchell 1969). In floriculture, the virus is associated with asymmetrical opening of flowers in lilies (Adekunle *et al.* 2006). Larger woody plants are also susceptible to disease as a result of SLRSV infection. It has been isolated from olive trees with narrowing and twisting of leaves, bunchy growth, deformed fruits and reduced yield (Faggioli *et al.* 2002). Grapevines exhibit severe leafroll symptoms, reduced growth and mild foliar malformations (Savino *et al.* 2010).

The risk scenario of concern for strawberry latent ringspot virus is the presence of the virus in the grape bunch, which includes the fruit pulp and seed, and the woody parts of the bunch which are the penduncle, rachis, laterals and pedicels.

4.8.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that strawberry latent ringspot virus will arrive in Western Australia with the importation of table grapes from California is: **MODERATE**.

Supporting information for this assessment is provided below:

- The virus is present in California (Martin *et al.* 2004), but Martin *et al.* (2004) only found the virus in 17% of the strawberry plants that they surveyed from California. Its prevalence in grapevines in California has not been documented.
- SLRSV infects grapevine (Credi *et al.* 1981; Savino *et al.* 2010). It is known to be present in plant sap (Walkey and Mitchell 1969) and could be present in the woody parts of the grape bunch. It is reported to affect the fruiting stages of its hosts (CABI 2011), but it is not known to be transmitted by seed in grapevine. So it is likely to be present in the fruit and woody parts of the bunch, but not the grape seed.

- Grapevines infected with SLRSV show disease symptoms. These can include chlorotic mottling, asymmetry and malformation of the leaves (Credi *et al.* 1981). The virus has also been isolated from grapevines showing symptoms of severe leafroll, reduced growth and mild foliar malformations (Savino *et al.* 2010).
- Although the virus is associated with obvious symptoms, the affect on grape bunches is not documented and symptomless infected grape bunches maybe harvested and exported.

The presence of SLRSV in plant sap and the woody parts of grape bunches, the probable presence of the virus in grape berries, combined with the lack of documented affect on grape berry quality and yield suggest that SLRSV would be imported with Californian table grapes. It is probably not widely distributed in California, but its prevalence in Californian vineyards is not reported. This supports a likelihood estimate for importation of 'moderate'.

Probability of distribution

The likelihood that strawberry latent ringspot virus will be distributed within Western Australia in a viable state as a result of the processing, sale or disposal of table grapes from California and subsequently transfer to a susceptible part of a host is: **VERY LOW**.

Supporting information for this assessment is provided below:

- Fresh grapes infected with SLRSV would be distributed for retail sale to multiple destinations within Western Australia, so a portion of the fruit and associated waste is likely to reach areas where there are suitable hosts and suitable conditions for the virus.
- SLRSV does not have a natural vector that would transmit the virus directly from a bunch of table grapes to a susceptible host. There are two known nematodes: *Xiphinema diversicaudatum* (Murant 1983; Adekunle *et al.* 2006) and *X. coxi* (Murant 1983), but they transmit the virus between plants by infesting their roots (CABI 2011) and would not distribute the virus from infected table grape bunches to susceptible host species.
- Seed transmission has been demonstrated in some hosts (Brunt *et al.* 1996b), but not in grapevine.
- SLRSV can be transferred to a suitable host by grafting (Brunt *et al.* 1996b), but grafting material is not taken from grape bunches. Transmission via contaminated tools, such as pruning tools, is not documented.

The distribution of infected table grape bunches and associated waste to areas where there are susceptible hosts is moderated by a lack of vectors, lack of ability for transmission via grafting from grape bunches, lack of evidence for transmission by contaminated equipment and no evidence of seed transmission in grapes. This supports a likelihood estimate for distribution of 'very low'.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that strawberry latent ringspot virus will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **VERY LOW**.

4.8.2 Probability of establishment

The likelihood that strawberry latent ringspot virus will establish within Western Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction is: **VERY LOW**.

Supporting information for this assessment is provided below:

- SLRSV has not been shown to be seed transmitted in grapevine and its natural vectors, two *Xiphinema* nematodes, are soil borne root pests that are not present in Australia. SLRSV can be transmitted via grafting (Brunt *et al.* 1996b), but this cannot occur from a table grape bunch and mechanical transmission has only been demonstrated through inoculation using laboratory preparations of infected plant material (Walkey and Mitchell 1969). There is no feasible way for SLRSV to establish in Western Australia from a Californian table grape bunch.
- SLRSV is found around the world including in Canada (Martin *et al.* 2004); Italy (Credi *et al.* 1981); India (Kulshrestha *et al.* 2004); Turkey (Yardimci and Çulal Kiliç 2010); Taiwan (Adekunle *et al.* 2006); Belgium, Finland, France, Germany, Ireland, Israel, Luxembourg, Netherlands, New Zealand, Poland, Romania, Spain, Switzerland, UK, USA, former Yugoslavia (Brunt *et al.* 1996b); and Jordan (Salem 2011). The current distribution suggests that there are suitable climates for the establishment of SLRV in Western Australia.

The presence of suitable hosts for SLRSV growing in Western Australia and probable suitability of the climate for establishment of SLRSV is moderated by the lack of a feasible means of establishment. This supports a likelihood estimate for establishment of ‘very low’.

4.8.3 Probability of spread

The likelihood that strawberry latent ringspot virus will spread within Western Australia, based on a comparison of factors in the source and destination areas that affect the expansion of the geographic distribution of the pest is: **MODERATE**.

Supporting information for this assessment is provided below:

- SLRSV can be vectored by two nematode species: *Xiphinema diversicaudatum* (Murant 1983; Adekunle *et al.* 2006) and *X. coxi* (Murant 1983). However, these are not present in Australia (CABI 2011) and they are soil-borne pests that transmit the virus from plant roots (CABI 2011).
- Mechanical transmission of SLRSV can occur through grafting (Brunt *et al.* 1996b); infected propagating material could disseminate the virus.
- SLRSV is known to be seed transmitted in shepherd’s purse, field mint, henbit deadnettle, raspberry, common groundsel, chickweed, quinoa, parsnip, parsley and celery (Brunt *et al.* 1996b). If SLRSV established in a host species in which seed transmission can occur, there could be long distance spread with natural or human assisted transport and use of seed. However, SLRSV is not seed transmitted in grapevine.
- In the USA, spread of SLRSV went undetected via the retail distribution of an ornamental mint (Elstein 2005).
- Because spread is likely to be limited to seed transmission or grafting, it would probably be localised. However, the USA experience of spread via the distribution of an

ornamental plant, suggests that if SLRSV was undetected in the production of retail nursery stock, it could be spread further.

- Infection of some weeds or cultivated plants in domestic gardens or farms may not be detected.

SLRSV can be spread through mechanical transmission and via seed in some species, but the only known vectors of SLRSV are absent from Australia and the virus is not seed transmitted in grapevine. However, experience in the USA has shown that spread of the virus can go unnoticed in retail nursery stock. This supports a likelihood estimate for spread of ‘moderate’.

4.8.4 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of ‘rules’ are shown in Table 2.2.

The likelihood that strawberry latent ringspot virus will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **EXTREMELY LOW**.

4.8.5 Consequences

The consequences of the establishment of strawberry latent ringspot virus in Western Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are ‘**E**’, the overall consequences are estimated to be **MODERATE.**

Reasoning for these ratings is provided below:

Criterion	Estimate and rationale
Direct	
Plant life or health	**E –Significant at the regional level:** • SLRSV, if present in plants in which seed transmission can occur, could spread naturally. This would be more likely if the virus infected weeds or other plants in the environment that are not under management, such as on road sides. However, the lack of vectors in Australia would still limit the virus’ spread between species. The hot and dry climatic conditions across parts of Western Australia would also limit the spread of the virus. • This virus can cause significant economic losses. For example, strap-leaf disorder in some cultivars of celery, caused by SLRSV, can result in up to 30 per cent of a crop becoming unmarketable (Walkey and Mitchell 1969). It is also known to cause lesions, stunting and early death in cucumber (Walkey and Mitchell 1969), asymmetrical opening of flowers in lilies (Adekunle *et al.* 2006), narrowing and twisting of leaves, bunchy growth, deformed fruits and reduced yield in olives (Faggioli *et al.* 2002) and severe leafroll symptoms, reduced growth and mild foliar malformations in grapevine (Savino *et al.* 2010).
Other aspects of the environment	**A – Indiscernible at the local level:** • There are no known other direct impacts of SLRSV on the environment.
Indirect	
Eradication, control etc.	**D – Significant at the district level:** • Control of SLRSV involves cultural methods as well as control of the nematode vector. There would be costs involved in cultural practices such as breeding virus free nursery stock, cleaning and sanitising tools and equipment when working in the field to prevent mechanical transmission, and removing plants from farms. The application of nematicides to control the vector (although the two known vectors are not currently present in Australia) would be costly and may have limited effect as even small numbers of vector nematodes are sufficient for efficient virus transmission (CABI 2011).

Domestic trade	**D – Significant at the district level:** • The presence of SLRSV in commercial production areas may have a significant effect at the district level due to any resulting interstate trade restrictions on potentially a wide range of commodities. These restrictions may lead to either a loss of markets or require additional measures to facilitate ongoing trade.
International trade	**D – Significant at the district level:** • International trade may be affected in commodities that are hosts of the virus especially for nursery stock and propagating material. These include: strawberry, rose, raspberry, blackberry, asparagus, grapevine (Brunt *et al.* 1996b), olive (Faggioli *et al.* 2002) and cucumber (Walkey and Mitchell 1969).
Environmental and non-commercial	**B – Minor at the local level:** • Control measures for SLRSV based on cultural practices would have no effect. • This virus has a very wide host range in at least 33 plant families (Brunt *et al.* 1996b), which suggests that there may be potential for infection of Australian native species. If the virus does infect native Australian plants it may cause disease symptoms like those documented in its current known hosts. Disease symptoms of the virus include lesions, stunting and early death (Walkey and Mitchell 1969); asymmetrical opening of flowers (Adekunle *et al.* 2006); narrowing and twisting of leaves, bunchy growth, deformed fruits and reduced yield (Faggioli *et al.* 2002); and severe leafroll, reduced growth and mild foliar malformations (Savino *et al.* 2010). • If the virus became widespread, then non-commercial plantings of its host plants in backyards and hobby farms could be affected.

4.8.6 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for strawberry latent ringspot virus	
Overall probability of entry, establishment and spread	Extremely low
Consequences	Moderate
Unrestricted risk	Negligible

As indicated, the unrestricted risk estimate for strawberry latent ringspot virus has been assessed as ‘negligible’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.9 Tomato ringspot virus [Comoviridae: Nepovirus]

Tomato ringspot virus EP

Tomato ringspot virus (ToRSV) has not been found in Western Australia and is a pest of quarantine concern for that state. It was reported more than two decades ago in *Pentas lanceloata* (Egyptian starflower) in South Australia (Chu *et al.* 1983), however the infected plants were removed and it has not been detected since that time in South Australia (Cartwright 2009), suggesting it has not spread and is probably now absent from Australia.

ToRSV is a member of the Nepovirus genus, Comoviridae family (Brunt *et al.* 1996c). It causes disease in grapevine as well as a range of other hosts (Bitterlin and Gonsalves 1988; Golino *et al.* 1992) including deciduous fruit such as peaches, blueberries, apples, elderberries, raspberries and cherries, and other plants such as dandelions, sheep sorrel, common chickweed, red clover and narrow-leaved plantain (Gonsalves 1988).

ToRSV is probably transmitted and disseminated by several mechanisms. It is transmitted through soil between host plants by root-feeding ectoparasitic dagger nematodes of the *Xiphinema americanum* group (Stace-Smith 1984; Brunt *et al.* 1996c). It is transmitted by grafting (Stace-Smith 1984; Brunt *et al.* 1996c) and may be introduced to orchards and vineyards in infected propagation material (Gonsalves 1988). It may be maintained in soil contaminated with viruliferous nematodes for long periods of time (Murant 1981; Gonsalves 1988; Pinkerton *et al.* 2008) as well as in contaminated weeds (Uyemoto 1975; Gonsalves 1988) and seeds (Gonsalves 1988). Uyemoto (1975) reported that ToRSV is seedborne in grapes, and can also be transmitted from seed to seedling.

The risk scenario of concern is the importation of fruit infected with ToRSV, germination of contaminated seed, survival of infected seedlings and the transmission of ToRSV to other host plants in Australia.

ToRSV was assessed in the existing import policy for table grapes from the People's Republic of China (Biosecurity Australia 2011a). The assessment of ToRSV presented here builds on this previous assessment.

The probability of distribution, establishment and spread of ToRSV in Western Australia, and the consequences it may cause, are comparable for table grapes imported from any country into Western Australia, as these probabilities relate specifically to events that occur in Western Australia and are independent of the importation pathway. Furthermore, the table grape season in China and California overlap as they are both in the northern hemisphere. Accordingly, there is no need to reassess these components, and the risk ratings for distribution, establishment, spread and consequences, as set out for ToRSV in the table grape from China risk analysis report (Biosecurity Australia 2011a) will be adopted for this assessment.

4.9.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that tomato ringspot virus will arrive in Western Australia with the importation of table grapes from California is: **MODERATE**.

Supporting information for this assessment is provided below:

- ToRSV has a wide distribution in North America and can infect both wild and cultivated plants (CABI 2011). Host plants in the USA include commercial crops such as grapevine (Golino *et al.* 1992), peach, raspberry, sweet cherry, prune, blueberry and apple, and weeds such as dandelion (*Taraxacum officinale*), sheep sorrel (*Rumex acetosella*) and common chickweed (*Stellaria* spp.) (Powell *et al.* 1984).
- ToRSV is indigenous to California (Adaskaveg *et al.* 2012). It is broadly distributed in the coastal areas and the Sacramento Valley, and it is also found in the San Joaquin Valley (Adaskaveg *et al.* 2012).
- Although the virus is widespread in some Californian fruit crops such as peach, apple and cherry, it has not often been reported in Californian vineyards (Golino *et al.* 1992). Golino *et al*. (1992) did not detect the grapevine yellow strain of ToRSV using ELISA on samples taken from 44 Californian vineyards, and concluded that the strain does not account for most of the nepovirus disease observed in San Joaquin County. However, the authors noted that several serologically distinct strains of ToRSV exist, and that there were a number of potential sources of error with the ELISA testing (Golino *et al.* 1992). However, the virus is known to occur in Californian vineyards (Gonsalves 1988; Bitterlin and Gonsalves 1988; Li *et al.* 2011).

- ToRSV symptoms include spots or chlorotic mottling of leaves, abnormal cane growth, small leaves, small grape bunches, uneven berry development, and lack of fruit production (Gilmer and Uyemoto 1972; Dias 1977). Symptom severity can vary between vines (CABI 2011) and disease symptoms can be limited during the first year of infection (Gonsalves 1988). Additionally, symptoms are also more pronounced in colder climates, with vine growth in California being much less affected by the virus than the colder Northeast (Gonsalves 1988). Differences in cultivars and strains of the virus may also affect the severity of disease symptoms (Gonsalves 1988). As such, although reports addressing the incidence of ToRSV in Californian vineyards are limited, the virus may be more widely distributed than is known due to asymptomatic infections. The virus might also spread in California without detection. It can spread to new areas when floods and cultural operations transport the infective dagger nematodes (*Xiphinema* spp.), or by wind-dispersed seeds of infected plants such as dandelion that germinate in areas where the dagger nematode is present (Adaskaveg *et al.* 2012). Dagger nematodes occur throughout California, although they are more prevalent in the northern part of the state (Adaskaveg *et al.* 2012).
- ToRSV has been shown to be transmitted through the seed of infected grapevine (Uyemoto 1975). There are over 60 varieties of fresh grapes grown in California, however out of the top fourteen varieties, only one variety, Red Globe, has seeded berries (California Table Grape Commission 2012). Red Globe represents the third top variety by volume shipped from California (Anonymous 2011), so it is possible that seeded table grapes with ToRSV-infected seeds may be imported into Western Australia.
- Fruit showing obvious symptoms of infection would likely be detected and culled during standard harvest and post-harvest quality assurance operations. However, infected asymptomatic grape bunches may go undetected during inspection procedures and could potentially be imported into Australia.

The presence of grapevine-infecting strains of ToRSV in California and the possible asymptomatic infection of grapevine and production of normal looking grapes carrying the virus, moderated by intermittent reports of infected vineyards in California and Red Globe being the only seeded variety grown in large volumes in California, support a likelihood estimate for importation of ‘moderate’.

Probability of distribution

The probability of distribution for tomato ringspot virus is being based on the assessment for table grapes from the People’s Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The rating from the previous assessment was **MODERATE**.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that tomato ringspot virus will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.9.2 Probability of establishment and spread

The probability of establishment and of spread for tomato ringspot virus is being based on the assessment for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessment are:

Probability of establishment:	**LOW**
Probability of spread:	**MODERATE**

4.9.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that tomato ringspot virus will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.9.4 Consequences

The consequences of the establishment of tomato ringspot virus in Australia have been estimated previously for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**E**	Significant at the regional level
Any other aspects of the environment	**A**	Indiscernible at the local level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**C**	Significant at the local level
International trade	**C**	Significant at the local level
Environment	**B**	Significant at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are **'E'**, the overall consequences are estimated to be **MODERATE**.

4.9.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for tomato ringspot virus	
Overall probability of entry, establishment and spread	Very low
Consequences	Moderate
Unrestricted risk	Very low

As indicated, the unrestricted risk estimate for tomato ringspot virus has been assessed as ‘very low’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.10 Grapevine yellow speckle viroid–1 and –2 [Pospiviroidae: Aspcaviroid]

Grapevine yellow speckle viroid–1 EP, grapevine yellow speckle viroid–2 EP

Grapevine yellow speckle viroid-1 (GYSVd-1) and grapevine yellow speckle viroid-2 (GYSVd-2) are not present in the state of Western Australia and are pests of quarantine concern for that state (DAWA 2006a). These viroids are present in other states and territories of Australia (Koltunow *et al.* 1989).

Both GYSVd-1 and GYSVd-2 belong to the Apscaviroid genus within the Pospiviroidae family (Little and Rezaian 2003). The biology and taxonomy of GYSVd-1 and GYSVd-2 is considered sufficiently similar to justify combining them into a single assessment. In this assessment, the term ‘grapevine yellow speckle viroid’ or ‘GYSVd’ is used to refer to these two viroids unless otherwise specified.

GYSVd causes yellow speckle disease in grapevine and grapevine is the only known host of GYSVd (Singh and Ready 2003; Singh *et al.* 2003b). GYSVd-1 and GYSVd-2 cause grapevine yellow speckle disease when present individually, although the two viroids often occur in combination (Krake *et al.* 1999b). The intensity of yellow speckle symptom expression can vary greatly, and may depend on the grapevine cultivar, the sequence variant of the viroid and environmental factors (Little and Rezaian 2003). Often no disease symptoms are present except in very hot weather (Singh and Ready 2003).

Although grapevines infected with GYSVd may show yellow speckle disease symptoms, there is no published evidence of a significant adverse effect due to infection (Krake *et al.* 1999b). One study did not detect any effect in grape yield, although grape juice from infested plants was lower in titratable acidity, slightly higher in pH, and had reduced vegetative growth as measured by pruning weight (Wolpert *et al.* 1996). It has also been suggested that severe cases of yellow speckle disease could possibly reduce growth and yield due to reduced levels of photosynthesis from infected leaves (Little and Rezaian 2003). Additionally, grapevines may produce vein-banding disease symptoms when concurrently infected with both GYSVd and grapevine fanleaf virus (GFLV) (Little and Rezaian 2003).

GYSVd is disseminated by vegetative propagation and transmitted by grafting (Krake *et al.* 1999b). Spread within vineyards has been reported and may involve mechanical transmission by contaminated tools (Krake *et al.* 1999b). Transmission of GYSVd-1 (Wan Chow Wah and Symons 1997; Wan Chow Wah and Symons 1999) and GYSVd-2 (Wan Chow Wah and Symons 1997) in grape seeds has also been shown.

The risk scenario of concern for GYSVd is the importation of grape bunches infected with one or both of the viroids, germination of infected seed, survival of infected seedlings and the transmission of one or both of the viroids to other grapevines.

GYSVd-1 and GYSVd-2, as well as grapevine yellow speckle viroid-3, were assessed in the existing import policy for table grapes from the People's Republic of China (Biosecurity Australia 2011a). The assessment of GYSVd presented here builds on this previous assessment.

The probability of distribution, establishment and spread of GYSVd in Western Australia and the consequences they may cause are comparable for table grapes imported from any country into Western Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. However, in this analysis, DAFF has revised the likelihood estimate for distribution from 'moderate' to 'low' based on closer examination of the biology of these viroids. This alteration to the probability of distribution would not change the unrestricted risk estimate (URE) for GYSVd in the report for table grapes from the People's Republic of China (Biosecurity Australia 2011a), which would remain 'negligible'. The reasons for this change are given in the *Probability of distribution* chapter below.

4.10.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that GYSVd-1 and/or GYSVd-2 will arrive in Western Australia with the importation of table grapes from California is: **HIGH**.

Supporting information for this assessment is provided below:

- GYSVd is present in California where it occurs in at least 12 grapevine cultivars (Singh *et al.* 2003a). Both GYSVd-1 and GYSVd-2 have been detected in California (Rezaian *et al.* 1992). They can occur individually in grapevines, although they are often found in combination (Krake *et al.* 1999b).
- The level of yellow speckle disease symptoms resulting from GYSVd infection can vary greatly, depending on factors such as the grapevine cultivar, the sequence variant of the viroid and environmental conditions (Little and Rezaian 2003). Leaves may develop small yellowish flecks scattered along the major and minor veins, which may result in a vein banding pattern (Little and Rezaian 2003). However disease symptoms are often absent except in very hot weather (Singh and Ready 2003). In California, GYSVd can be present as an asymptomatic infection in grapevines (Singh *et al.* 2003a; Szychowski *et al.* 2012). Furthermore, there is no published evidence of a significant adverse effect on grapevines due to infection with GYSVd and infected vines continue to give acceptable commercial yields (Krake *et al.* 1999b). No report of symptoms on fruit was found. Therefore, infected, symptomless grape bunches will go undetected during harvesting and inspection procedures, and could potentially be imported into Western Australia.
- Viroids are thought to be ubiquitous in grapevines from California (Singh *et al.* 2003a). Yet despite the presence of GYSVd and other viroids, grapevine certification programs in California do not test for viroids (Singh *et al.* 2003a). As such, GYSVd might be more widely distributed than is documented due to asymptomatic infections. This may be compounded by the fact that GYSVd is spread by vegetative propagation and grafting (Krake *et al.* 1999b).

- Fruit from infected vines that are asymptomatic may be harvested and exported. Normal grapes carrying grapevine yellow speckle viroid might be imported to Western Australia.

The presence of GYSVd in California and widespread presence of viroids in grapevines in California, the asymptomatic infection of grapevine and production of normal looking grapes in GYSVd infected plants as well as the importation of at least some seeded grape varieties from California support a likelihood estimate for importation of ‘high’.

Probability of distribution

The probability of distribution for GYSVd-1 and GYSVd-2 is being based on the assessment for table grapes from the People’s Republic of China (Biosecurity Australia 2011a). The rating from that assessment was ‘moderate’. However, with further consideration of the biology of these pathogens, DAFF has reassessed the likelihood rating for distribution to **LOW**. Supporting information is provided below:

- Additional information not presented in the existing import policy for table grapes from the People’s Republic of China (Biosecurity Australia 2011a):
    - There are no known natural vectors of GYSVd-1 and GYSVd-2, so they cannot be transmitted from an imported table grape bunch to a susceptible part of a host by natural means.
    - Distribution from an imported Californian table grape bunch would need to occur either via mechanical means (such as grafting or contaminated pruning tools) or seed transmission. Grafting material cannot be obtained from table grape bunches and it is not considered likely that pruning, or other, equipment would be used on a table grape bunch imported from California and then on a susceptible grapevine in either a commercial or domestic situation. Grapevine is the only known host of GYSVd-1 and GYSVd-2 (Singh and Ready 2003) further supporting the case that distribution via mechanical means would not be likely to occur.
    - GYSVd-1 (Wan Chow Wah and Symons 1997; Wan Chow Wah and Symons 1999) and GYSVd-2 (Wan Chow Wah and Symons 1997) can be seed transmitted in grape seeds. The likely risk scenario for distribution of GVYSd is via the germination of an infected seed and infection of the resultant seedling. However, the germination of a GYSVd-positive Californian grape seed, followed by transmission of the viroid from seed to seedling, and the survival and growth of the seedling would be required for distribution via this method to be successful. As discussed in the introduction to this chapter, the risk of a grapevine seed germinating and establishing from a Californian table grape is very low because:
        - Most of the table grapes grown in California are seedless. Of the four main varieties only Red Globe contains seeds and it accounts for less than 5% of the table grapes planted in California (CDFA 2012b).
        - Untreated table grape seeds have variable rates of germination, although stratification is easier in some varieties. Consumers could deliberately attempt to germinate seed, but grapevines grown from seed produce inferior fruit and are less vigorous compared to grafted plants, which are readily available.

- Some table grape waste may go to household compost, but the risk of a seed germinating is low.

The likelihood estimate for distribution of GYSVd given in the existing import policy for table grapes from the People's Republic of China (Biosecurity Australia 2011a) was 'moderate'. That rating has been reduced because there are no known natural vectors of GYSVd and the viroids can only be transmitted mechanically or via seed transmission. Distribution is only likely to occur through seed transmission, which would not occur easily and only some table grapes grown in California have seeds, which further reduces the risk of distribution. Therefore, the likelihood estimate for distribution is 'low'.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that GYSVd-1 and/or GYSVd-2 will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.10.2 Probability of establishment and spread

The probability of establishment and of spread for GYSVd-1 and GYSVd-2 is being based on the assessment for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from the previous assessment are:

Probability of establishment:	**LOW**
Probability of spread:	**LOW**

4.10.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that GYSVd-1 and GYSVd-2 will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.10.4 Consequences

The consequences of the establishment of GYSVd-1 and GYSVd-2 in Australia have been estimated previously for table grapes from the People's Republic of China (Biosecurity Australia 2011a). That assessment used the same methodology as described in Chapter 2 of this report. The ratings from that assessment can be used in this review for Western Australia because the geographic level in the consequence impact scores did not exceed *Regional*. The estimate of impact scores from that analysis is provided below:

Plant life or health	**C**	Significant at the local level
Any other aspects of the environment	**A**	Indiscernible at the local level
Eradication, control, etc.	**D**	Significant at the district level
Domestic trade	**A**	Indiscernible at the local level

International trade	**B**	Minor significance at the local level
Environment	**A**	Indiscernible at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are **'D'**, the overall consequences are estimated to be **LOW**.

4.10.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for GYSVd-1 and GYSVd-2	
Overall probability of entry, establishment and spread	Very low
Consequences	Low
Unrestricted risk	Negligible

As indicated, the unrestricted risk estimate for GYSVd-1 and GYSVd-2 has been assessed as 'negligible', which achieves Australia's ALOP. Therefore, no specific risk management measures are required for this pest.

4.11 Hop Stunt Viroid [Pospiviroidae: Hostuviroid]

Hop Stunt Viroid

Hop stunt viroid is not present in Western Australia (DAWA 2006a) and is a pest of quarantine concern for that state. In Australia it is known to be present in South Australia and Victoria (Koltunow *et al.* 1988).

The disease hop stunt was first observed in hops (*Humulus lupulus*) cultivated in Japan in the 1950s (Little and Rezaian 2003). However, hop is not native to Japan and when the disease first emerged, its origin was not known. Sasaki and Shikata (1977) found the causal agent to be HSVd. Several years later, the complete nucleotide sequence of HSVd was established (Ohno *et al.* 1983).

Hop cultivation only started in Japan in the 19th Century with breeding programs, to create unique varieties, starting in 1910 using plants imported mainly from Germany and the USA (Hadidi *et al.* 2003a). HSVd was likely imported with the hops planting material or had moved from another host present in Japan into hops. The first incidence of hop stunt disease emerged somewhere around the Nagano and Fukushima prefectures. Both areas are popular fruit production centres and it is not uncommon to have hop gardens adjoining vineyards (Sano 2003a). The HSVd isolates found in hops in Japan form a single clade with the isolates recovered from grapevines (Sano 2003a) and the emerging consensus was that the viroid was transmitted from grapevines into hops. The molecular work of Sano *et al.* (1986); testing viroid isolates from grapevines imported into Japan, suggested that grapevines were indeed the source of hop stunt disease in Japan. Sano *et al.* (2001) theoretically confirmed this claim. However, it was not until Kawaguchi-Ito *et al.* (2009) published their work, that the transmission of HSVd from grapevine to hop was confirmed. They showed that 15 years of persistent infection in hops resulted in the evolution of HSVd-grapevine variants into HSVd-hop variants identical to those responsible for the hop stunt epidemic in Japan.

Although originally thought to be isolated to hops in Japan, HSVd was imported to Korea with hops rhizomes from Japan (Lee *et al.* 1988). But, it has also now been isolated from hops in China (Guo *et al.* 2008) and is known to be widespread in hop production areas of Washington state, suggesting that it has been present there for some time (Eastwell and Nelson 2007). The origin of HSVd infected hop plants in China and the USA has not been investigated. Given that HSVd is thought to occur in grapevines worldwide (Little and Rezaian 2003), the viroid could have transferred from grapevine to hops in China and the USA via mechanical means like it did in Japan, however this has not been studied.

Despite the name, HSVd is actually associated most commonly with fruit trees, especially stone fruit (or drupes), where it tends to remain symptomless (Pallas *et al.* 1998; Osman *et al.* 2012). Some sequence variants of HSVd cause plant diseases in certain hosts, which affects agronomic quality. In hops it causes hop stunt disease (Little and Rezaian 2003). In citrus it has been associated with the diseases cachexia (Alavi *et al.* 2006), yellow corky vein (Bagherian and Izadpanah 2009) and split bark disorder (Bagherian and Izadpanah 2009). In plums and peaches it is associated with dapple fruit disease (Sano *et al.* 1989) although the symptoms vary with the species and cultivar (Sano 2003a; Pallás *et al.* 2003a). Its other hosts are thought to carry the viroid latently; including almond, apricot, grapevine (Astruc *et al.* 1996; Little and Rezaian 2003; Pallás *et al.* 2003a), jujube (Zhang *et al.* 2009), cherry (Osman *et al.* 2012) and pomegranate (Astruc *et al.* 1996).

HSVd is a single stranded covalently closed RNA molecule of 295-303 nucleotides which, like other members of the family *Pospiviroidae*, contains a Central Conserved Region (CCR) and a Terminal Conserved Hairpin (TCH) located in the left terminal domain, which are presently used for taxonomical classification of viroids (European Food Safety Authority 2008). There are around 120 HSVd sequence entries in biological databases (Matoušek *et al.* 2003).

The main method of transmission of HSVd between plants is via human assisted mechanical means. In the initial stages of an epidemic, the presence of the viroid may not be recognised because the development of symptoms resulting from HSVd infection are normally delayed (Sano 2003a; Pallás *et al.* 2003a). The distribution of infected cuttings plays an important role in spreading the viroid at this stage. This is what occurred in the initial stages of the epidemic in hops in Japan. Once the viroid is established, mechanical transmission from infected plants to adjacent plants on contaminated farming tools and equipment becomes important in the spread of the viroid within a farm (Sano 2003a).

Spread of HSVd by natural means seems to be limited. Yaguchi and Takahashi (1984) demonstrated that, in hops, HSVd is not pollen or seed transmitted, which confirmed earlier findings that it is also not seed transmitted in tomato (Sano *et al.* 1981). It is only in grapevine that seed transmission has been demonstrated (Wan Chow Wah and Symons 1999). No natural vectors are known to be involved in the transmission and dispersal of HSVd (European Food Safety Authority 2008).

The risk scenario of concern for hop stunt viroid is the presence of the viroid in grape bunches, which includes the fruit and seed, and the woody parts of the bunch which are the penduncle, rachis, laterals and pedicels.

4.11.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that hop stunt viroid will arrive in Western Australia with the importation of table grapes from California is: **HIGH**.

Supporting information for this assessment is provided below:

- Hop stunt viroid is known to infect plants systemically as the viroid has been isolated from the leaves of various plants, hops cones (1984) and fruit (Astruc *et al.* 1996). HSVd is also seed transmitted in grapes (Kawaguchi-Ito *et al.* 2009). It would likely be present in grape bunches harvested from infected plants in the berries, seeds and woody parts of the bunch.
- No disease symptoms have been observed in grapevines as a result of HSVd infection (Little and Rezaian 2003). The viroid is not reported to affect crop quality or yield and accordingly, no specific control practices are undertaken for HSVd in the field. Therefore, any grapes infected by HSVd that meet export standards and phytosanitary conditions will be harvested, packed and exported.
- HSVd is present in California (Osman *et al.* 2012), but its prevalence in Californian vineyards is not documented. However, the viroid is considered to be widespread in areas where it occurs. Work on hops by Eastwell and Nelson (2007) in Washington state suggests that the viroid has probably been present there for some time because it was so widespread in the hop gardens that they surveyed. Likewise, Osman *et al.* (2012) found that it was one of the most prevalent viruses or viroids when they surveyed *Prunus* species trees at the national clonal germplasm repository in California.
- HSVd remains stable in infected plant materials kept indoors or under refrigeration. The viroid was found to survive in hop plant leaves and cones for at least 6 months when kept refrigerated at 4°C or indoors (Yaguchi and Takahashi 1984). The viroid would survive transportation to Australia as it takes less than 2 months for Californian table grapes to reach retail outlets in Australia after they have been harvested and a cold chain is maintained during their storage and transportation.

The presence of HSVd in all parts of the grape bunch; the ability of the viroid to be seed transmitted in grapes; the lack of disease symptoms in grapevine, control measures in vineyards or surveys for its presence; it's likely widespread distribution on the west coast of the USA and its ability to survive transport to Western Australian retail outlets support a likelihood estimate for importation of 'high'.

Probability of distribution

The likelihood that hop stunt viroid will be distributed within Western Australia in a viable state as a result of the processing, sale or disposal of table grapes from California and subsequently transfer to a susceptible part of a host is: **LOW**.

Supporting information for this assessment is provided below:

- As there are no known natural vectors of HSVd (European Food Safety Authority 2008) it is unlikely that it would be transferred from infected Californian table grape bunches imported into Western Australia to a suitable host through natural means. Similarly, the discarded stem material that forms part of the grape bunch is unlikely to pose a risk for the transfer of the viroid to a suitable host as there are no known vectors. Furthermore, discarded stem material would be colonised and degraded by saprophytic microorganisms.

- As HSVd can be seed transmitted (Wan Chow Wah and Symons 1999), there is some risk of fresh grapes with HSVd-infected seed being distributed for retail sale to multiple destinations within the PRA area. However, the germination of a HSVd-positive Californian grape seed, followed by transmission of the viroid from seed to seedling, and the survival and growth of the seedling would be required for distribution via this method to be successful. As discussed in the introduction to this chapter, the risk of a grapevine seed germinating and establishing from a Californian table grape is very low because:
    - Most of the table grapes grown in California are seedless. Of the four main varieties only Red Globe contains seeds and it accounts for less than 5% of the table grapes planted in California (CDFA 2012b).
    - Untreated table grape seeds have variable rates of germination, although stratification is easier in some varieties. Consumers could deliberately attempt to germinate seed, but grapevines grown from seed produce inferior fruit and are less vigorous compared to grafted plants, which are readily available.
    - Some table grape waste may go to household compost, but the risk of a seed germinating is low.
- During distribution to retail outlets table grape bunches would be kept refrigerated. The viroid was found to survive in hop plant leaves and cones for at least 6 months when kept refrigerated at 4°C or indoors (Yaguchi and Takahashi 1984). The viroid would remain stable during the distribution of table grapes for retail sale if cold storage conditions were maintained.
- HSVd can be transferred to a suitable host by graft-propagation of infected budwood and mechanically by cutting and pruning tools (European Food Safety Authority 2008). Budwood cannot be obtained from grape bunches. It is also very unlikely that cutting and pruning tools would be used on retail table grape bunches and then used on suitable host plants in either a domestic or commercial situation.

The possible long term viability of HSVd in cold-stored table grapes (as indicated by the survival of the viroid in hop plant leaves and cones) and the possibility for the viroid to be seed transmitted in grapes are moderated by obstacles to seed germination, including the fact that only some table grapes grown in California contain seeds, negligible risk of mechanical transmission and lack of vectors. This supports a likelihood estimate for distribution of ‘low’.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that hop stunt viroid will enter Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.11.2 Probability of establishment

The likelihood that hop stunt viroid will establish within Western Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction is: **LOW**.

Supporting information for this assessment is provided below:

- There are two means by which HSVd could establish in Western Australia based on how the viroid could be distributed: (1) via mechanical transmission of the viroid from an infected Californian table grape bunch to a new host; or (2) via the germination of an infected grape seed from California. The assessment of the probability of entry (above) determined that the likely risk scenario for importation and distribution of HSVd would be via the germination of infected grape seed, establishment of the seedling and transmission of the viroid to the seedling. The probability of establishment is also, therefore, linked to the likelihood that an infected table grape seed from California will germinate, that the viroid will be transmitted to the seedling, and that the resultant HSVd-infected plant will grow and establish in Western Australia. The likelihood for the establishment of a grapevine is supported by the following information:

  - There are climatic regions in Western Australia that are suitable for grapevines. Western Australian commercial table grape vineyards extend from the Gascoyne region (Carnarvon) to the South-West (Harvey, Donnybrook, Margaret River and Busselton) (DAWA 2006b). The main wine grape growing regions span from Gingin just north of Perth, extending through the south-west and across to the Porungurup's near Mount Baker (DAFWA 2006). As such, HSVd-infected table grape seeds from California may encounter suitable climatic conditions for germination and establishment.
  - As discussed in the assessment of the probability of entry (above), the likelihood of grape seed from an imported Californian table grape bunch germinating and a grapevine establishing is very low.

- HSVd has been associated with the following host species: grapevine (Little and Rezaian 2003), hops (Sano 2003a), apricots (Pallas *et al*. 2003), peach (Sano *et al.* 1989; Hassan *et al.* 2003), plum (Sano *et al.* 1989; Yang *et al.* 2006), almond (Pallás *et al.* 2003), sweet cherry (Gazel *et al.* 2008), sour cherry (Gazel *et al.* 2008), jujube (Zhang *et al.* 2009), *Citrus* spp., pomegranate (Astruc *et al.* 1996) and common fig (Yakoubi *et al.* 2007). This wide host range demonstrates that there would be suitable hosts available in Western Australia for establishment of HSVd. However, the likely scenario for entry limits the viroid to a grapevine grown from infected seed. The presence of other hosts is only significant when considering mechanical transmission, which is not likely.
- HSVd has a wide geographic distribution. It is currently known to occur across Europe and the Mediterranean (Pallas *et al.* 1998; Hassan *et al.* 2003; Matic *et al.* 2005; Amari K. *et al.* 2007; Mandic *et al.* 2008; Bennett *et al.* 2009; EPPO 2009b), the Middle East and north Africa (Pallas *et al.* 1998; Choueiri *et al.* 2002; Ghanem-Sabanadzovic and Choueiri 2003; Hassen *et al.* 2004; Gazel *et al.* 2008; Mandic *et al.* 2008), North America (Michelutti *et al.* 2004; Bennett *et al.* 2009) and Asia (Lee *et al.* 1988; Guo *et al.* 2008; Zhang *et al.* 2009; Bennett *et al.* 2009; Kawaguchi-Ito *et al.* 2009). It is also found in Australia in Victoria and South Australia (Koltunow *et al.* 1988). This suggests that climatic conditions in parts of Western Australia would be suitable for the establishment of HSVd.

The likely means of distribution would be via infected Californian table grape seed, which would require conditions favourable for germination of the seed, transmission of the viroid from seed to seedling, and suitable conditions for the growth and establishment of the vine. It is therefore unlikely that the viroid will establish in other hosts in the initial stages of any incursion. This supports a likelihood estimate for establishment of 'low'.

4.11.3 Probability of spread

The likelihood that hop stunt viroid will spread within Western Australia, based on a comparison of factors in the source and destination areas that affect the expansion of the geographic distribution of the pest is: **LOW**.

Supporting information for this assessment is provided below:

- As there is no known natural vector of HSVd (European Food Safety Authority 2008). The only method of natural spread for this viroid would be seed transmission, which has only been demonstrated in grapevines (Wan Chow Wah and Symons 1999). As discussed above, the likely scenario for establishment of HSVd is via seed transmission to a seedling grown from an infected Californian grape seed. It is unlikely that such a seedling will grow into a vine that produces fruit with viable seed that would be disseminated and go on to germinate and grow in other locations and, as such, further spread the viroid.
- Transmission by pollen has not been demonstrated in any host species; and it has been shown that transmission by pollen does not occur in hops (Yaguchi and Takahashi 1984).
- HSVd probably spread to Japan in grapevine propagating material from Europe and the USA (Hadidi *et al.* 2003a). If undetected, the viroid could be spread in Western Australia via grapevine propagating material. However, it is very unlikely that the viroid would establish in propagating material source vines because the risk of establishment is in vines grown from infected Californian table grape seed.
- During the initial stages of an epidemic, before it is recognised that the viroid has established, the main mode of spread of HSVd across a region is via the distribution of infected cuttings and grafting material (Sano 2003a). It is unlikely that cuttings and grafting material would be sourced from seedlings deliberately or unintentionally grown from HSVd-infected seed.
- Once HSVd has established in a farm, the main method of transmission is then via contaminated cutting and pruning tools (Hadidi *et al.* 2003a), but this mainly occurs within a farm (Sano 2003a) and not between farms. If HSVd did establish on a farm its spread is likely to be limited to that farm. This scenario would also apply if the viroid established in a backyard grapevine.

The risk of HSVd being seed transmitted in grapevines is moderated by the lack of natural vectors for this viroid and its inability to be transmitted via pollen. The likelihood that HSVd will be spread from an infected pioneer grapevine germinated from an infected California grape seed is extremely low (via mechanical means), but this is combined with the high likelihood that once established within a farm HSVd is likely to be spread within that farm via contaminated cutting and pruning equipment. The viroid is also only known to be seed transmitted in grapevine, but not all grape berries contain seeds. These factors support a likelihood estimate for spread of ‘low’.

4.11.4 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of ‘rules’ are shown in Table 2.2.

The likelihood that hop stunt viroid will enter Western Australia as a result of trade in table grapes from California be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.11.5 Consequences

The consequences of the establishment of hop stunt viroid in Western Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**D**', the overall consequences are estimated to be **LOW**.

Reasoning for these ratings is provided below:

Criterion	Estimate and rationale
Direct	
Plant life or health	**C – Significant at the local level:** • HSVd is a latent infection in grapevines (Little and Rezaian 2003), apricot, almond (Pallás *et al.* 2003a), jujube (Zhang *et al.* 2009), cherry (Osman *et al.* 2012) and pomegranate (Astruc *et al.* 1996). Only some of its hosts show symptoms of disease that affect agronomic quality. These include: hop stunt disease in hops (Little and Rezaian 2003); cachexia (Alavi *et al.* 2006), yellow corky vein (Bagherian and Izadpanah 2009) and split bark disorder (Bagherian and Izadpanah 2009) in citrus; and dapple fruit disease in peaches and plums (Sano *et al.* 1989). • An epidemic is likely to be localised - no natural vectors are known to be involved in the transmission and dispersal of HSVd (European Food Safety Authority 2008) and seed transmission has only been demonstrated in grapevine (Kawaguchi-Ito *et al.* 2009). Initially, any infection in the PRA area would be localised. Mechanical transmission is the main mode of spread; which generally restricts spread of the viroid to a relatively small area of farm land (Sano 2003a). • Mechanical transmission is needed for the viroid to move from one host to another, as occurred between grapevine and hops in Japan. If the viroid established and the infection was not detected, then mechanical transmission could spread the viroid to other susceptible hosts.
Other aspects of the environment	**A – Indiscernible at the regional level:** • In parts of Australia where HSVd is known to exist (it infects grapevines in Victoria and South Australia (Koltunow *et al.* 1988)) no other environmental consequences have been reported.
Indirect	
Eradication, control etc.	**D – Significant at the district level:** • The control of HSVd is through cultural practices and the registration and supply of viroid free nursery stock. However, this is only for species in which HSVd infection results in disease symptoms, which are hops, citrus, plum and peach. The presence of HSVd in grapevine in Australian eastern states has not resulted in the need for eradication or control measures in any species. If it was to jump to a susceptible host species, than eradication and control measures could be necessary. • In the event of an incursion, eradication and control measures may be implemented to protect Western Australia's fruit production industry. • When an epidemic occurs in species that are susceptible to disease, such as in hops in Japan, then drastic measures may be taken to control the viroid. In Japan, diseased hops were surveyed, removed and replanted with healthy plants. Once infected stock is found, several nearby plants, including the infected individuals are replanted (Sano 2003a).
Domestic trade	**A – Indiscernible at the district level:** • HSVd is already known to be present in Australian eastern states. Its establishment in Western Australia would have no negative impact on domestic trade.
International trade	**C – Minor significance at the district level:** • HSVd can infect a variety of commercially grown species. International trade in any of those species from Western Australia to areas where HSVd doesn't occur could be affected. However, HSVd already occurs in Victoria and South Australia, but it is limited to grapevine. The presence of HSVd in grapevine in eastern states has not affected international trade from the eastern states. The broader host range of HSVd compared to grapevine yellow speckle viroid, which is limited to grapevine, has resulted in a higher consequence rating for international trade.
Environmental and non-commercial	**A – Indiscernible at the district level:** • Eradication and control of HSVd is through cultural practices and there would be no increase in the use of pesticides on farms as a result of HSVd infection. • HSVd is not likely to infect native species. Its known host range is limited to grapevines, hops, pomegranate and drupes (including almond, apricot, peach, plum and jujube). • Backyard and other non-commercial hosts are unlikely to become infected as HSVd would be unlikely to spread beyond commercial crops as its major mode of transmission is mechanical.

4.11.6 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for hop stunt viroid	
Overall probability of entry, establishment and spread	Very low
Consequences	Low
Unrestricted risk	Negligible

As indicated, the unrestricted risk estimate for hop stunt viroid has been assessed as ‘very low’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.12 Citrus exocortis viroid [Pospiviroidae: Pospiviroid]

Citrus exocortis viroid

Citrus exocortis viroid (CEVd) is not known to occur in Western Australia (DAWA 2006a) and is a pest of quarantine concern for that state. In Australia, CEVd is only known to be present in New South Wales, Queensland and South Australia (Barkley and Büchen-Osmond 1988) and has been detected in grapevine in South Australia (Wan Chow Wah and Symons 1997). The viroid is present in California (Duran-Vila *et al.* 1988; Adaskaveg 2008) and has been detected in grapevine from that state (Little and Rezaian 2003).

Citrus exocortis viroid (CEVd) belongs to the *Pospiviroid* genus, *Pospiviroidae* family (Duran-Vila and Semancik 2003). CEVd is the causal agent of exocortis disease in citrus. The disease is characterised by bark scaling, yellow blotching of twigs and severe stunting of susceptible citrus varieties (Duran-Vila and Semancik 2003). CEVd is symptomless in most citrus varieties, however disease symptoms occur on susceptible rootstocks including *Poncirus trifoliata*, Rangpur lime, Swingle citrumelo and citrange (Hardy *et al.* 2008). CEVd can also infect tomato (Verhoeven *et al.* 2004) and carrot (Fagoaga and Duran-Vila 1996); and has been detected in symptomless grapevine (Little and Rezaian 2003), broad bean (Fagoaga *et al.* 1995), eggplant, turnip (Fagoaga and Duran-Vila 1996), and *Impatiens* and *Verbena* varieties (Singh *et al.* 2009).

Citrus exocortis viroid consists of 371 to 375 nucleotides (Singh *et al.* 2009) with a number of sequence variants reported (Duran-Vila and Semancik 2003). The viroid associates with host membranes and nuclei (Semancik 1980). In tomato, it has been detected in both vascular tissues and the nuclei of mesophyll cells, with the highest viroid concentrations reported to be in the leaves (Bonfiglioli *et al.* 1996). In citrus, CEVd is found in the plant sap and is spread via mechanical means through budding, grafting, pruning and hedging (Hardy *et al.* 2008). Transmission of CEVd to citrus seeds has not been demonstrated (Duran-Vila and Semancik 2003; Hardy *et al.* 2008). However, in grapevine, CEVd transmission from seed to seedling has been observed using reverse transcription PCR (Wan Chow Wah and Symons 1997). CEVd has also been detected in seeds and seedlings of *Impatiens* and *Verbena* plants (Singh *et al.* 2009), and in tomato seedlings (Mink 1993). There are no known insect vectors of CEVd (Hardy *et al.* 2008).

In Australia, exocortis disease in citrus has largely been controlled by the use of viroid-free citrus budwood (Hardy *et al.* 2008). Exocortis of citrus in California has also been controlled by regulations on budwood sources to ensure new plantings are CEVd-free (Adaskaveg 2008).

The risk scenario of concern is the importation of grape bunches infected with CEVd, germination of infected seed disseminated in fruit waste, seed-transmission of the viroid, survival of infected seedlings, and the transmission of CEVd to other host plants in Australia.

Citrus exocortis viroid was included in the final import risk analysis for fresh Unshu mandarin fruit from Shizuoka Prefecture in Japan (Biosecurity Australia 2009a). In that assessment, the potential for establishment and/or spread in the pest risk assessment area was assessed as 'not feasible' as the viroid is not reported to be vectored or seed transmitted in citrus. As a result, no pest risk assessment was required. The assessment of CEVd presented here differs in that there are reports for seed transmission of CEVd in grapevine (Wan Chow Wah and Symons 1997). Accordingly, the potential for establishment and/or spread in Western Australia is deemed to be 'feasible' and a pest risk assessment is required for table grapes from California into Western Australia.

4.12.1 Probability of entry

The probability of entry is considered in two parts, the probability of importation and the probability of distribution, which consider pre-border and post-border issues, respectively.

Probability of importation

The likelihood that citrus exocortis viroid will arrive in Western Australia with the importation of table grapes from California is: **HIGH**.

Supporting information for this assessment is provided below:

- CEVd is present in California in both citrus (Duran-Vila *et al.* 1988; Adaskaveg 2008) and grapevine (Little and Rezaian 2003). Wan Chow Wah and Symons (1997) detected CEVd in ten grapevine cultivars, five red and five white, using RT-PCR. They also detected the viroid in an *in vitro* germinated Emperor red table grape seedling. The seedling had been included as a putative negative control, however it was determined to be positive for CEVd. This was first report of CEVd transmission via seeds in grapevine. The result was confirmed on a second Emperor seedling (Wan Chow Wah and Symons 1997).
- CEVd is spread to new areas by budding, grafting, pruning and hedging activities (Hardy *et al.* 2008). It is also spread by propagation of infected budwood and exchange of infected plant materials (Duran-Vila and Semancik 2003).
- As CEVd infects grapevines asymptomatically (Little and Rezaian 2003), the viroid may be more widely distributed in Californian vineyards than is documented. CEVd may also spread in California without detection.
- Infected, symptomless grape bunches would go undetected during harvesting and inspection procedures.
- In grape bunches harvested from CEVd-infected plants, both the stem material and grape berries may carry the viroid. CEVd is present in the vascular tissue of tomatoes (Bonfiglioli *et al.* 1996), the sap of citrus plants (Hardy *et al.* 2008) and in grape seeds (Wan Chow Wah and Symons 1997). It is therefore feasible that the viroid may be present in the vascular tissue and seed associated with grape bunches imported from California to Australia.

- Out of the top fourteen varieties of fresh grapes grown in California, only one variety, the Red Globe, has seeded berries (California table grape Commission 2012d). However, Red Globe represents a significant proportion of production, estimated as the third top variety by volume in 2010 (Anonymous 2011). It is therefore likely that some seeded grape berries would be exported from California to Australia. It is possible that these berries may contain CEVd-infected seed.
- No records of the rate of seed transmission for CEVd in grapevine were found, however reports of rates of seed transmission in other host species were. After a two-year storage period of *Impatiens walleriana* and *Verbena* x *hybrid* seeds at 4^{o}C, CEVd was detected in both the non-germinated seeds and, once germinated, in the seedlings (Singh *et al.* 2009). The transmission rates in *Impatiens walleriana* seeds and seedlings were 6% and 26%, respectively, and the transmission rates in *Verbena* x *hybrid* seeds and seedlings were 5% and 45%, respectively (Singh *et al.* 2009). The long-term survival of CEVd in *Impatiens* and *Verbena* seeds at 4^{o}C (Singh *et al.* 2009) and the transmission of CEVd via grape seed, as demonstrated in two Emperor table grape seedlings (Wan Chow Wah and Symons 1997), indicates that the viroid may also be present and remain viable in Californian grape seeds during the period from harvest to arrival in Australia, including a period of cold storage. The majority of grapes imported to Australia from California arrive by sea freight, however transport may also be by air freight. The total time in transport, from orchard until arrival in Australia, is therefore expected to be from a few days to several weeks.

The presence of CEVd in California, the asymptomatic infection of grapevine and production of normal looking grapes carrying CEVd-infected seeds, the ability of the viroid to be seed transmitted to seedlings, its stability for long periods and during cold storage, moderated by the low volumes of seeded grapes that would be imported to Western Australia from California support a likelihood estimate for importation of ‘high’.

Probability of distribution

The likelihood that citrus exocortis viroid will be distributed within Western Australia in a viable state as a result of the processing, sale or disposal of table grapes from California and subsequently transfer to a susceptible part of a host is: **LOW**.

Supporting information for this assessment is provided below:

- As there are no known insect vectors of CEVd (Hardy *et al.* 2008), it is unlikely that CEVd would be transferred from infected Californian table grape bunches imported into Western Australia to a suitable host through natural means. Similarly, the discarded stem material that forms part of the grape bunch is unlikely to pose a risk for the transfer of the viroid to a suitable host as there are no known insect vectors. Furthermore, discarded stem material would be colonised and degraded by saprophytic microorganisms.
- As CEVd can be seed transmitted in grapevine (Wan Chow Wah and Symons 1997), there is some risk of fresh grapes with CEVd-infected seed being distributed for retail sale to multiple destinations within the PRA area. However, the germination of a CEVd-positive California grape seed, followed by transmission of the viroid from seed to seedling, and the survival and growth of the seedling would be required for distribution via this method to be successful. As discussed in the introduction to this chapter, the risk of a grapevine seed germinating and establishing from a Californian table grape is very low because:

- Most of the table grapes grown in California are seedless. Of the four main varieties only Red Globe contains seeds and it accounts for less than 5% of the table grapes planted in California (CDFA 2012b).
- Untreated table grape seeds have variable rates of germination, although stratification is easier in some varieties. Consumers could deliberately attempt to germinate seed, but grapevines grown from seed produce inferior fruit and are less vigorous compared to grafted plants, which are readily available.
- Some table grape waste may go to household compost, but the risk of a seed germinating is low.
- Furthermore, viroids are not always transmitted from infected seeds to seedlings. Singh *et al*. (2009) studied transmission rates of CEVd in seed of *Impatiens walleriana* and *Verbena* x hybrida and found the transmission rate from infected seeds to seedlings was 66% and 28% respectively, and these rates were further reduced after seed was stored for two years.

- Table grape bunches would be kept refrigerated during distribution to retail outlets. As CEVd was detected in *Impatiens walleriana* and *Verbena* x *hybrid* seeds after a two-year storage period at 4^{o}C (Singh *et al.* 2009), it is probable that the viroid would also remain viable during the distribution of table grapes for retail sale.
- CEVd can be mechanically transferred to a susceptible host via pruning activities (Hardy *et al.* 2008). It is unlikely that pruning tools would be used on Californian table grape bunches and then used on suitable host plants in either a domestic or commercial situation.

The possible long term viability of CEVd in cold-stored seeded table grapes (as indicated by the survival of CEVd in *Impatiens* and *Verbena* seeds) and the possibility for the viroid to be seed transmitted in table grapes are moderated by obstacles to seed germination, including the fact that only some of the table grapes grown in California contain seeds, negligible risk of mechanical transmission and lack of insect vectors. This supports a likelihood estimate for distribution of ‘low’.

Overall probability of entry (importation × distribution)

The overall probability of entry is determined by combining the probabilities of importation and of distribution using the matrix of rules shown in Table 2.2.

The likelihood that citrus exocortis viroid will enter Western Australia as a result of trade in table grapes from California and be distributed in a viable state to a susceptible host is: **LOW**.

4.12.2 Probability of establishment

The likelihood that citrus exocortis viroid will establish within Western Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction is: **LOW**.

Supporting information for this assessment is provided below:

- There are two means by which CEVd could establish in Western Australia based on how the viroid could be distributed: (1) via mechanical transmission of the viroid from an infected Californian grape bunch to a new host; or (2) via the germination of an infected grape seed from California. The assessment of the probability of entry (above) determined that the likely risk scenario for importation and distribution of CEVd would be via the germination of infected grape seed, establishment of the seedling and transmission of the viroid to the seedling. The probability of establishment is also, therefore, linked to the likelihood that an infected grape seed from California will germinate, that the viroid will be transmitted to the seedling, and that the resultant CEVd-infected plant will grow and establish in Western Australia. The likelihood for the establishment of a grapevine is supported by the following information:

  - There are climatic regions in Western Australia that are suitable for grapevines. Western Australian commercial table grape vineyards extend from the Gascoyne region (Carnarvon) to the South-West (Harvey, Donnybrook, Margaret River and Busselton) (DAWA 2006b). The main wine grape growing regions span from Gingin just north of Perth, extending through the south-west and across to the Porungurup's near Mount Baker (DAFWA 2006). As such, CEVd-infected grape seeds from California may encounter suitable climatic conditions for germination and establishment.
  - As discussed in the assessment of the probability of entry (above), the likelihood of grape seed from an imported California grape bunch germinating and a grapevine establishing is very low.

- CEVd has been detected in grapevine (Little and Rezaian 2003); citrus (Duran-Vila and Semancik 2003); annual crops such as tomato (Verhoeven *et al.* 2004), carrot (Fagoaga and Duran-Vila 1996), broad bean (Fagoaga *et al.* 1995), eggplant and turnip (Fagoaga and Duran-Vila 1996); and ornamentals such as *Impatiens* and *Verbena* varieties (Singh *et al.* 2009). A range of these hosts are grown in Western Australia, including grapevine (Gladstones 1992), citrus (DAFWA 2007), tomatoes (Graham 2005), carrots (McKay and Pasqual 2006) and broad bean (Burt 2005). This wide host range demonstrates that there would be suitable hosts available in Western Australia for establishment of CEVd. However, the risk scenario for entry limits the viroid to a grapevine grown from infected Californian table grape seed. The presence of other hosts is only significant when considering mechanical transmission, which is not likely.
- CEVd has a worldwide distribution (CABI 2011) and is found in Australia in New South Wales, Queensland and South Australia (Barkley and Büchen-Osmond 1988). This suggests that climatic conditions in parts of Western Australia would be suitable for the establishment of CEVd.

The likely means of distribution would be via infected Californian table grape seed, which would require conditions favourable for germination of the seed, transmission of the viroid from seed to seedling, and suitable conditions for the growth and establishment of the vine. It is therefore unlikely that the viroid will establish in other hosts in the initial stages of any incursion. This supports a likelihood estimate for establishment of 'low'.

4.12.3 Probability of spread

The likelihood that citrus exocortis viroid will spread within Western Australia, based on a comparison of factors in the source and destination areas considered pertinent to the expansion of the geographic distribution of the pest is: **MODERATE**.

Supporting information for this assessment is provided below:

- It has been suggested that CEVd may have originally been associated with cultivated grapevine in the Middle East, and only spread to citrus once citrus plants were introduced to that region (Bar-Joseph 2003). This indicates that CEVd may spread from grapevine to other host plants via, for example, contaminated pruning tools.

- As there are no known insect vectors of CEVd (Hardy *et al.* 2008), natural spread of this viroid occurs through natural grafting of plant roots (Hardy *et al.* 2008) and via seed transmission in some species, including grapevine. It is unlikely that a rogue grapevine would grow in close proximity to a susceptible plant in an orchard or vineyard so that CEVd is able to spread to new plants via root grafting. Regarding seed transmission, as discussed above, the likely scenario for establishment of CEVd is via seed transmission to a seedling grown from an infected Californian grape seed. It is unlikely that such a seedling will grow into a vine that produces fruit with viable seed that would be disseminated and go on to germinate and grow in other locations and, as such, further spread the viroid.
- CEVd is primarily spread via contaminated pruning and hedging tools, as well as through budding and grafting activities (Hardy *et al.* 2008). In Australia, citrus budwood testing for graft transmissible pathogens helps control the spread of CEVd (Hardy *et al.* 2008). Prior to these activities, CEVd was a major disease of Australian citrus trees (Hardy *et al.* 2008). The need for a budwood testing program, as well as the presence of CEVd in New South Wales, Queensland and South Australia (Barkley and Büchen-Osmond 1988), indicates that the viroid has the ability to spread in Australia. However, it is unlikely that budwood would be sourced from seedlings grown from CEVd-infected seed. It is also unlikely that pruning and hedging tools would be used on such plants and subsequently used on other susceptible hosts.
- The most likely means of spread would be through seed transmission from infected plants (likely limited to grapevine), or via mechanical transmission. Therefore, any CEVd outbreak is likely to be localised. However once present in a vineyard, or commercial crop of another host, spread could occur within that farm via contaminated cutting and pruning equipment.

The risk of CEVd being seed transmitted in multiple host species in Western Australia is moderated by the lack of natural vectors for this viroid. The likelihood that CEVd will be spread from an infected pioneer grapevine germinated from an infected California grape seed is extremely low (via mechanical means), but this is combined with the higher likelihood that once established within a farm CEVd is likely to be spread within that farm via contaminated cutting and pruning equipment. The viroid is also known to be seed transmitted in multiple hosts which results in a higher likelihood estimate for spread than grapevine yellow speckle viroid and hop stunt viroid eventhough the risk of establishment in hosts other than grapevine would be extremely low. These factors support a likelihood estimate for spread of ‘moderate’.

4.12.4 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of ‘rules’ are shown in Table 2.2.

The likelihood that citrus exocortis viroid will enter Western Australia as a result of trade in table grapes from California, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **VERY LOW**.

4.12.5 Consequences

The consequences of the establishment of citrus exocortis viroid in Western Australia have been estimated according to the methods described in Table 2.3.

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**D**', the overall consequences are estimated to be **LOW.**

Reasoning for these ratings is provided below:

Criterion	Estimate and rationale
Direct	
Plant life or health	**B – Minor significance at the local level:** • CEVd has been detected in symptomless grapevine (Little and Rezaian 2003), broad bean (Fagoaga *et al.* 1995), eggplant, turnip (Fagoaga and Duran-Vila 1996), *Impatiens* and *Verbena* (Singh *et al.* 2009). Symptomless plants may serve as reservoirs for the disease (Hammond and Owens 2006). • CEVd causes exocortis disease in susceptible citrus varieties. The disease is characterised by bark scaling, yellow blotching of twigs and severe stunting (Duran-Vila and Semancik 2003). Susceptible rootstocks include *Poncirus trifoliata*, Rangpur lime, Swingle citrumelo and citrange varieties (Hardy *et al.* 2008). Trees grown on *P. trifoliata* rootstock are the most severely affected, with significant symptoms developing when trees are about 4-years-old (Hardy *et al.* 2008). There can be reductions in yield due to stunting of the tree, but fruit quality is not affected (Hardy *et al.* 2008). • In citrus, the economic impact of CEVd depends on the susceptibility of the specific scion/rootstock combinations used (Duran-Vila and Semancik 2003). Where susceptible varieties are used, strategies to provide growers with viroid-free planting material are necessary (Duran-Vila and Semancik 2003). The only means of controlling viroid diseases is via prevention measures such as through the provision of viroid-free budwood sources, and treating hedging and harvesting tools with sodium hypochlorite (Duran-Vila and Semancik 2003). In Australia, growers can already obtain citrus budwood and rootstock seed that has a high health status through a citrus industry organisation (Hardy *et al.* 2008). • Tomato plants and *Gynura aurantiaca* inoculated with CEVd have also been shown to produce disease symptoms including stunting, epinasty and leaf rugosity 3-to-4 weeks post inoculation (Duran-Vila *et al.* 1988). CEVd has also been reported to cause bunchytop or leaf chlorosis in tomato (Singh *et al.* 2009). Carrots inoculated with CEVd produced smaller leaves after three months, but still flowered and produced viable seed (Fagoaga and Duran-Vila 1996). • Any CEVd outbreak is likely to be localised as, if transmission does occur, the most likely means would be through seed transmission from infected grapevines, or via contaminated mechanical transmission.
Other aspects of the environment	**A – Indiscernible at the regional level:** • There are no known other direct impacts of CEVd on the environment.
Indirect	
Eradication, control etc.	**D – Significant at the district level:** • In the event of an incursion in Western Australia, control measures are likely to be implemented to minimise exocortis disease spreading from grapevine to susceptible citrus scion/rootstock combinations. Where susceptible citrus varieties are used, strategies to provide growers with viroid-free planting material are necessary (Duran-Vila and Semancik 2003). • In Australia, citrus growers can already obtain budwood and rootstock seed that has a high health status through a national industry organisation (Hardy *et al.* 2008). Citrus exocortis disease symptoms are now rarely observed in Australia due to the use of pathogen-free budwood (Hardy *et al.* 2008).
Domestic trade	**A – Indiscernible at the district level:** • CEVd is already known to be present in New South Wales, Queensland and South Australia (Barkley and Büchen-Osmond 1988).As there are no domestic restrictions based on CEVd, its establishment in Western Australia would have no negative impact on domestic trade.
International trade	**C – Minor significance at the district level:** • CEVd can infect a variety of commercially grown species including citrus and grapevine (Singh *et al.* 2009). International trade in those species from Western Australia to areas where CEVd doesn't occur could be affected. However, CEVd already occurs in New South Wales, Queensland and South Australia. The presence of CEVd in citrus in those states has not affected international trade. The broader host range of CEVd compared to grapevine yellow speckle viroid, which is limited to grapevine, has resulted in a higher consequence rating for international trade.

Environmental and non-commercial	**A – Indiscernible at the district level:** • There would be no increase in the use of pesticides that may have environmental consequences as a result of CEVd infection, as CEVd is controlled via prevention measures such as the use of viroid-free budwood and cultural practices such as treating hedging and harvesting equipment with sodium hypochlorite (Duran-Vila and Semancik 2003). • CEVd is unlikely to infect native plant species. It is present in other Australian states and does not infect native plants in these states. • Backyard and other non-commercial hosts are unlikely to become infected as a result of a CEVd outbreak in a commercial crop as CEVd would be unlikely to spread beyond commercial crops as its major mode of transmission is through the exchange of propagation material and mechanical transmission.

4.12.6 Unrestricted risk estimate

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

Unrestricted risk estimate for citrus exocortis viroid	
Overall probability of entry, establishment and spread	Very low
Consequences	Low
Unrestricted risk	Negligible

As indicated, the unrestricted risk estimate for citrus exocortis viroid has been assessed as ‘negligible’, which achieves Australia’s ALOP. Therefore, no specific risk management measures are required for this pest.

4.13 Pest risk assessment conclusions

Key to Error! Not a valid result for table. **(starting next page)**

Genus species **EP**	pests for which policy already exists; the PRA in this analysis will be based on the risk ratings given in the previous assessments
Genus species region	PRA area for which quarantine pests have been identified

Likelihoods for entry, establishment and spread

N	negligible
EL	extremely low
VL	very low
L	low
M	moderate
H	high
P[EES]	overall probability of entry, establishment and spread

Assessment of consequences from pest entry, establishment and spread

PLH	plant life or health
OE	other aspects of the environment
EC	eradication, control etc.
DT	domestic trade
IT	international trade
ENC	environmental and non-commercial
A-G	consequence impact scores are detailed in chapter 2.2.3
	A Indiscernible at the local level
	B Minor significance at the at the local level
	C Significant at the local level
	D Significant at the district level
	E Significant at the regional level
	F Significant at the national level
	G Major significance at the national level
URE	unrestricted risk estimate. This is expressed on an ascending scale from negligible to extreme.

Table 4.2 – Summary of unrestricted risk estimates for pests of quarantine concern associated with Californian table grapes to Western Australia

Pest name	Likelihood of						Consequences							URE
	Entry			Establishment	Spread	P[EES]	Direct	Indirect					Overall	
	Importation	Distribution	Overall				PLH	OE	EC	DT	IT	ENC		
Order Coleoptera														
Harmonia axyridis [EP]	H	H	H	H	H	H	C	D	D	E	D	E	M	**M**
Order Hemiptera														
Lygus hesperus [EP] *Lygus lineolaris* [EP]	VL	M	VL	H	M	VL	E	B	D	C	C	B	M	**VL**
Parthenolecanium corni [EP]	M	L	L	H	M	L	D	B	D	C	C	B	L	**VL**
Pseudococcus calceolariae [EP]	L	M	L	H	H	L	D	A	D	D	D	A	L	**VL**
Order Lepidoptera														
Marmara gulosa	M	H	M	H	M	L	D	B	D	D	C	B	L	**VL**
Order Diaporthales														
Phomopsis viticola [EP]	L	VL	VL	H	M	VL	C	A	D	B	B	B	L	**N**
Viruses														
Strawberry latent ringspot virus	M	VL	VL	VL	M	EL	E	A	D	D	D	B	M	**N**
Grapevine fanleaf virus [EP]	H	M	M	L	VL	VL	E	A	D	B	A	A	M	**VL**
Tomato ringspot virus [EP]	M	M	L	L	M	VL	E	A	D	C	C	B	M	**VL**
Viroids														
Grapevine yellow speckle viroid-1 [EP] Grapevine yellow speckle viroid-2 [EP]	H	L	L	L	L	VL	C	A	D	A	B	A	L	**N**

Pest name	**Likelihood of**						**Consequences**							**URE**
	Entry			**Establishment**	**Spread**	**P[EES]**	**Direct**		**Indirect**				**Overall**	
	Importation	**Distribution**	**Overall**				**PLH**	**OE**	**EC**	**DT**	**IT**	**ENC**		
Hop stunt viroid	H	L	L	L	L	VL	C	A	D	A	C	A	L	**N**
Citrus exocortis viroid	H	L	L	L	M	VL	B	A	D	A	C	A	L	**N**

5 Pest risk management

This chapter provides information on the management of quarantine pests identified in the pest risk assessment with an unrestricted risk exceeding Australia's appropriate level of protection (ALOP). The recommended biosecurity measures are described below. Information is also provided about the existing import conditions for Californian table grapes to all other Australian states and territories and the quarantine pests and pathogens these are for.

5.1 Pest risk management measures and phytosanitary procedures

Pest risk management selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests for Australia where they have been assessed to have an unrestricted risk above Australia's ALOP. In calculating the unrestricted risk, existing commercial production practices in California have been considered, as have post-harvest procedures.

In addition to California's existing commercial production practices for table grapes and minimum border procedures in Australia, specific pest risk management measures are proposed to achieve Australia's ALOP.

This non-regulated analysis builds on the existing policy for fresh table grapes from California to Australia (excluding Western Australia) (AQIS 2000a; AQIS 2000b; Biosecurity Australia 2006; Biosecurity Australia 2009b). The existing policy for Californian table grapes already includes measures for the pests listed in Table 5.2 and Table 5.3. The pest categorisation in Appendix A found that those pests are also quarantine pests for Western Australia. It is proposed that all measures required under the existing policy for Californian table grapes also be applied for imports into the state of Western Australia. An outline of the current conditions is given in Chapter 5.1.2.

Additional pests requiring risk management measures that were identified in the process of conducting this analysis of policy are discussed in Chapter 5.1.1.

Finalisation of the quarantine conditions may be undertaken with input from the Australian states and territories as appropriate.

5.1.1 Pest risk management for quarantine pests identified in the analysis of existing policy

The pest risk analysis identified a quarantine pest listed in Table 5.1 as having an unrestricted risk above Australia's ALOP.

Table 5.1 – Biosecurity measures proposed for quarantine pests for Western Australia for fresh table grapes from California

Pest	Common name	Measures
Arthropods		
*Harmonia axyridis***	Harlequin ladybird	Visual inspection and remedial action*
* Remedial action may include: treatment of the consignment to ensure that the pest is no longer viable (if detected during phytosanitary inspection by USA authorised officers or during offshore or on arrival inspection by DAFF) or withdrawing the consignment from export to Australia (if detected pre-export during phytosanitary inspection by USA authorised officers or during offshore inspection by DAFF). ** This pest has been identified as above ALOP for all Australian states and territories (not just Western Australia); this measure will apply to table grapes imported into all Australian states and territories.		

Management for *Harmonia axyridis* (harlequin ladybird)

DAFF proposes the following approach based on visual inspection and remedial action to reduce the risks associated with this arthropod pest to meet Australia's ALOP[2].

Visual inspection and remedial action

The objective of visual inspection is to ensure that any consignments of table grapes from California infested with this pest are identified and subjected to appropriate remedial action. The remedial action will reduce the risk associated with ladybirds to a very low level to meet Australia's ALOP.

Adult ladybirds are external pests, 5-8 mm long, that can be detected by trained biosecurity inspectors using optical enhancement where necessary (such as a hand lens). The light orange or red elytra and black spots of the harlequin ladybird also makes them conspicuous, which aids in their detection. The standard 600 unit quarantine inspection undertaken by APHIS will be effective in identifying consignments infested with these pests.

Remedial action, if required, could include any treatment known to be effective against the target pest. Currently, standard methyl bromide fumigation rates for external pests are recognised (as per T9030). However, DAFF would also consider any other treatment that APHIS proposes, if it is found to provide an equivalent level of protection.

The consignment would not be passed for export (if the detection was pre-export) or from quarantine (if detected on arrival in Australia) until the remedial action has been undertaken.

The objective of these measures is to reduce the likelihood of importation for this pest to at least 'very low'. The restricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

[2] Visual inspection and remedial action will be undertaken in addition to the current commercial production, and packing and treatment practices already in place for Californian table grapes to the rest of Australia.

Policy for table grapes from the People's Republic of China

The *Final import risk analysis report for table grapes from the People's Republic of China* (Biosecurity Australia 2011a) recommends for the management of *Harmonia axyridis* for table grapes from China:

- systems approach – vineyard and packing management; and
- visual inspection and remedial action.

DAFF considers that the commercial production and packing practices for table grapes in the Californian counties approved for export to Australia achieve the same outcome and are therefore equivalent to the requirements of the systems approach recommended for table grapes from the People's Republic of China.

Additionally, Californian table grapes have been exported to all other states and territories of Australia since 2002 and during this time DAFF officers have not detected *Harmonia axyridis* on the import pathway during inspection.

5.1.2 Pest risk management for pests under the existing policy

Under the existing policy for the importation of Californian table grapes to all other Australian states, the pests listed in Table 5.2 and Table 5.3 have an unrestricted risk above Australia's ALOP. Measures are currently applied to manage the risks associated with these pests so that the restricted risk meets Australia's ALOP.

Table 5.2 – Quarantine, sanitary and contaminant pests for Australia with existing biosecurity measures under the current Californian table grape policy for other Australian states and territories

Pest	Common name	Measures
Arthropods		
Colomerus vitis – strain c	Grape erineum mite – leaf curl strain	▪ Visual inspection and remedial action*
Eotetranychus carpini	Hornbeam spider mite	
Eotetranychus williamettei	Williamette mite	
Tetranychus pacificus	Pacific mite	
Euschistus conspersus	Consperse stink bug	
Homalodisca vitripennis	Glassy-winged sharpshooter	
Planococcus ficus	Vine mealybug	
Pseudococcus maritimus	Grape mealybug	
Amyelois transitella	Navel orangeworm	
Argyrotaenia citrana	Orange tortrix	
Desmia funeralis	Grape leaffolder	
Estigmene acrea	Salt marsh moth	

Pest	Common name	Measures
Harrisina brillians	Western grapevine skeletoniser	
Platynota stultana	Omnivorous leafroller	
Caliothrips fasciatus	Bean thrips	
Drepanothrips reuteri	Grape thrips	
Frankliniella occidentalis	Western flower thrips	
Frankliniella minuta	Thrips	
Scirtothrips citri	Californian citrus thrips	
Drosophila suzukii	Spotted wing drosophila	▪ Sulfur dioxide/carbon dioxide fumigation (1:6%) followed by cold treatment for 6 days at –0.50°C ± 0.50°C
Daktulosphaira vitifoliae	Grapevine phylloxera	▪ Sulfur dioxide/carbon dioxide fumigation (1:6%)
Sanitary and Contaminant Pests		
Cheiracanthium inclusum	Yellow sac spiders	▪ Sulfur dioxide/carbon dioxide fumigation (1:6%)
Cheiracanthium mildei		
Latrodectus hesperus	Black widow spider	
*: Remedial action may include: treatment of the consignment to ensure that the pest is no longer viable (if detected during phytosanitary inspection by USA authorised officers or during offshore or on arrival inspection by DAFF) or withdrawing the consignment from export to Australia (if detected pre-export during phytosanitary inspection by USA authorised officers or during offshore inspection by DAFF)..		

Table 5.3 – Quarantine pests for other Australian states and territories absent from areas designated as pest free area or for which non- host status applies with existing biosecurity measures under the current Californian table grape policy

Pest	Common name	Measures
Arthropods		
Ceratitis capitata	Mediterranean fruitfly	▪ Pest free area
Craponius inaequalis	Grape curculio	
Eulithis diversilineata	Grape looper	
Fidia viticida	Grape root worm	
Polychrosis viteana	Grape berry moth	
Tetranychus mcdanieli	McDaniel spider mite	▪ Non-host status
Scirtothrips perseae	Avocado thrips	
Lobesia botrana	European grapevine moth	▪ Pest free area (county freedom)
Pathogens		
Guignardia bidwellii	Black rot	▪ Pest free area
Mycosphaerella angulata	Angular leaf spot	

Pest	Common name	Measures
Physopella ampelopsidis	Rust	
Pseudopezicula tetrapsora	Angular leaf scorch	

Summary of existing policy

The *Final import risk analysis for the importation of fresh table grapes from the state of California in the United States of America* (AQIS 2000b) (pages 28 – 35) provides detail of the original biosecurity measures recommended for the importation of table grapes to all other Australian states and territories. This was supplemented by the policy determination released in 2002 (Biosecurity Australia 2002), after which trade commenced.

Since the policy determination, several reviews of the import conditions have been conducted. These were based on research supporting different treatment methods, knowledge gained through experience of the trade in Californian table grapes to Australia, better knowledge of quarantine pests, and the emergence of new pests associated with table grapes in California.

In 2006, DAFF released a policy memorandum (Biosecurity Australia 2006) for the removal of mandatory methyl bromide fumigation subject to the continuing application of other quarantine conditions. This change in policy considered the fact that routine inspections of table grapes in California since the commencement of trade in 2002 and the results of intensive destructive sampling in October 2005 did not identify any pests which routinely require mandatory methyl bromide fumigation, including glassy winged sharpshooter.

In 2009, DAFF released a Biosecurity Advice (Biosecurity Australia 2009b) reviewing management measures for *Daktulosphaira vitifoliae* (grapevine phylloxera). The review assessed and supported a request to recognise combined sulfur dioxide/carbon dioxide (SO_2/CO_2) fumigation as effective in managing the risk of grapevine phylloxera, removing the requirement for the inclusion of sulfur pads in export consignments.

The current biosecurity measures for Californian table grapes to all Australian states and territories (excluding WA) are provided on the Department's Import Conditions Database (ICON) (AQIS 2012). The following is a summary of the current conditions:

Permitted counties, vineyards, packers and treatment facilities

- Grapes are permitted into Australia only from approved counties in the Central and Coachella valley regions of the State of California. These counties are:
    - Fresno, Kern, Kings, Madera, Riverside and Tulare
- Only fresh field grown table grapes from United States Department of Agriculture (USDA) registered growers and packers are permitted entry.
- Fumigation and cold treatments can only be conducted in USDA registered facilities.

Treatment

- Mandatory SO_2/CO_2 fumigation followed by cold treatment
    - All packed table grapes must undergo mandatory preshipment fumigation with 1% sulfur dioxide (SO_2) and 6% carbon dioxide (CO_2) by volume for 30 minutes, delivered using forced air at a pulp temperature of 15.6°C (60°F) or greater. The chamber load must not exceed 30%. The SO_2/CO_2 treatment must be completed

prior to cold treatment and phytosanitary inspection and must be supervised by APHIS or an accredited certifying official. The quarantine services of the USA will follow their normal standard operating procedures to measure gas concentrations during the fumigation with SO_2/CO_2 gas.

  - Cold treatment can only commence once the fruit pulp temperature reaches -0.50°C or below.
  - Cold treatment must be undertaken for at least 6 continuous days at a pulp temperature of –0.50°C ± 0.50°C. Cold treatment can be performed at temperatures lower than the set temperature range. Cold treatment can be performed in the USA prior to shipment or as an in-transit treatment before grapes are presented for DAFF inspection.

USDA-APHIS inspection

- Sufficient boxes will be selected at random from the nominated inspection lot to ensure a 600 bunch inspection can be completed. If the consignments or the inspection lots have less than 1000 bunches, a 450-bunch inspection rate will be applied.
- For mandatory preshipment SO_2/CO_2 fumigation followed by preshipment cold treatment.
  - Inspection will be undertaken by USDA-APHIS, or officers authorised by APHIS certified by USDA-APHIS, after successful completion of the fumigation and cold treatment but prior to DAFF inspection.
- For mandatory preshipment SO_2/CO_2 fumigation followed by intransit cold treatment.
  - Inspection will be undertaken by USDA-APHIS, or an agent certified by USDA-APHIS, after successful completion of the fumigation but prior to loading the consignment into the container. USDA-APHIS, or the agent, must verify that the cold treatment has commenced.

DAFF inspection

- DAFF inspection can be undertaken as Offshore Pre-shipment Inspection in California or on arrival in Australia.
- Sufficient boxes will be selected at random from the consignment (on arrival inspection) or the nominated inspection lot (for offshore preshipment inspection or OPI) to ensure a 600 bunch inspection can be completed. If the consignments or the inspection lots have less than 1000 bunches, a 450-bunch inspection rate will be applied.

Timing of DAFF inspection

- For mandatory preshipment SO_2/CO_2 fumigation followed by preshipment cold treatment.
  - DAFF inspection will be undertaken after successful completion of the fumigation and cold treatment, either as OPI in USA or as on arrival inspection.
- For mandatory preshipment SO_2/CO_2 fumigation followed by intransit cold treatment.
  - If DAFF inspection is undertaken as OPI in USA, this will occur post SO_2/CO_2 fumigation but prior to fruit proceeding to cold treatment in transit. In this instance the in transit cold treatment will be verified on arrival in Australia, prior to the containers of fruit being cleared.
  - If DAFF inspection is undertaken on arrival in Australia, then this will occur after assessment of in transit cold treatment and verification of documents certifying

that SO_2/CO_2 fumigation has occurred prior to shipping as part of the combination of measures for *Drosophila suzukii*.

Actions for pest interceptions

- If live life stages of *Drosophila suzukii* are found during APHIS or DAFF inspection after treatment completion, the consignment will not be eligible for export/or allowed entry into Australia. DAFF may direct USDA-APHIS to suspend the packing facility/treatment provider until the cause of the non-compliance is investigated and corrective actions are impelemnted to DAFF’s satisfaction.
- The detection of a live glassy-winged sharpshooter (GWSS) during APHIS or DAFF inspection will result in the suspension of all exports until the problem is investigated. If a dead GWSS is found during the pre-clearance inspection, then an investigation will be conducted by DAFF and APHIS to evaluate the relationship of GWSS to the table grape pathway.
- If pests are detected at inspection that are managed by ‘Pest Free Area’ (PFA) or ‘Non Host Status’ (NHS) (pests listed in Table 5.3), which includes *Lobesia botrana*, at the DAFF inspections, then table grape imports from California will be suspended, pending further investigation by both DAFF and APHIS.
- The detection of spider egg sacs will lead to a quarantine hold and determination of the pest status and viability. However, during OPI if the inspection lot presented in the Notice of Intention to export (NOI) is from more than one fumigation lot and if the detection of egg sacs was on fruit from a specific fumigation lot then this can be removed and the rest of the inspection lot can be represented for another DAFF inspection under a new NOI. Inspection lots/consignments detected with confirmed non-viable egg sacs can be released.
- Consignments must be free of soil, contaminant seeds and trash (splinters, twigs and leaves). Consignments detected with trash or prohibited weed seeds at OPI or on arrival inspections by DAFF must be held pending investigation and determination of remedial action as directed by DAFF.
- Appropriate remedial actions for detection of trash, soil and contaminant seed at OPI include either sorting the specific grower lot to remove contaminants and reinspection of the inspection lot under the same NOI or withdrawal of the specific grower lot from export to Australia and reinspection of the remaining inspection lot under a different NOI.
- Appropriate remedial actions for detections at on arrival inspections include either sorting the consignment to remove contaminants and reinspection of the inspection lot or re-export or destruction.
- If live quarantine pests are detected during inspections of treated table grapes, DAFF may direct APHIS to suspend the treatment facility responsible.

Post treatment security of fruit

  - Table grapes that have completed quarantine treatments or have passed OPI by DAFF must be securely stored in an approved cold storage facility prior to loading and shipping, and must be segregated from any other domestic or export produce at all times. The quarantine integrity and traceability of passed lots must also be maintained throughout storage, transport and on-arrival clearance in Australia and be labelled with grower lotand treatment facility references for traceability.

Packaging, labelling and identification

- Grapes must be packed in clean new packages.
- Timber packaging and pallets must be treated in accordance with a DAFF approved method or be ISPM15 compliant.
- The table grapes must be packed in perforated transparent polyvinyl bags or equivalent wrapping (e.g. perforated plastic punnets or clamshells) that does not impede fumigant penetration, and then placed into new packages. Package types that are approved for fresh Californian table grapes are: Toyon Kraft Veneer (TKV) boxes, plastic boxes, expanded polystyrene (EPS) boxes, and fully plastic coated cardboard packages. The wooden slats for the TKV boxes must be made out of processed wood, wood veneer or chipboard, or comply with the timber packaging requirements noted above. No unprocessed packing material is permitted.
- Palletised product must be identified by attaching a uniquely numbered pallet card to each pallet or part pallet. Pallet cards must be marked with the grower lot reference and the treatment facility reference.

On arrival verification of fruit that has undergone OPI in USA

- All consignments may be cleared on presentation of conforming documentation (except for those containers under intransit cold treatment), which must include the phytosanitary certificate and a copy of the NOI. However DAFF may undertake random verification and inspection of consignments.
- The physical verification ensures continued compliance with the OPI procedures and container numbers and seal numbers will be checked where applicable.
- Any consignment with incomplete phytosanitary certification, or for which seals of the containers are damaged or missing, or documentation that does not align with the physical labelling, will be held pending clarification and decision by DAFF in consultation with APHIS. Any consignment that cannot be verified as having undergone OPI may require on –arrival inspection, re-export or destruction.
- Any consignment that cannot be verified as having undergone the quarantine treatments will require re-export or destruction.

5.1.3 Consideration of alternative measures

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms* (FAO 2004), DAFF will consider any alternative measure proposed by USDA-APHIS, providing that it achieves an equivalent level of quarantine protection. Evaluation of such measures or treatments will require a technical submission from USDA-APHIS that details the proposed measures or treatments, including data from suitable trials to demonstrate efficacy.

5.2 Operational system for the maintenance and verification of phytosanitary status

A system of operational procedures are already in place to maintain and verify the phytosanitary status of table grapes from California. This ensures that risk management measures have been met and are maintained.

Details of the operational system, or equivalent, will continue to be determined by agreement between DAFF and USDA-APHIS, prior to the season commencement.

5.2.1 Registration of export orchards by USDA-APHIS

The objective of this procedure is to ensure that table grapes are sourced from registered export orchards producing export quality fruit, as the pest risk assessments are based on existing commercial production practices.

This procedure provides DAFF with assurance that USDA-APHIS can trace consignments back to the vineyard should any non-compliance be found.

5.2.2 Registration of processing facilities and auditing of procedures

The objectives of this procedure ensure that:

- packed table grapes are stored and treated in USDA-APHIS registered facilities, processing export quality fruit,
- references to the packing house (by registration number or reference code and packing house name) are clearly stated on crates destined for export of table grapes to Australia for trace-back and auditing purposes.

USDA-APHIS must provide DAFF with a list of registered facilities prior to season commencement each year and inform DAFF of any changes to registrations during the season. This list must be maintained as current by USDA-APHIS in order to facilitate trace-back of any consignment.

USDA-APHIS, or an authorised officer, is required to audit these facilities at the beginning of each season to ensure that they are suitably equipped to carry out the specified phytosanitary tasks and are able to conduct acceptable treatments. Records of USDA-APHIS audits are to be made available to DAFF on request.

5.2.3 Packaging and labelling

The objectives of this procedure ensure that:

- table grapes recommended for export to Australia and all associated packaging is not contaminated by quarantine pests or regulated articles (e.g. trash, soil and contaminant seeds)
- unprocessed packing material (which may vector pests not identified as being on the pathway) is not imported with fresh table grapes
- timber packaging and pallets are treated in accordance with a DAFF approved method (or are ISPM15 compliant)

- secure packaging is used during storage and transport for export to Australia and must meet Australia's general import conditions for fresh fruits and vegetables (C6000 General requirements for all fruit and vegetables, available at http://www.aqis.gov.au/icon/)
- the packaged table grapes are labelled with the packing house name for the purposes of trace-back

5.2.4 Storage and movement

The objectives of this procedure ensure that:

- product for export to Australia that has been treated and/or inspected is kept secure and segregated at all times from any fruit for domestic or other markets, untreated product to prevent mixing or cross-contamination elsewhere
- the quarantine integrity of the commodity during storage and movement is maintained.

5.2.5 Freedom from trash

All table grapes must be free from trash (e.g. extraneous materials, twigs/stem and leaf material, seeds, soil, animal matter/parts or other extraneous material), foreign matter and pests of quarantine concern to Australia. Freedom from trash will be confirmed by the inspection procedures. Export lots or consignments found to contain trash, foreign matter, or pests of quarantine concern to Australia are withdrawn from export unless approved remedial action is available and applied to the export consignment.

5.2.6 Pre-export phytosanitary inspection and certification by USDA-APHIS

The objectives of this procedure ensure that:

- all consignments have been inspected in accordance with official procedures for all visually detectable quarantine pests and other regulated articles (including soil, animal and plant debris) at a standard 600 unit sampling rate per phytosanitary certificate
- consignments that contain live quarantine pests or trash will be rejected
- an international phytosanitary certificate (IPC) is issued for each consignment upon completion of inspection and treatment to verify that relevant measures have been undertaken
- each IPC includes:
    - a description of the consignment (including quantity, grower lot reference, packing house details);
    - details of disinfestation treatments (e.g. fumigation) which includes date, concentration, temperature, duration, and/or the fumigation certificate (as appropriate); and cold treatment details when undertaken offshore.
    - any additional declarations required.

5.2.7 Phytosanitary inspection by DAFF

The objectives of this recommended procedure are to ensure that:

- all consignments comply with Australian import requirements

- consignments are as described on the phytosanitary certificate and quarantine integrity has been maintained.

To ensure that phytosanitary status of consignments of table grapes from California meet Australia's import conditions DAFF completes a verification inspection of all consignments of table grapes.

On-arrival in Australia, DAFF undertakes a documentation compliance examination to verify that the consignment is as described on the phytosanitary certificate, that required phytosanitary actions have been undertaken and that product security has been maintained.

If the cold treatment is undertaken in-transit, DAFF will complete a phytosanitary inspection of the consignment on-arrival in Australia.

5.2.8 Remedial action(s) for non-compliance

The objectives of remedial action(s) for non-compliance are to ensure that:

- any quarantine risk is addressed by remedial action, as appropriate
- non-compliance with import requirements is addressed, as appropriate.

Any consignment that fails to meet Australia's import conditions must be subject to a suitable remedial treatment, if one is available, re-exported from Australia, or destroyed.

Separate to the corrective measures mentioned above, there may be other breach actions (ie investigation of possible treatment failures or post-treatment security) necessary depending on the specific pest intercepted and the risk management strategy put in place against that pest in the protocol.

If product repeatedly fails inspection, DAFF reserves the right to suspend the export program and conduct an audit of the risk management systems. The program will recommence only when DAFF is satisfied that appropriate corrective action has been taken.

5.3 Uncategorised pests

If an organism, including contaminant pests/pathogens, is detected on table grapes either in California or on-arrival in Australia that has not been categorised, it will require assessment by DAFF to determine its quarantine status and whether phytosanitary action is required. Assessment is also required if the detected species was categorised as not likely to be on the import pathway. If the detected species was categorised as on the pathway but assessed as having an unrestricted risk that achieves Australia's ALOP due to the rating for likelihood of importation, then it would require reassessment. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action and/or temporary suspension of trade while an analysis is conducted to ensure that existing measures continue to provide the appropriate level of protection.

5.4 Review of Processes

5.4.1 Audit of protocol

The phytosanitary system for table grapes may be audited by DAFF from time to time. Audits have, and would, include export production, field packing, packing facility operations, mandatory SO_2/CO_2 fumigation, cold treatment and pre-export inspection and certification.

As Californian table grapes have been exported to all other Australian states since 2002, DAFF proposes that all existing measures and operational systems continue for trade to Western Australia. DAFF has previously audited operational systems for Californian table grape exports to Australia (the latest in 2012), and as a result, there is no requirement for DAFF to conduct an audit prior to the commencement of exports to Western Australia. Audits may, however, be conducted at the discretion of DAFF on the entire production cycle.

5.4.2 Review of policy

DAFF reserves the right to review the import policy at any time.

USDA-APHIS must inform DAFF immediately on detection in California of any new pests of table grapes that are of potential quarantine concern to Australia or a significant change in the application of existing commercial practices considered in this review.

5.5 Import conditions

The risk management measures recommended in this final report will be taken into account in formulating import requirements. The details of the import conditions will be made available on the DAFF website (www.daff.gov.au/iconsearch), once the import policy is finalised and DAFF is satisfied that the phytosanitary systems meet Australia's requirements.

5.6 Meeting Australia's food standards

Imported food for human consumption must satisfy Australia's food standards. Australian law requires that all food, including imported food, meets the standards set out in the Australia New Zealand Food Standards Code (hereafter referred to as 'the Code'). Food Standards Australia New Zealand (FSANZ) is responsible for developing and maintaining the Code, including Standard 1.4.2, Maximum Residue Limits (MRLs), available at www.comlaw.gov.au/Details/F2012C00822. The standards apply to all food in Australia, irrespective of whether it is grown domestically or imported.

If a specific chemical is used on imported foods to control pests and diseases, then any resulting residues must not exceed the specific MRLs in Standard 1.4.2 of the Code for that food.

If there is no MRL listed in the Code for a specific food (or a composite, processed food), then there must be no detectable residues in that specific food.

Where an exporting country uses a chemical for which there is no current listed Australian MRL, there are mechanisms to consider establishing an Australian MRL by harmonising with an MRL established by the Codex Alimentarius Commission (Codex) or by a regulatory authority in a recognised jurisdiction. The mechanisms include applications, submissions or consideration as part of a FSANZ proposal to vary the Code. The application process, including the explanation of establishment of MRLs in Australia, is described at www.foodstandards.gov.au/foodstandards/changingthecode/.

Appendices

Appendix A Initiation and categorisation for pests of fresh table grapes from California[3]

Initiation (columns 1 – 3) identifies the pests of table grapes that have the potential to be on table grapes produced in California using commercial production and packing procedures.

Pest categorisation (columns 4 - 7) identifies which of the pests with the potential to be on table grapes are quarantine pests for Western Australia and require a pest risk assessment.

The steps in the initiation and categorisation processes are considered sequentially, with the assessment terminating at the first 'No' for columns 3, 5 or 6 or 'Yes' for column 4.

Details of the method used in this analysis are given in Chapter 2: Method for pest risk analysis.

For pests and pathogens with existing policy for Californian table grapes to the other Australian states and Territories, only column 4 was assessed to determine if it is of quarantine concern for Western Australia

Table A Initiation and pest categorisation

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
DOMAIN BACTERIA						
Class Alphaproteobacteria:						
Order Rhizobiales (Agrobacterium, Rhizobium)						
Rhizobium rhizogenes **(**Riker et al. 1930) Young et al. 2001 Synonym: *Agrobacterium tumefaciens* Conn [Rhizobiaceae] Crown gall	**Yes** Present in California (Bradbury 1986; Flaherty *et al.* 1992; CABI 2011)	**No** Causes crown gall disease, infecting roots, trunks and canes (Ellis 2008; Vizitiu and Dejeu 2011).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Rhizobium vitis (Ophel & Kerr 1990) Young *et al.* 2001 Synonym: *Agrobacterium vitis* Ophel & Kerr 1990 [Rhizobiaceae] Crown gall of grapevine	**Yes** Present in the USA (CABI 2011).	**No** This bacterium is found in the soil, roots and near the base of the vine (Nicholas *et al.* 1994).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

[3] This pest categorisation table does not represent a comprehensive list of all the pests associated with the entire plant of an imported commodity. Reference to soilborne nematodes, soiborne pathogens, wood borer pests, root pests or pathogens, and secondary pests have not been listed or have been deleted from the table, as they are not directly related to the export pathway of fresh table grapes and would be addressed by Australia's current approach to contaminating pests.

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Class Gammaproteobacteria						
Order Pseudomonadales (Pseudomonas)						
Pseudomonas syringae pv. *syringae* van Hall 1902 [Pseudomonadaceae] Bacterial canker	**Yes** Present in California (Little *et al.* 1998)	**Yes** May cause blossom blight by infection of stalks and/or cause lesions on fruit (Bradbury 1987).	**Yes for WA** Present in WA (Shivas 1989; Plant Health Australia 2001). **Yes for other states** Present in NSW, Qld, Tas., Vic. (Plant Health Australia 2001)	**Assessment not required**	**Assessment not required**	**No**
Order Xanthomonadales						
Xylella fastidiosa [Xanthomonadaceae] Pierce's disease	**Yes** First described in 1892 from southern California (Pearson and Goheen 1988) and is responsible for Pierce's disease, alfalfa dwarf disease and almond leaf scorch in California (Gubler *et al.* 2009).	**No** Vectored by xylem feeding insects such as sharpshooters and spittlebugs in North America. Spreads systemically through xylem vessels in its hosts and can be present where ever these tissues occur (Pearson and Goheen 1988). There is limited information on the distribution of the bacterium in host vines, but it is feasible that grape bunch material could pose a potential risk pathway for the disease.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**[4]

[4] *Xylella fastidiosa* has been subject to rigorous assessment in context with the Glassy wing sharpshooter (GWSS) review of policy in 2002, and with significant trade of table grapes into eastern Australian states since that time. Although an assessment of presence in the exporting country, pathway association, potential for establishment, spread and consequences is given, it is considered that no further pest risk assessment is required here. Should new information suggest there is a change in the risk profile of this disease and/or its vectors, this would initiate a further review process to ensure appropriate measures are in place to reduce the risks posed to meet Australia's appropriate level of protection.

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
DOMAIN EUKARYA						
ANIMALIA (Animal Kingdom)						
ARTHROPODA: Arachnidia: Acari (Phylum: Class Sub-class)						
Order Araneae						
Existing California table grape policy *Cheiracanthium inclusum* (Hentz 1847) [Miturgidae] Yellow sac spider			**No records found**			
Existing California table grape policy *Cheiracanthium mildei* Koch 1864 [Miturgidae] Yellow sac spider			**No records found**			
Existing California table grape policy *Latrodectus hesperus* Chamberlin & Ivie 1935 [Theridiidae] Black widow spider			**No records found**			
Sassacus spp. [Salticidae] Jumping spider	**Yes** Present in the USA (Richman 2008).	**No** Spiders in this genus are predators not plant pests. However, they have been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. Due to their size and external habit they would be detected during inspection.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Misumena spp. Latreille, 1804 [Thomisidae] Crab spiders	**Yes** Several species are present in California: including *M. californica*, *M. pictilis* (Banks 1896) and *M. vatia* (Hogg *et al.* 2010).	**No** Spiders in this genus are predators not plant pests. However, they have been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. Due to their size and external habit they would be detected during inspection.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Neoscona oaxacensis Keyserling 1864 [Araneidae] Western spotted orbweaver	**Yes** Present in the USA (Costello and Daane 2005).	**No** This species is a predator not a plant pest. However, it has been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. Due to its size and external habit it would be detected during inspection.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Trombidiformes						
Colomerus vitis Pagenstecher 1857 [Eriophyidae] Grape erineum mite	**Yes** Present in California (CABI 2011).	**No** The *Colomerus vitis* erineum strain forms galls on upper surfaces of leaves; the bud mite strain results in blisterlike growths on buds; and the leaf-curl strain causes downward curling of leaves (Flaherty *et al.* 1992).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Eotetranychus carpini* (Oudemans) [Tetranychidae] Hornbeam spider mite			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Eotetranychus williamettei* [Tetranychidae] Williamette mite			**No records found**			
Polyphagotarsonemus latus Banks 1904 [Tarsonemidae] Broad mite	**Yes** Present in California (CABI 2011).	**No** *Polyphagotarsonemus latus* feeds on leaves (Li 2004; Zhang 2005; AQSIQ 2006a).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Tetranychus mcdanieli* McGregor [Tetranychidae] McDaniel spider mite			**No records found**			
Existing California table grape policy *Tetranychus pacificus* *[Tetranychidae]* Pacific mite			**No records found**			
Tetranychus urticae Koch, 1836. Koch (1836) [Tetranychidae] Two spotted spider mite	**Yes** Present in California (Bentley *et al.* 2009).	**Yes** Occasionally found on grapes in California (Bentley *et al.* 2009).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, NT, QLD, SA, Vic. and Tas. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
ARTHROPODA: Insecta (Phylum: Class)						
Order Coleoptera						
Anthicus ephippium LaFerté-Sénectère 1849 Synonyms: *Anthicus confusus* LeConte 1852; *Anthicus difficilis* LeConte 1850; *Anthicus luteolus* LeConte 1851; *Anthicus pinguescens* Casey 1895; *Anthicus simiolus* Casey 1895 [Anthicidae] Antlike flower beetle	**Yes** Present in the USA (Pfeiffer and Axtell 1980). It is widespread in North America (Hilburn and Gordon 1989).	**No** Interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. However, these beetles are a contaminant and are not pests of table grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Carpophilus hemipterus Linnaeus, 1758 [Nitidulidae] Dried fruit beetle	**Yes** Present in California (Flaherty *et al.* 1992; Arnett Jr 1993).	**Yes** May infest damaged grapes (Buchanan *et al.* 1984), ripe grapes and overripe grapes (Flaherty *et al.* 1992).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in QLD, NSW, NT, SA, Vic. and Tas. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Craponius inaequalis* Say 1831 [Curculionidae] Grape curculio			**No records found**			
Cryptolestes pusillus Schönherr 1878 Synonym: *Laemophloeus pusillus* Schönherr [Laemophloeidae] Flat grain beetle	**Yes** Present in California (CABI 2011).	**No** *C. pusillus* is a common pest of stored grain (PaDIL 2010). It has been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Fidia viticida* Walsh 1867 [Chrysomelidae] Grape root worm			**No records found**			
Glyptoscelis squamulata Crotch [Chrysomelidae] Grape bud beetle	**Yes** Present in California, including the Central Valley and the Coachella Valley (Bentley *et al.* 2009).	**No** Adult beetles feed on newly opening buds, with feeding damage becoming negligible once shoots reach 26 to 38 mm. They feed at night, hiding during the day in bark and cracks in wooden stakes. Immature stages are found in the soil and feed on grapevine roots. Eggs are laid under bark or between layers of bark (Flaherty *et al.* 1992).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Harmonia axyridis Pallas 1773 [Coccinellidae] Harlequin ladybird	**Yes** Present in California (Lucas *et al.* 2002; CABI 2011).	**Yes** Adults of *H. axyridis* can attack ripe fruit and aggregate in clusters during harvest and wine processing. This insect cannot directly damage, or penetrate grape skins. *Harmonia axyridis* only feed on berries that have been previously damaged by other insects, birds, diseases, or "splitting". (Kovach 2004; Missouri State University 2005; Galvan *et al.* 2006; Kenis *et al.* 2008)	**No for WA** **No for other states** Not present in Australia (Walker 2008)	**Yes** *H. axyridis* was introduced as a biological control agent of aphids and coccids in Europe, North America, Africa and South America (Koch *et al.* 2006; Brown *et al.* 2008). It has a wide host range and is able to establish and disperse in new environments. In Europe, *H. axyridis* is considered to be an invasive alien species (Brown *et al.* 2008). Many parts of Europe, Africa and North and South America have similar climates to parts of Australia which suggests that this beetle would be able to establish in Australia.	**Yes** Even small numbers of beetles inadvertently processed along with grapes can taint the flavor of wine due to their noxious odour. Tainted wine has reportedly resulted in millions of dollars in losses to the wine industry throughout the Eastern USA and Southern Canada (Potter *et al.* 2005; Galvan *et al.* 2006). As a predator, *H. axyridis* can impact native species (Brown *et al.* 2008) Recent studies suggest that infestations can cause allergies in some individuals, ranging from eye irritation to asthma which may incur medical costs. *H. axyridis* has also invade buildings, incurring cleanup and pest control costs (Potter *et al.* 2005).	**Yes**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Hoplia spp. Illiger [Scarabaeidae] Hoplia beetles	**Yes** There are twelve *Hoplia* spp. in North America (Arnett Jr 1993). *H. dispar* LeConte (brown chafer) and *H. callipyge* Leconte (grapevine Hoplia) are present in California (Arnett Jr 1993). *H. callipyge* is recorded from the San Joaquin Valley (Bentley *et al.* 2009).	**No** Eggs are laid in pastures and other undisturbed vegetation, and larvae feed on decaying vegetation and plant roots (Perry 2010). Adults emerge from the soil and fly to feeding sites that include buds, flowers and leaves of a range of plants (Perry 2010). They may feed on grape berry clusters (Molinar and Norton 2003; Bentley *et al.* 2009), however they feign death and fall to the ground when disturbed (University of California 2012a). They are therefore unlikely to be associated with grape bunches, but may be a contaminating pest.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Hypurus bertrandi Perris 1852 [Curculionidae] Leaf mining weevil	**Yes** Present in California (McFadyen 1994) including the Central Valley (Norris 1997).	**No** *H. bertrandi* only has one reported host, *Portulaca oleracea* (Waterhouse 1994). Larve feed on leaves and adults feed on leaf margains, stems and developing seed capsules (Waterhouse 1994). Eggs are laid singly in leaf tissue and pupation takes place in the soil (Awadallah *et al.* 1980). No evidence of an association with *Vitis vinifera* could be found.	**Assessment not required**	**No assessed**	**No assessed**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Limonius canus LeConte [Elateridae] Pacific coast wireworm (Click beetle)	**Yes** Present in California vineyards (Flaherty *et al.* 1992).	**No** The eggs and larval stages are soil-borne (Andrews *et al.* 2008); (Bentley *et al.* 2009) with the larvae living for periods of 2-5 years in the soil feeding on seeds and plant roots (Andrews *et al.* 2008). Following pupation, adults emerge in late spring through summer to feed on the buds (Bentley *et al.* 2009). Not known as a pest of grape bunches. Seldom occurs in sufficient numbers to warrant any specific management measures (Flaherty *et al.* 1992). Given their size, mobility, prevalence, and the predominant larval stages which remain below ground, it is unlikely to be associated with grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Melalgus confertus Dejean 1833 [Bostrichidae] Branch and twig borer	**Yes** Present throughout California (Bentley *et al.* 2009).	**No** *M. confertus* eggs are laid in cracks of the trunck or on bark (Hamman Jr *et al.* 1998). Both adults and larvae injure grapevines (Bentley *et al.* 2009). Larvae bore into dead or dying wood and adults bore into fruiting canes at the base of the bud or shoot, or at the crotch (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Otiorhynchus sulcatus Fabricius 1775 [Curculionidae] Black vine weevil	**Yes** Present in California (Bentley *et al.* 2009).	**No** Larvae feed on roots and pupate in the soil (Bentley *et al.* 2009). Adults feed at night on buds, flowers and the cluster rachis (Bentley *et al.* 2006). Most adult activity occurs 3 to 4 hours after sunset and they will often drop to the ground if disturbed during feeding (Moorhouse *et al.* 1992). They hide during the day in the soil and in cracks at the base of petioles (Moorhouse *et al.* 1992). As picking of grape bunches occurs during the day, *O. sulcatus* would not be associated with grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Philonthus Stephens, 1829 [Staphylinidae] Rove beetle	**Yes** There are 134 species in North America, including *P. politus* Linnaeus in California (Arnett Jr 1993).	**No** Rove beetles in the Staphylinidae family may occur in vineyards but are typically found under rocks and vegetation on the vineyard floor, or in foliage and bark (Ontario Grape IPM 2009). They are nocturnal and mostly feed on other insects and decaying vegetation, but some species are parasitic (Ontario Grape IPM 2009). A *Philonthus* sp. has been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. However, these beetles are likely to be present only as a contaminant and, due to their size and external habit, would be detected during inspection.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Popillia japonica Newman 1838 [Coleoptera: Scarabaeidae] Japanese beetle	**No** Widespreead east of the Missippi River and highly invasive. Several incursions have been eradicated from California and it has not established in California (Potter and Held 2002; Summers 2005).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Scobicia declivis LeConte 1860 [Bostrichidae] Leadcable borer	**Yes** Present in California, including in San Joaquin County and North Coast vineyards (Bentley *et al.* 2009).	**No** Adults bore into wood to make egg tunnels and larvae feed on trunk or cordon wood (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Trogoderma variabile Ballion 1879 [Dermestidae] Warehouse beetle	**Yes** Present in California (Von Ellenrieder 2004).	**No** *T. variabile* attacks foodstuffs in stores and homes, infesting cereals and seeds. It can also be found in packaging materials such as corrugated cardboard (Emery 1999). *T. variabile* has been interecepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. However, these beetles are likely to be present only as a contaminant and, due to their size and external habit, would be detected during inspection.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Xanthogaleruca luteola Müller 1766 Synonym: *Pyrrhalta luteola* Müller, 1766*; Pyrrhalta luteola* Müller 1766 – invalid [Chrysomelidae] Elm leaf beetle	**Yes** Present in California (Arnett Jr 1993; Dreistadt *et al.* 2004).	**No** *X. luteola* feeds only on elm trees (OSU 2012) although it may overwinter in crevises near elm trees (DPIPWE 2012), houses, sheds and other protected places (OSU 2012).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Xyleborus dispar Fabricius 1792 [Scolytinae] Pear blight beetle	**Yes** Present in California (Wood 1982).	**No** Adults and larvae bore and mine injured limbs and holes (5-20 cm diameter or larger) of host trees (Wood 1982).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Diptera						
Existing California table grape policy *Ceratitis capitata* (Wiedemann 1824) Synonyms: *Ceratitis citripeda* Efflatoun 1924, *Ceratitis citriperda* Macleay 1829, *Ceratitis hispanica* Breme 1842, *Pardalaspis asparagi* Bezzi 1924, *Tephritis capitata* Wiedemann 1824, *Trypeta capitata* (Wiedemann 1824) [Tephritidae] Mediterranean fruit fly			**Yes for WA** Under official control **No for other states** Medfly is not present in the eastern states of Australia (Hancock *et al.* 2000)			
Drosophila melanogaster [Drosophilidae] Common fruit fly	**Yes** Present in California (Nunney 1996).	**No** Associated with rotted and fermenting fruit with no evidence that intact fruit can be infested (CABI 2011).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Drosophila simulans Sturtevant 1919 [Drosophilidae] Vinegar fly	**Yes** Present in California (Schlenke and Begun 2004; Bentley *et al.* 2009).	**Yes** Eggs are oviposited in damaged berries and larvae feed on the berries (Bentley *et al.* 2012b).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in Vic. (Plant Health Australia 2001), NSW and QLD (Evenhuis 2007).	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Drosophila suzukii* Matsumara 1931 [Drosophilidae] Spotted wing drosophila			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Eristalinus aeneus Scopoli 1763 Synonym: *Conops aeneus* Scopoli, 1763 [Syrphidae] Hover fly	**Yes** Present in California (North Carolina State University 2012).	**No** Larvae feed on decaying organic matter, and adult flies are attracted by flowers and the odour of decay (North Carolina State University 2012). Some species within the Syrphidae family prey on other insects such as aphids (University of California 2011). This insect has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Limonia maculate (Meigen) Synonym: Rhipidia maculate Meigen 1818 [Tipulidae] Small cranefly	**Yes** Present in California (Usinger 1956).	**No** Crane flies are mainly associated with freshwater environments (Salmela 2010). Feeding is predominantly confined to the larval stage which feed on detritus in habitats such as streams and forest floors (Fetzner Jr 2008). Additional habitats include marshes, springs, meadows, seeps, tree holes, algal growth or mosses, mud, and decaying vegetable debris surrounding streams and ponds (Fetzner Jr 2008). Adults are poor fliers, are most active around dusk, and usually live near moist woodlands and around water, where larval life is spent (Fetzner Jr 2008). Has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Psychoda alternata Say [Psychodidae] Moth fly	**Yes** Present in California (Ebeling 2002).	**No** Larvae live in moist areas around sewage plants and drain pipes. Adults may infest buildings and are often found in showers (Barnes 2009). Has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Hemiptera						
Aphis gossypii Glover, 1877 [Aphididae] Cotton aphid	**Yes** Present in California (CABI 2011) including the San Joaquin Valley (Grafton-Cardwell *et al.* 2012).	**Yes** It is associated with foliage, clustering on the underside of leaves. Its hosts include citrus, cucurbits, cotton and a range of weeds (Natwick *et al.* 2012). It has been recorded as a grape pest in Israel (Barjadze and Ben-Dov 2011). Adult and nymph stages may be present as contaminants on the fruit and stems during trade (CABI 2011).	**Yes for WA** Present in WA. **Yes for other states** Present in NSW, NT, QLD, SA, Tas., Vic. (Plant Health Australia 2001; CSIRO 2005).	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Daktulosphaira vitifoliae* Fitch 1855 Synonym: As *Viteus vitifolii* Fitch 1855 in AQSIQ (2006b); As *Phylloxera vitifolli* Fitch in Li (2004) [Phylloxeridae] Grapevine phylloxera			**No for WA** No records found for WA. **Yes for other states** Present in NSW and Vic. (CSIRO 2005), but it is under official control and measures are in place regulating the movement of grapevine materials including fruit.			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Draeculacephala minerva Ball 1927 [Cicadellidae] Green sharpshooter	**Yes** Present in California (Redak *et al.* 2004; Bentley *et al.* 2009).	**No** Economically important as a potential vector of Pierce's disease and is most abundant in riparian habitats in association with weeds, shrubs and trees (Redak *et al.* 2004). *D. Minerva* feeds on pastures, and *Vitis vinifera* is only an occasional host (Purcell and Frazier 1985; Cabrera-La Rosa *et al.* 2008; Bentley *et al.* 2009). Furthermore, given the large size and mobility of sharpshooter species, they are easily detected and disturbed during harvest and packing house operations.	**No records found**	**Assessment not required**	**Assessment not required**	**No**
***Erythroneura variabilis* Beamer** [Cicadellidae] **Variegated leafhopper**	**Yes** Present in California (Bentley *et al.* 2009).	**No** Eggs are laid on the underside of leaves and the adults and nymphs feed on the contents of leaf cells (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Erythroneura elegantula Osborn [Cicadellidae] Grape leafhopper	**Yes** Present in California (Bentley *et al.* 2009).	**No** Eggs are laid on the underside of leaves and the adults and nymphs feed on the contents of leaf cells (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Euschistus conspersus* (Uhler) [Pentatomidae] Consperse stink bug			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Ferrisia virgata Cockerell 1893 [Pseudococcidae] Striped mealy bug	**Yes** Present in California (Ben-Dov 1994; CABI 2011)	**Yes** *Vitis vinifera* is a host of *F. virgata* (Ben-Dov 1994) and it infests the fruit, leaves, shoots and, in dry conditions, roots of its hosts (Schreiner 2000).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in QLD, NT (Ben-Dov 1994; Plant Health Australia 2001; CSIRO 2005) and NSW (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Graphocephala atropunctata (Signoret, 1854) [Cicadellidae] Blue-green sharpshooter	**Yes** Found in coastal regions of California and is most abundant on cultivated grape (Bentley *et al.* 2009).	**No** This pest is most abundant in riparian habitats in association with weeds, shrubs and trees (Redak *et al.* 2004). Sharpshooters feed on the succulent new growth of shoots, not fruit (Redak *et al.* 2004). Furthermore, given the large size and mobility of sharpshooter species, they are easily detected and disturbed during harvest and packing house operations.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Hemiberlesia lataniae Signoret 1869 Synonym: *Aspidiotus lataniae* Signoret 1869 [Diaspididae] Latania scale	**Yes** Present in California (Faber *et al.* 2011).	**Yes** *H. lataniae* can be associated with fruit and is known to occur on *Vitis vinifera* (CABI 2011). However, *V. vinifera* is only an occasional host and infestations are light; occurring mostly on twigs and branches (Brimblecombe 1962).	**Yes for WA** Present in WA (Plant Health Australia 2001; CSIRO 2005). **Yes for other states** Present in QLD, NSW (Plant Health Australia 2001; CSIRO 2005), NT and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Homalodisca vitripennis* Germar 1821 Synonym: *Homalodisca coagulata* Say 1832 [Cicadellidae] Glassy-winged sharpshooter			**No records found**			
Ilnacorella sulcata Knight 1925 [Miridae] Mirid plant bug	**Yes** Present in the USA (ITIS 2009). And has been intercepted by DAFF operational staff on Californian table grapes.	**No** Has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. As no records could be found that associate *I. sulcata* with *Vitis vinifera*, it is likely that this pest was intercepted as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Lygus hesperus Knight 1917 [Miridae] Western plant bug	**Yes** Present in California (Zalom *et al.* 2012) including the San Joaquin Valley (Mills 2012).	**Yes** A literature search did not reveal any records that showed an association with *Vitis vinifera*. However, a live *L. hesperus* specimen was intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. Furthermore, another species in the genus, *L. lineolaris*, has been associated with *V. vinifera* (Jubb, Jr. *et al.* 1979) and grape bunches (Fleury *et al.* 2006). This suggests that *L. hesperus* may be associated with grape bunches despite the lack of records in the literature.	**No records found**	**Yes** *L. hesperus* is highly polyphagous and has been reported from over 100 plant species in 24 families (Scott 1977). It is found in California, the Pacific Northwest and arid southwest of the USA (Naranjo and Stefanek 2012) (Seymour *et al.* 2005). Its polyphagy and current geographic distribution suggest that there is a risk that it could establish and spread in similar parts of Australia.	**Yes** *Lygus hesperus* is an important pest of fruit, vegetable, fibre, tree and seed crops in North America (Day *et al.* 2012). This is the most important pest of the alfalfa seed industry in California and the Pacific Northwest. Applications of insecticides to control this pest impacts on beneficial insects such as bees reducing crop yields even further. Insecticide resistant populations of Insecticide resistant populations of *Ligus* sp. have also been reported (Seymour *et al.* 2005).	**Yes**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Lygus lineolaris **(Palisot 1818)** **[Miridiae]** Tarnished plant bug	**Yes** Commonly reported in the San Joaquin Valley (Mueller 2003; Mueller *et al.* 2012) and is the most widely distributed *Lygus* species in North America (CABI 2011). It is found in all states of the continental USA and from all agricultural areas in North America (CABI-EPPO 2000; CABI 2011).	**Yes** *Lygus lineolaris* is highly polyphagous and attacks a wide range of economic hosts including herbaceous plants, vegetable crops, commercial flower plants, fruit trees and nursery stock (Dixon 2009). More than half of cultivated plant species in the USA are reported as hosts for *L. lineolaris* (Dixon 2009). It is the principal mirid pest in the eastern and southern USA and is primarily reported in association with cotton; canola; mustard; seed lucerne; vegetable crops such as *Phaseolus vulgaris* and *P. lunatus*; fruit crops such as strawberry, apple and peach; and from nursery stock (CABI 2011). An association with grapes is also reported (Jubb, Jr. *et al.* 1979; Fleury *et al.* 2006). It feeds on all aerial plant parts, but favours leaf and flower buds, flowers, fruits and seeds (CABI 2011).	**No records found**	**Yes** *Lygus lineolaris* is found throughout North America in climates which share similarities to that of Australia, indicating it is likely to establish and spread should it be introduced into the Australian environment. Its wide host range, small size, and relatively quick reproductive cycles would facilitate its ability to establish and spread in Australia also.	**Yes** *Lygus lineolaris* has caused economic damage to fruit and vegetable crops in North America. Significant damage has been reported on apples, strawberries and peaches, with fruits developing 'catfacing' injuries around feeding sites and fruit development can be affected (CABI 2011). In New York State, 67% fruit damage and a 30% reduction in berry weight was observed with strawberry (CABI 2011).	**Yes**
Macrosiphum euphorbiae Thomas 1878 [Aphididae] Potato aphid	**Yes** Present in California (CABI 2011; Godfrey and Haviland 2012).	**Yes** *M. euphorbiae* has been reported to attack *Vitis vinifera* in Italy and is associated with grape bunches (Ciampolini and Maiulini 1990).	**Yes for WA** Present in WA (Plant Health Australia 2001; CSIRO 2005) **Yes for other states** Present in QLD, NSW, Vic., SA, Tas. (Plant Health Australia 2001; CSIRO 2005) and NT (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Metcalfa pruinosa Say 1830 [Flatidae] Frosted moth bug	**No** Although reported as being present in California (Wilson and McPherson 1981; CABI 2011) these records reference authorities from before 1960 (van Duzee 1917; Metcalf and Bruner 1948; Metcalf 1957). According to Wilson and Lucchi (2000; 2012) the records from California are unreliable because features of the genetalia of both sexes may not have been used to identify the specimens. With no contemporary records to confirm this insect's occurrence in California, DAFF considers the species to be absent from California.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Nysius raphanus Howard, 1872 [Lygaeidae] False chinch bug	**Yes** Present in California including the San Joaquin Valley (Bentley *et al.* 2009).	**No** Nymphs and adults may migrate from weed hosts to grapevine in search of new green growth (Flaherty *et al.* 1992; Bentley *et al.* 2009). Grapes become susceptible after leafing out, with the pest feeding on the foliage (Barnes 1970). Eggs are laid in the soil (Flaherty *et al.* 1992). Although most injury occurs during the prebloom period (Flaherty *et al.* 1992) on foliage (Barnes 1970), live *N. raphanus* insects have been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states and this pest should be consider a potential contaminant.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Parasaissetia nigra Nietner 1861 [Coccidae] Pomegranate scale	**Yes** Present in California (Ben-Dov *et al.* 2010).	**Yes** *Vitis vinifera* is a host of *P. nigra* (Ben-Dov *et al.* 2010) and may be present on plant stems (CABI 2011). As such, the pest may be associated with grape bunches.	**Yes for WA** Present in WA (Plant Health Australia 2001; CSIRO 2005). **Yes for other states** Present in QLD, NSW, Vic., NT (Plant Health Australia 2001; CSIRO 2005) and SA (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Parthenolecanium corni Bouché 1844 [Coccidae] European fruit lecanium	**Yes** Present in California (Golino *et al.* 2002; Ben-Dov *et al.* 2010).	**Yes** *P. corni* is a pest of *Vitis vinifera* (Ben-Dov *et al.* 2010) and can be found on grape bunches (Flaherty *et al.* 1992).	**No for WA** No records found for WA. **Yes for other states** Present in Vic., Tas. (Plant Health Australia 2001; CSIRO 2005) and NSW (CSIRO 2005).	**Yes** This pest is widely distributed in temperate and subtropical regions in North, Central and South America; Oceania; Asia and Europe (Ben-Dov *et al.* 2010). It is highly polyphagous with host plants in at least 40 families. Host genera include: *Acer*, *Pistacia*, *Acacia*, *Mentha*, *Asparagus*, *Pinus, Malus*, *Prunus*, *Pyrus* and *Vitis*. Could establish and spread in WA.	**Yes** Frequent and severe attacks on avocado in the Canary Ilands, also an important pest of avocado in the Caribbean (Swirski *et al.* 1997). It is mainly a pest of plum, raspberry, grape and sometimes apple, pear, apricot, peach and cherry (amongst others). Infested trees lose leaves and decrease their annual growth. Heavy infestations lead to fungal growth on the honeydew secretions (David'yan 2008). Also transmits viruses (Ben-Dov *et al.* 2010).	**Yes**
Philaenus spumarius Linnaeus1758 [Aphrophoridae] Meadow froghopper	**Yes** Present in California (CABI 2011)	**No** *P. spumarius* is a xylem feeding insect (Crews *et al.* 1998) that attacks the leaves of *Vitis vinifera* (Bournier 1977). No association was found with fruit. Eggs are oviposited into crevices such as leaf sheafs (CABI 2011).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Planococcus ficus* (Signoret) Synonyms: *Coccus vitis* (Nedzilskii 1869, *Dactylopius vitis* (Lichtenstein 1870), *Pseudococcus citri* (Balachowsky & Mesnil 1935) [Pseudococcidae] Vine mealybug			**No records found**			
Pseudococcus calceolariae Maskell 1879 [Pseudococcidae] Citrophilus mealybug	**Yes** Present in California (Ben-Dov 1994).	**Yes** *P.calceolariae* is a pest of *Vitis vinifera* (Ben-Dov 1994). Mealybugs are commonly found in sheltered locations such as grape bunches (Furness and Charles 1994).	**No for WA** No records found for WA. **Yes for other states** Present in QLD, NSW, Vic., Tas. and SA (Plant Health Australia 2001; CSIRO 2005).	**Yes** This insect has a wide host range and is recorded from hosts in 40 plant families (Ben-Dov 2009) most of which occur in Australia. Its wide host range, global distribution and presence in eastern Australia and Tasmania suggests potential for establishment and spread in WA (Gullan 2000; CABI 2011).	**Yes** This mealybug is a highly polyphagous species, reported as a pest of citrus and grapevines (CABI 2011). Mealybugs produce honeydew that causes the development of sooty mould which discolours the fruit (CABI 2011).	**Yes**
Pseudococcus longispinus (Targioni Tozzetti, 1867) [Pseudococcidae] Long-tailed mealybug	**Yes** Cosmopolitan species known to be in California since 1933 and is limited to Central Coast vineyards (Daane *et al.* 2008).	**Yes** Although primarily reported in association with the bark of the trunk, cordons, spurs and leaves (Bentley *et al.* 2009), infestation of grape bunches is known (Charles 1982).	**Yes for WA** Present in WA (Plant Health Australia 2001) **Yes for other states** Present in ACT, NSW, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Pseudococcus maritimus* (Ehrhorn, 1900) [Pseudococcidae] Grape mealybug			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pseudococcus viburni (Signoret, 1875) [Pseudococcidae] Obscure mealybug	**Yes** Commonly found in Central Coast Californian vineyards (Daane *et al.* 2008; Bentley *et al.* 2009).	**Yes** In late spring, obscure mealybugs begin feeding on leaves, with the majority remaining hidden under bark or within grape clusters (Bentley *et al.* 2009).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, QLD, SA and Tas. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Saissetia coffeae Walker 1852 [Coccidae] Hemispherical scale	**Yes** Present in California (Ben-Dov 1993)	**Yes** *S. coffeae* may be found on leaves, twigs, branches and fruit (CABI 2011). It is a pest of *Vitis vinifera* (Ben-Dov 1993). Some scales are found on grape bunches (Flaherty *et al.* 1992).	**Yes for WA** **Yes for other states** Present in all states and territories (Plant Health Australia 2001; CSIRO 2005).	**Assessment not required**	**Assessment not required**	**No**
Scaphoideus titanus Ball Synonym: *Scaphoideus littoralis* [Cicadellidae]	**Yes** Present in California (CABI 2011)	**No** All life stages of this pest have been collected on *Vitis vinifera* in the USA (Maixner *et al.* 1993). The eggs are found under the bark; adults and fourth and fith instar nymphs can feed on green shoots and stems (Lessio and Alma 2006). A direct association with fruit was not found.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Xyphon fulgida Nottingham Synonym: *Carneocephala fulgida* [Cicadellidae] Red-headed sharpshooter	**Yes** Present in California (Redak *et al.* 2004; Bentley *et al.* 2009).	**No** *C. fulgida* feeds on pastures, and *Vitis vinifera* is only an occasional host (Purcell and Frazier 1985; Bentley *et al.* 2009). Furthermore, given the large size and mobility of sharpshooter species, they are easily detected and disturbed during harvest and packing house operations.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Order Hymenoptera						
Formica aerata Francoeur 1973 [Formicidae] Gray field ant	**Yes** Present in California, including San Joaquin Valley (Bentley *et al.* 2009).	**No** No records found of association with grape bunches	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Formica perpilosa Wheeler 1913 [Formicidae]	**Yes** Present in California, including Riverside County (Tollerup *et al.* 2007).	**No** No records found of association with grape bunches	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Linepithema humile Mayr 1868 [Formicidae] Argentine ant	**Yes** Present in California (Bentley *et al.* 2009).	**No** No records found of association with grape bunches	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Solenopsis molesta Say 1836 [Formicidae] Fourmi ravisseuse, Thief ant	**Yes** Present in California (Bentley *et al.* 2009).	**No** No records found of association with grape bunches	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Solenopsis xyloni McCook [Formicidae] Southern fire ant	**Yes** Native to the USA and Mexico, present on the Pacific coast of California (Harris 2012; Lubertazzi and Alpert 2012).	**No** Primarily a ground nesting pest (Harris 2012), but it does feed on honeydew excreted by the European fruit lecanium scale and mealybugs (Bentley *et al.* 2009). However, it is not a pest of grapevines. Given its size, colouring, mobility, and aggressive behaviour, it is unlikely to be present as a contaminant pest on harvested table grape bunches for export.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Tetramorium caespitum Linnaeus 1758 [Formicidae] Pavement ant	**Yes** Present in California (University of California 2008b).	**No** No records found of an association with grape bunches	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Vespula germanica Fabricius [Vespidae] European wasp	**Yes** Present in California (Spradbery P and P & Dvorak L 2010).	**No** Although recorded as a pest of grapevine (Ward 2001), it is believed that no stage of the wasp's life cycle would be present on the commodity after harvesting and grading. The larvae feed on insects and meat (Department of Primary Industry 2011). Adults feed on nectar and ripe fruits but are aggressive when disturbed (Department of Primary Industry 2011; INRA 2012).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Lepidoptera						
Existing California table grape policy *Amyelois transitella* (Walker 1863) Synonym: *Paramyelois transitella* (Walker 1863); *Emporia cassiae* Dyar 1917; *Myelois duplipunctella* Ragonot 1887; *Nephopterix notatalis* Walker 1863; *Myelois solitella* Zeller 1881; *Myelois venipars* Dyar 1914 [Pyralidae] Navel orangeworm			**No records found**			
Existing California table grape policy *Argyrotaenia citrana* Fernald 1889 Synonym: *Argyrotaenia franciscana* Walsingham 1879; *Eulia citrana* Fernald 1889; *Argyrotaenia kearfotti* Obraztsov 1961 [Tortricidae] Orange tortrix			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Cnephasia longana (Haworth) [Tortricidae] Omnivorous leaf roller or Omnivorous leaf-tier	**Yes** First recognised in California in 1948 (Pritchard and Middlekauff 1950). Occurs throughout the United States (Hollingsworth 2008).	**No** A literature search found two papers listing *Vitis vinifera* as a host of *Cnephasia longana* (Hill 1987; Plantwise 2012). However, these authors do not provide an authority for the host association. All other papers reviewed did not give *V. vinifera* as a host although at least 20 host plants have been listed (for example, see Antonelli *et al.* (2004). This pest has been present in California since the early 20th Century (Powell 1997), but no reports of an association with *V. vinifera* in California have been found.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Desmia funeralis* Hübner 1796 [Pyralidae] Grape leaffolder			**No records found**			
Epiphyas postvittana (Walker) [Torticinae] Light brown apple moth	**Yes** Present in California (APHIS 2011b).	**Yes** *Vitis vinifera* is a host (Venette *et al.* 2003) and it feeds on the leaves, buds, flowers and fruit of its hosts (Gilligan and Epstein 2009). Although regulatory mechanisms and eradication programs have been implemented since its detection in California, reports for some Californian counties persist (APHIS 2011b) and federal orders remain in place for the movement of regulated articles, including table grape commodities (APHIS 2011a).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in ACT, NSW, NT, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Estigmene acrea* (Drury 1773) [Actiidae] Salt marsh moth			**No records found**			
Euchromius californicalis Packard [Crambidae]	**Yes** Present in California (Capps 1966; Brown 2000).	**No** Has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. As no records could be found that associate *E. californicalis* with *Vitis vinifera*, it is likely that this pest was intercepted as a contaminant rather than a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Eulithis diversilineata* (Hübner, 1813) [Geometridae] Grape looper			**No records found**			
Existing California table grape policy *Harrisina brillians* Barnes and McDunnough 1910 [Zygaenidae] Western grapevine skeletoniser			**No records found**			
Existing California table grape policy *Lobesia botrana* (Denis & Schiffermuller 1775) [Tortricidae] European grapevine moth			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Marmara gulosa Guillèn and Davis [Gracillariidae] Citrus peelminer	**Yes** Present in California (Stelinski 2007; Kirkland 2009)	**Yes** Is known to be associated with the stem, petiole, tendril, bunch rachis and berry of grapes (Eichlin and Kinnee 2001).	**No records found**	**Yes** Reported from California, Arizona, Texas, Florida, Mexico and Cuba (Eichlin and Kinnee 2001; Stelinski 2007; Kirkland 2009). Many of the climates in its known range are similar to that of Western Australia. Its wide host range across species of commercial fruit crops, ornamentals and weeds (Eichlin and Kinnee 2001) would also allow it to establish and spread in Western Australia.	**Yes** Infestations have resulted in considerable economic losses to citrus growers (Kirkland 2009). Extensive damage has been recorded in citrus groves in southern California and Arizona and it aggressively feeds on citrus and a range of other commodities in the San Joaquin Valley, with fruit infestation rates of up to 70% reported (Kirkland 2009). In grapes, mining damage can also lead to secondary infections, such as bunch rot (Kirkland 2009).	**Yes**
Orthodes rufula Grotes [Noctuidae] Brassy cutworm	**Yes** Found in both coastal and San Joaquin Valley grape growing areas of California (Donaldson *et al.* 2012).	**No** It is not associated with mature grape bunches. This pest damages grapevines in early spring and is associated with developing buds not fruit (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Peridroma saucia (Hübner, 1808) [Arctiidae] Variegated cutworm, pearly underwing moth	**Yes** Present in California, including the San Joaquin Valley and North Coast (Bentley *et al.* 2009).	**No** *Peridroma saucia* larvae feed on buds on grapevines (MAF Biosecurity New Zealand 2009; Bentley *et al.* 2009). Larvae move to the soil or under bark during the day (Bentley *et al.* 2009) and adults are inactive during the day, remaining under foliage or at the base of the plant (Mau and Martin Kessing 2007).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Platynota stultana* Walsingham [Tortricidae] Omnivorous leafroller			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Plodia interpunctella Hübner 1813 [Pyralidae] Indian meal moth	**Yes** Present in California (Flaherty *et al.* 1992).	**No** Primarily a storage pest of dried fruits, nuts, grains and cereal products with infestations most commonly occurring after 30-60 days of storage (Flaherty *et al.* 1992). It is commonly encountered as a household pest, feeding on stored food products (Fasulo 1998).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Polychrosis viteana* Clemens [Tortricidae] Grape berry moth			**No records found**			
Xestia c-nigrum (Linnaeus 1758) Synonym: *Amathes c-nigrum* [Arctiidae] Spotted cutworm	**Yes** Present in California (Bentley *et al.* 2009).	**No** This pest is not associated with mature grape bunches. They feed on buds and young foliage during the night and return to the ground to shelter under leaf litter or debris during the day (Pfeiffer 2009). They can also be found under grapevine bark (Bentley *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Mantodea						
Iris oratoria Linnaeus 1758 [Mantidae] Mediterranean Mantis	**Yes** Present in California (Maxwell and Eitan 1998)	**No** Mantids are generalist predators and are not associated with particular plants. This species has been intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states. However, it was a contaminant of the consignment and is not a pest of grapes.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Neuroptera						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Chrysoperla spp. Steinmann 1964 [Chrysopidae]	**Yes** Species of this genus are known to occur in California (Brooks 1994).	**No** *Chrysoperla* are known to occur on *Vitis vinifera* in California (Costello and Daane 1999). However, species in this genus are not plant pests; they are unselective predators that search freely over the host plant. *Chrysoperla* was intercepted by DAFF operational staff during inspections of Californian table grapes for export to Australian eastern states, but they do not have a host relationship with grapes and were a contaminant.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Thysanoptera						
Existing California table grape policy *Caliothrips fasciatus* (Pergande) Synonyms: *Heliothrips fasciatus* Pergande 1895; *Caliothrips woodworthi* Daniel 1904 [Thripidae] <u>Bean thrips</u>			**No records found**			
Existing California table grape policy *Drepanothrips reuteri* [Thripidae] <u>Grape thrips</u>			**No records found**			
Existing California table grape policy *Frankliniella minuta* (Moulton 1907) Synonyms: *Euthrips minutus* Moulton, 1907; *Euthrips minutus* var. *setosus* Crawford DL, 1909; *Frankliniella minuta* f. *luminosa* Moulton, 1948 [Thripidae]			**No records found**			

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Existing California table grape policy *Frankliniella occidentalis* (Pergande 1895) [Thripidae] Western flower thrips			**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states except NT** Present in ACT, NSW, QLD, SA, Tas. and Vic. (Plant Health Australia 2001), but is absent from NT (DRDPIFR NT 2008).			
Existing California table grape policy *Scirtothrips citri* (Moulton) Synonyms: *Euthrips citri* Moulton 1909, *Scirtothrips clivicola* Hood 1957 [Thripidae] Californian citrus thrips			**No records found**			
Existing California table grape policy *Scirtothrips perseae* Nakahara [Thripidae] Avocado thrips			**No records found**			
Thrips hawaiiensis Morgan 1913 [Thripidae] Hawaiian flower thrips	**Yes** Present in California (Palmer and Wetton 1987; Nakahara 1994)	**Yes** This is a phytophagous species (Childers and Nakahara 2006) associated with table grapes and fruiting stages of its hosts (CABI 2011). International trade of fruit from contaminated areas is probably the main reason for its spread (Reynaud *et al.* 2008).	**Yes for WA** Present in WA (Plant Health Australia 2001; Poole 2008; Poole 2010) **Yes for other states** Present in NSW, NT, QLD, SA and Vic. (Plant Health Australia 2001)	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
CHROMALVEOLATA (Kingdom)						
Order Peronosporales (Albugo, Phytophthora)						
Phytophthora cryptogea Pethybr. & Laff. 1919 [Pythiaceae] Phytophthora root rot	**Yes** Present in California (CABI 2011).	**Yes** *P. cryptogea* is primarily soil borne (CABI 2011) and causes canker at or below the ground line in the root-crown area (Jones and Sutton 1996). However zoospores may be splashed onto fruit and cause rot (Jones and Sutton 1996), and fruit and stems may carry hyphae and spores in trade or transport (CABI 2011). *Vitis vinifera* is a host of *P. crytogea* (CABI 2011).	**Yes for WA** Present in WA (Plant Health Australia 2001) **Yes for other states** Present in QLD, NSW, ACT, Vic., SA and Tas. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Plasmopara viticola (Berk. & M.A. Curtis) Berl. & De Toni 1888 Synonym: *Botrytis viticola* Berk. & M.A. Curtis 1848 [Family] Grapevine downy mildew	**Yes** Present in California (Gubler *et al.* 2009).	**Yes** Infects flower clusters, bunches and young berries, however mature fruit is resistant to infection (Magarey *et al.* 1994).	**Yes for WA** Present in WA (Plant Health Australia 2001) **Yes for other states** Present in ACT, NSW, NT, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Saprolegniales						
Pythium Nees 1823 [Incertae sedis]	**Yes** A number of *Pythium* spp. are reported from California, including *P. irregular*, *P. splendens* (CABI 2011) and *P. ultimum* (Granett *et al.* 1998).	**No** *Pythium* spp. are soil borne and cause root roots and damping off of seedlings (RBG 2012a).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
DOMAIN FUNGI						
Order Agaricales						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Armillaria mellea (Vahl : Fr.) P. Kumm. 1871 [Physalacriaceae] Grape root rot	**Yes** Found on a wide range of woody plants in California with pre-plant treatments sometimes required for vineyards in Napa, Sonoma, Santa Clara, Salinas and northern San Joaquin Valley (Flaherty *et al.* 1992).	**No** Survives on diseased wood and roots below ground (Flaherty *et al.* 1992). It infects roots and is not typically soil borne (Pearson and Goheen 1988). Movement between plants occurs through root contact (Pearson and Goheen 1988).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Pleurotus ostreatus (Jacq. : Fr.) P. Kumm. 1871 Anamorph/ Teleomorph: Synonym: *Agaricus ostreatus* Jacq. : Fr. 1774 Note: Sanctioned by Fries, Syst. Mycol. I:182, 1821. [Pleurotaceae] Oyster mushroom	**Yes** Present in California (CABI 2011).	**No** *P. ostreatus* uses living and dead wood as a substrate for growth (Farr and Rossman 2006). *Vitis vinifera* is not listed as a common host of *P. ostreatus* (Hickman *et al.* 2011).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Botryosphaeriales						
Botryosphaeria australis Slippers, Crous & M.J. Wingf. 2004 Anamorph: *Neofusicoccum australe* (Slippers, Crous & M.J. Wingf.) Crous, Slippers & A.J.L. Phillips [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2006).	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**Yes for WA** Present in WA (Plant Health Australia 2001; Taylor *et al.* 2005) **Yes for other states** Present in NSW, SA and Vic. (Plant Health Australia 2001)	**Assessment not required**	**Assessment not required**	**No**
Botryosphaeria corticola A.J.L. Phillips, A. Alves & J. Luque Anamorph: *Diplodia corticola* A.J.L. Phillips, A. Alves & J. Luque 2004 [Botryosphaeriaceae]	**Yes** Present in California (recorded as *Diplodia corticola*) (Gubler *et al.* 2010).	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**No records found**	**Yes** Other species of *Botryosphaeria* are already present in Western Australia (Plant Health Australia 2001) which suggests that new species could establish and spread.	**No** Current management practises for other species of *Botryosphaeria* are likely to control this species.	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Botryosphaeria iberica A.J.L. Phillips, J. Luque & A. Alves 2005 Anamorph: *Dothiorella iberica* A.J.L. Phillips, J. Luque & A. Alves [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2007)	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**No for WA** No records found for WA. **Yes for other states** Present in SA and Vic. (Plant Health Australia 2001).	**Yes** Other species of *Botryosphaeria* are already present in Western Australia (Plant Health Australia 2001) which suggests that new species could establish and spread.	**No** Current management practises for other species of *Botryosphaeria* are likely to control this species.	**No**
Botryosphaeria lutea A.J.L. Phillips 2002 Anamorph: *Neofusicoccum luteum* (Pennycook & Samuels) Crous, Slippers & A.J.L. Phillips [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2006).	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Botryosphaeria obtusa (Schwein.) Shoemaker 1964 Anamorph: *Diplodia seriata* De Not. Synonym: *Sphaeria obtusa* Schwein. 1832 [Botryosphaeriaceae] <u>Dead arm</u>	**Yes** Present in California (Úrbez-Torres *et al.* 2006)	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**Yes for WA** Present in WA (Plant Health Australia 2001; Taylor *et al.* 2005). **Yes for other states** Present in ACT, NSW, QLD, Vic. and SA (Plant Health Australia 2001)	**Assessment not required**	**Assessment not required**	**No**
Botryosphaeria parva Pennycook & Samuels 1985 Anamorph: *Neofusicoccum parvum* (Pennycook & Samuels) Crous, Slippers & A.J.L. Phillips [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2006).	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, NT and QLD (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Botryosphaeria rhodina (Berk. & Curtis) Arx Anamorph: *Lasiodiplodia theobromae* (Pat.) Griffon & Maubl. Synonyms: *Physalospora rhodina* Berk. & M.A. Curtis 1889; *Botryodiplodia theobromae* Pat. 1892 [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2006).	**Yes** *Botryosphaeria* species are most commonly associated with wood decay and canker (Úrbez-Torres *et al.* 2007) but can also be associated with bunch rot (Cooperative Research Centre for Viticulture 2005; Wunderlich *et al.* 2010).	**Yes for WA** Present in WA (Plant Health Australia 2001; Taylor *et al.* 2005). **Yes for other states** Present in NSW, Qld and SA (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Fusarium oxysporum Schltdl. : Fr. 1824 Synonym: *Fusarium angustum* Sherb. 1915 [Nectriaceae] <u>Fusarium wilt</u>	**Yes** Present in California (Farr and Rossman 2006).	**Yes** Mainly found as a soil saprophyte (Booth 1970), however it has been intercepted in Australia on fresh mangosteen fruit from Thailand.	**Yes for WA** **Yes for other states** Present in all states and territories (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Fusarium proliferatum (Matsushima) Nirenberg ex Gerlach & Nirenberg 1982 Synonym: *Cephalosporium proliferatum* Matsush. 1971 [Nectriaceae]	**Yes** Present in California (Farr and Rossman 2006).	**Yes** Occurs widely on grape berries and has been investigated as a biocontrol agent against grapevine downy mildew (Falk *et al.* 1996).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, NT, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Fusarium sacchari (E.J. Butler) W. Gams 1971 [Nectriaceae]	**Yes** Present in California (CABI 2011).	**No** No records found of an association with table grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Gibberella intricans Wollenw. 1930 Anamorph: *Fusarium equiseti* (Corda) Sacc. [Nectriaceae]	**Yes** Present in California (Farr and Rossman 2006).	**No** No records found of an association with table grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Guignardia bidwellii (Ellis) Viala & Ravaz Anamorph*: Phyllosticta ampelicida* (Engelm.) Van der Aa Synonyms: *Sphaeria bidwellii* Ellis 1880; *Botryosphaeria bidwellii* (Ellis) Petr. 1958 [1957]; *Carlia bidwellii* (Ellis) Prunet 1898; *Laestadia bidwellii* (Ellis) Viala & Ravaz 1888. [Botryosphaeriaceae] <u>Black rot</u>	**No** Present in eastern USA (Spotts 1977; Becker and Pearson 1996), including Michigan (Ferrin and Ramsdell 1978), New York (Hoffman *et al.* 2002), Virginia (Zhou and Stanosz 2001) and Ohio (Spotts 1980). Not present in western USA (Farr and Rossman 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Lasiodiplodia crassispora T. Burgess & Barber 2006 [Botryosphaeriaceae]	**Yes** Present in California (Úrbez-Torres *et al.* 2010).	**No** No records found of an association with table grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Neofusicoccum mangiferae (Syd. & P. Syd.) Crous, Slippers & A.J.L. Phillips 2006 Synonym*: Nattrassia mangiferae* (Syd. & P. Syd.) B. Sutton & Dyko 1989 [Botryosphaeriaceae] <u>Leaf spot</u>	**Yes** Present in California (Mayorquin *et al.* 2012).	**No** No records found of an association with *Vitus* spp.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Neofusicoccum mediterraneum Crous, M.J. Wingf. & A.J.L. Phillips 2007 Anamorph/ Teleomorph: Synonym: [Botryosphaeriaceae] <u>Common name</u>	**Yes** Present in California (Úrbez-Torres *et al.* 2010)	**No** No records found of an association with table grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Spencermartinsia viticola (A.J.L. Phillips & J. Luque) A.J.L. Phillips, A. Alves & Crous 2008 Anamorph: *Dothiorella viticola* A.J.L. Phillips & J. Luque 2006 Synonym: *Botryosphaeria viticola* A.J.L. Phillips & Luque 2006 [Dothideaceae]	**Yes** Present in California including Riverside County (Úrbez-Torres *et al.* 2007).	**Yes** Has been isolated from berries at harvest (Wunderlich *et al.* 2011).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW and SA (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Capnodiales						
Cladosporium herbarum (Pers.:Fr) Pouzar [Meruliaceae] <u>Summer bunch rot</u>	**Yes** Present in California (Bensch *et al.* 2010).	**Yes** Causes rot on wine grapes in Chile (Briceño and Latorre 2007). *C. herbarum* is common in the San Joaquin Valley of California (Flaherty *et al.* 1992). This pathogen causes secondary infection following mechanical damage to the berries (Flaherty *et al.* 1992). Masses of black, brown or green spores develop on the surface of infected berries (Gubler *et al.* 2009).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Chaetothyriales						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phaeomoniella chlamydospora (W. Gams, Crous, M.J. Wingf. & Mugnai) Crous & W. Gams 2000 Synonym: *Phaeoacremonium chlamydosporum* W. Gams, Crous, M.J. Wingf. & Mugnai 1996 [Herpotrichiellaceae] Esca and Petri disease	**Yes** Present in California (Crous *et al.* 1996; Whiting *et al.* 2005).	**No** *P. chlamydospora*, in combination with *Phaeoacremonium aleophilum*, is reported as the main causal agent of esca disease and Petri decline of grapevine in California (University of California 2013b), both of which are reported from Western Australia (Plant Health Australia 2001; Edwards and Pascoe 2004). It is commonly reported as a fungal trunk pathogen and is thought to establish during nursery operations resulting from the use of infected propagation material (Aroca *et al.* 2010). In the field, infection occurs through roots and pruning wounds (Mostert *et al.* 2006) and symptoms typically manifest as vascular streaking, stunted growth and shoot tip dieback (University of California 2013b). Leaf chlorosis and spotting of the berry surfaces has also been reported (University of California 2013b), but these symptoms are predominantly attributed to the translocation of toxic fungal metabolites from the infected parts of the trunk and branches via the xylem stream (Bruno *et al.* 2007). Accordingly, *P. chlamydospora* is unlikely to be associated with commercial grape bunches. This is further supported by official detection records which indicate that *P. chlamydospora* has not been detected during inspection of table grapes from California into eastern Australia since trade commenced in 2002.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Diaporthales						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Greeneria uvicola (Berkley & M.A. Curtis) Punithalingam [Gnomoniaceae] <u>Bitter rot</u>	**No** Present in eastern USA, including North Carolina (Longland and Sutton 2008) and Mississippi (Kummuang *et al.* 1996). No records of the pathogen in California were found.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Phaeoacremonium aleophilum W. Gams, Crous, M.J. Wingf. & Mugnai 1996 Teleomorph: *Togninia minima* (Tul. & C. Tul.) Berl. [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (University of California 2013b) including in Riverside County (Scheck *et al.* 1998b). The teleomorph *Togninia minima* is also recorded from California, including Madera and Fresno counties (Rooney-Latham *et al.* 2005a).	**No** *Phaeoacremonium aleophilum*, in combination with *Phaeomoniella chlamydospora*, is reported as the main causal agent of esca disease and Petri decline of grapevine in California (University of California 2013b), both of which are reported from Western Australia (Plant Health Australia 2001; Edwards and Pascoe 2004). In Australia, for example, *P. aleophilum* was isolated from 19 of 124 samples taken from grapevines showing esca and Petri disease symptoms, and *P. chlamydospora* was isolated in 122 of those samples (Edwards and Pascoe 2006). Petri disease symptoms include streaking of the xylem tissues, stunted growth and dieback, whereas esca symptoms include internal wood deterioration, leaf chlorosis and berries with small, brown to purple spots (Essakhi *et al.* 2008). Although leaf chlorosis and berry spots have been reported, studies on *P. aleophilum* and *Pm. chlamydospora* have associated these symptoms with the translocation of toxic fungal metabolites from the infected parts of the trunk and branches via the xylem stream (Bruno *et al.* 2007). Airborne spores and surface contamination of the aerial parts of the vine have also been reported, however pruning wounds are thought to be the main	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Phaeoacremonium angustius W. Gams, Crous & M.J. Wingf. 1996 [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (University of California 2013b).					
Phaeoacremonium inflatipes W. Gams, Crous & M.J. Wingf. 1996 [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California, including Contra Costa, Lake, San Joaquin and Riverside counties (Scheck *et al.* 1998b).					
Phaeoacremonium mortoniae Crous & W. Gams 2001 Teleomorph*: Togninia fraxinopennsylvanica* (T.E. Hinds) Hausner, Eyjólfsdóttir & J. Reid [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (Rooney-Latham *et al.* 2005b).					

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phaeoacremonium parasiticum (Ajello, Georg & C.J.K. Wang) W. Gams, Crous & M.J. Wingf. 1996 Teleomorph: *Togninia parasitica* L. Mostert, W. Gams & Crous [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (Dupont *et al.* 2002);(Mostert *et al.* 2005).	port of entry for *Phaeoacremonium* spp. into grapevines (Eskalen and Gubler 2001; Eskalen *et al.* 2007a). In addition, esca fungi are also thought to spread and establish during nursery operations as a result of infected propagation material (Aroca *et al.* 2010). Although *P. aleophilum* and *P. chlamydospora* are the main species involved in esca and Petri disease, some additional *Phaeoacremonium* spp. have also been reported from grapevine however there is some uncertainty regarding their significance in the etiology of the disease in California (these species are listed to the left) (University of California 2013b). In addition, there has been some contention as to the validity of records for these additional species in California, with recent molecular work showing some records are in fact misidentifications of *P. aleophilum*. This has been the case for *P. inflatipes*, and some questions have also been raised in relation to *P. angustius* (Rooney-Latham *et al.* 2005b). For *P. parasiticum* and *P. rubrigenum*, these species have only been recorded as human pathogens in California (Dupont *et al.* 2002; Mostert *et al.* 2005), with no association with commercial grapevine production established. Reports of an additional two species, *P. mortoniae* and *P. viticola*, have been detected from Californian vineyards (Groenewald *et al.* 2001; Eskalen *et al.* 2005a; Eskalen *et al.*				
Phaeoacremonium rubrigenum W. Gams, Crous & M.J. Wingf. 1996 Teleomorph: *Togninia rubrigena* L. Mostert, W. Gams & Crous [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (University of California 2013b).					
Phaeoacremonium viticola J. Dupont 2000 Teleomorph: *Togninia viticola* L. Mostert, W. Gams & Crous [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (Eskalen *et al.* 2005a).					
Togninia californica [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (Eskalen *et al.* 2007b)					
Togninia davisiana [Togniniaceae] <u>Esca disease complex</u>	**Yes** Present in California (Eskalen *et al.* 2007b)					

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
		2005b), however following a review of these records for California as well as from various countries worldwide, these species have only been isolated from wood and vegetative tissue of grapevines, and not from grape bunches (Dupont *et al.* 2000; Groenewald *et al.* 2001; Eskalen *et al.* 2005b; Gramaje *et al.* 2007; Mohammadi 2011; CBS KNAW 2013). The teleomorph stages (*Togninia* spp.) have been identified for a range of *Phaeoacremonium* spp., however there is significant uncertainty regarding its role in esca disease. While there are limited reports on the occurrence of perithecia of *Togninia* species in association with grapevine, *Togninia minimia* (sexual stage of *P. aleophilum*) is the most commonly identified species in the literature, which is reported in Australia from grapevine wood (Edwards *et al.* 2006). Studies in the literature have largely identified perithecia *in vitro* and there are only limited accounts of perithecia being identified under natural conditions, where they are associated with old pruning wounds, cordons and cracks in the trunks (Eskalen *et al.* 2005a; Eskalen *et al.* 2005b), but not on berries or bunches. Moreover, official detection records indicate that *Phaeoacremonium* spp. have not been detected during inspection of table grapes from California into other Australian states and territories since trade commenced in 2002. Accordingly, these species are unlikely to be associated with fresh mature harvested commercial table grape bunches.				

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phomopsis viticola (Sacc.) Sacc. 1915 Teleomorph: *Cryptosporella viticola* Shear Synonym: *Phoma viticola* Sacc. 1880; *Phomopsis ampelopsidis* Petr. 1916; *Fusicoccum viticola* Reddick 1909. [Diaporthaceae] Phomopsis cane and leaf spot	**Yes** Present in California, including the North Coast and the San Joaquin Valley (Gubler *et al.* 2009).	**Yes** *P. viticola* can infect leaves, shoots and canes of *Vitis vinifera* (Flaherty *et al.* 1992). It infects all parts of the grape bunch including rachis, pedicels and berries (Hewitt and Pearson 1988).	**No for WA** Plant Health Australia (2001) shows distribution records for WA, but these have been shown to be a misidentification. Sequencing of the ITS region has identified these samples as *Diaporthe australafricana* or other species of *Phomopsis* (Poole and Hammond 2011). **Yes for other states** Present in NSW, QLD, SA and Vic. (Plant Health Australia 2001).	**Yes** *P. viticola* is established in temperate grape growing regions throughout the world including in Africa, Asia, Australia (except Western Australia), Europe and North America (Hewitt and Pearson 1988). *P. viticola* is dispersed by rain splash and insects within the vineyard. Long distance dispersal occurs by movement of contaminated propagation material, pruning equipment and agricultural machinery (Burges *et al.* 2005).	**Yes** *P. viticola* is a serious pathogen of grapes in several viticultural regions around the world (Hewitt and Pearson 1988) and can cause vine stunting and reduced fruit yield (Burges *et al.* 2005).	**Yes**
*Pilidiella diplodiella (*Speg.) Crous & Van Niekerk Synonyms: *Coniella diplodiella* (Speg.) Petr. & Syd.; *Coniothyrium diplodiella* (Speg.) Sacc. [Schizoparmaceae] White rot	**No** Known to be present in the USA (CABI 2011) with specific records for eastern states, Floida and Texas (as *Coniothyrium diplodiella*) (Farr and Rossman 2012). But no records were found for California.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Erysiphales						
Erysiphe necator var. *necator* Schwein. 1834 Anamorph: *Oidium tuckeri* Berk. 1847 Synonyms: *Uncinula necator* (Schwein.) Burrill 1892; *Uncinula americana* Howe 1872 [Erysiphaceae] Grapevine powdery mildew	**Yes** Present in California (USDA 1960)	**Yes** Affects all green tissue of the grapevine, including fruit (CABI 2011).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in Vic., SA, Tas., NT, QLD and NSW (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Order Eurotiales						
Aspergillus aculeatus Iizuka 1953 Synonyms: *Aspergillus japonicus* var. *aculeatus* (Iizuka) Al-Musallam 1980 [Trichocomaceae]	**Yes** Present in California (as *Aspergillus japonicus* var. *aculeatus*) (Doster *et al.* 1996).	**Yes** This is a wound pathogen of grape berries. It enters the berries through fractures caused by partial detachment of the fruit at the pedicel and through splits and insect punctures (Jarvis and Traquair 1984).	**No for WA** No records found for WA. **Yes for other states** Present in NSW (Plant Health Australia 2001) and Victoria (Leong *et al.* 2008).	**Yes** *Aspergillus* spores drift on air currents and disperse both short and long distances. When they come into contact with solid or liquid surfaces, if the moisture conditions are right, they germinate. *Aspergillus* disperse easily and grow almost anywhere when food and water are available (Bennett 2010).	**No** *Aspergillus* spp. are secondary invaders of grape berries that have been damaged by insects, pathogens, environmental factors such as rain and wind (Somma *et al.* 2012), or through fractures caused by partial detachment of berries at the pedicel (Jarvis and Traquair 1984). Furthermore, *A. niger* is already present in WA (Plant Health Australia 2001) and is associated with grape berries (Leong *et al.* 2006). Introduction of this species is unlikely to have significant economic effects.	**No**
Aspergillus carbonarius (Bainier) Thom 1916 Synonyms: *Sterigmatocystis carbonaria* Bainier 1880; *Rhopalocystis carbonaria* (Bainier) Grove 1911 [Trichocomaceae]	**Yes** Present in California (Rooney-Latham *et al.* 2008).	**Yes** Causes rot in grape berries (Leong *et al.* 2004).	**No for WA** No records found for WA. **Yes for other states** Present in NSW (Plant Health Australia 2001) and Victoria (Leong *et al.* 2008).	**Yes** *Aspergillus* spores drift on air currents and disperse both short and long distances. When they come into contact with solid or liquid surfaces, if the moisture conditions are right, they germinate. *Aspergillus* disperse easily and grow almost anywhere when food and water are available (Bennett 2010).	**No** *Aspergillus* spp. are secondary invaders of grape berries that have been damaged by insects, pathogens, environmental factors such as rain and wind (Somma *et al.* 2012), or through fractures caused by partial detachment of berries at the pedicel (Jarvis and Traquair 1984). Furthermore, *A. niger* is already present in WA (Plant Health Australia 2001) and is associated with grape berries (Leong *et al.* 2006). Introduction of this species is unlikely to have significant economic effects.	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Aspergillus japonicus Saito 1906 Synonyms: *Aspergillus brunneoviolaceus* Bat. & Maia 1955 [Trichocomaceae]	**Yes** Present in California (Doster and Michailides 1994; Doster *et al.* 1996).	**Yes** Assoicated with rotting grape berries (Bejaoui *et al.* 2006; Somma *et al.* 2012).	**No records found**	**Yes** *Aspergillus* spores drift on air currents and disperse both short and long distances. When they come into contact with solid or liquid surfaces, if the moisture conditions are right, they germinate. *Aspergillus* disperse easily and grow almost anywhere when food and water are available (Bennett 2010).	**No** *Aspergillus* spp. are secondary invaders of grape berries that have been damaged by insects, pathogens, environmental factors such as rain and wind (Somma *et al.* 2012), or through fractures caused by partial detachment of berries at the pedicel (Jarvis and Traquair 1984). Furthermore, many species of *Aspergillus* are already present in Australia (Plant Health Australia 2001) and *A. carbonarius*, *A. niger*, and *A. aculeatus* are all known to be associated with grape berries already (Leong *et al.* 2006).	**No**
Aspergillus niger Tiegh. [Trichocomaceae] Black mould	**Yes** Present in California, including in the San Joaquin Valley (Flaherty *et al.* 1992).	**Yes** Infects berries as a post harvest rot (Perrone *et al.* 2006).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in ACT, NSW, NT, QLD and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Penicillium sp. Link: Fr [Trichocomaceae] Penicillium rots	**Yes** *Penicillium* species are present in California, including in the San Joaquin Valley (Flaherty *et al.* 1992).	**Yes** Ripening and stored grape berries are susceptible to infection and rotting (Flaherty *et al.* 1992). A number of *Penicillium* species can infest grape berries (Duncan *et al.* 1995; Franck *et al.* 2005; Kim *et al.* 2007). Duncan *et al.* (Duncan *et al.* 1995) isolated 18 species of *Penicillium* from grape berries in California, with *P. glabrum* and *P. brevicompactum* being frequently recovered. Furthermore, *P. expansum* has been recorded on grapes (Franck *et al.* 2005) and has also been recorded in California (CABI 2011).	**Yes for WA** **Yes for other states** Many species of *Penicillium* have been recorded from all states and territories in Australia (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Helotiales						
Botrytis cinerea Pers.: Fr. 1794 Teleomorph: *Botryotinia fuckeliana* (de Bary) Whetzel [Sclerotiniaceae] Grey mould	**Yes** Present in California, including the Central Valley (Rosslenbroich and Stuebler 2000; Gubler *et al.* 2009).	**Yes** The fungus can grow on damaged or ripe grape berries, as well as flowers, young shoots or dead leaves (Flaherty *et al.* 1992).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in ACT, NSW, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Existing California table grape policy *Pseudopezicula tetraspora* Korf, R.C. Pearson & Zhuang 1986 [1985] [Helotiaceae] Angular leaf scorch			**No records found**			
Order Hypocreales						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Cylindrocarpon destructans (Zinssm.) Scholten 1964 Teleomorph: *Neonectria radicicola* (Gerlach & Nilsson) Mantiri & Samuels [Nectriaceae] Black foot	**Yes** Present in California (Kodira 2007); (Scheck *et al.* 1998a)	**No** *C. destructans* is found in soil, roots, wood and herbaceous debris (Farr and Rossman 2012). In grapevine, it may cause necrotic root lesions, discolouration of the trunk and stunted growth (Halleen *et al.* 2006a). Hyphae may be present in the ray cells of the trunk and xylem vessels may become plugged with tyloses (Halleen *et al.* 2006a). A pathogeniciy study showed *C. radicicola* (= *C. destructans*) could infect inoculated green grape berries, but only when the berry skin was first damaged, indicating the fungus is a secondary invader of damaged tissue (Halleen *et al.* 2006a).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Cylindrocarpon liriodendri J.D. MacDon. & E.E. Butler 1981 Teleomorph: *Ilyonectria liriodendri* (Halleen, Rego & Crous) P. Chaverri & C. Salgado 2011 [Nectriaceae] Black foot	**Yes** Present in California (CDFA 2009);(Halleen *et al.* 2006b);(Petit and Gubler 2007).	**No** *C. liriodendri* causes back foot of grapevines (Halleen *et al.* 2006b);(Mohammadi *et al.* 2009). Black foot fungi cause necrotic root lesions and necrosis at the base of the trunk (Petit and Gubler 2005). Xylem vessels may become plugged with tyloses, leaves may appear water-stressed and vines may become stunted (Petit and Gubler 2005).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Cylindrocarpon macrodidymum Halleen, Schroers & Crous Teleomorph: *Neonectria macrodidyma* Halleen, Schroers & Crous [Nectriaceae] Black foot	**Yes** Present in California (Petit and Gubler 2005).	**No** In grapevine, *C. macrodidymum* causes necrotic root lesions and necrosis at the base of the trunk (Petit and Gubler 2005). Xylem vessels may become plugged with tyloses, leaves may appear water-stressed and vines may become stunted (Petit and Gubler 2005).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Cylindrocarpon obtusisporum (Cooke & Harkn.) Wollenw. 1926 Teleomorph: *Neonectria tawa* Dingley [Nectriaceae] Black foot	**Yes** Present in Californian debris (Farr and Rossman 2012) including Tulare County (Scheck *et al.* 1998a).	**No** *C. obtusisporum* is a soil and water-borne root rot pathogen (Farr and Rossman 2012). It infects grapevines through openings or wounds on the roots and other below ground parts of the rootstock (Scheck *et al.* 1998a). It has been isolated from roots and trunks of symptomatic grapevines (Scheck *et al.* 1998a).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Fusarium oxysporum Schltdl. : Fr. 1824 Anamorph/ Teleomorph: Synonym: *Fusarium angustum* Sherb. 1915 [Nectriaceae] Fusarium wilt	**Yes** Present in California (Farr and Rossman 2006; CABI 2011).	**Yes** Mainly found as a soil saprophyte (Booth 1970), however it has been intercepted in Australia on fresh mangosteen fruit from Thailand.	**Yes for WA** **Yes for other states** Present in all states and territories (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Fusarium proliferatum (Matsushima) Nirenberg ex Gerlach & Nirenberg 1982 Synonym: *Cephalosporium proliferatum* Matsush. 1971 [Nectriaceae]	**Yes** Present in California (O'Donnell *et al.* 1998).	**Yes** Occurs widely on grape berries and has been investigated as a biocontrol agent against grapevine downy mildew (Falk *et al.* 1996).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, NT, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Fusarium sacchari (E.J. Butler) W. Gams 1971 [Nectriaceae]	**Yes** Present in California (CABI 2011)	**No** No records found of an association with table grape bunches.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Gibberella intricans Wollenw. 1930 Anamorph: *Fusarium equiseti* (Corda) Sacc. [Nectriaceae]	**Yes** Present in California (Farr and Rossman 2006).	**No** No records found of an association with table grape bunches.	**Assessment not required**.	**Assessment not required**	**Assessment not required**	**No**
Order Incertae sedis						
Cryptovalsa ampelina (Nitschke) Fuckel 1870 Anamorph: *Libertella* sp. Synonyms: *Valsa ampelina* Nitschke 1867; *Engizostoma ampelinum* (Nitschke) Kuntze 1898 [Incertae sedis]	**Yes** Present in California (Farr and Rossman 2006; Trouillas *et al.* 2010).	**No** Infects grapevine wood, causing decay of vascular tissues (Trouillas *et al.* 2011). It is not a highly virulent pathogen of grapevines (Mostert *et al.* 2004).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Mucorales						
Rhizopus stolonifer (Ehrenb.: Fr.) Vuill. [Mucoraceae] Anamorph: Synonyms: *Mucor stolonifer* Ehrenb. 1818; *Rhizopus artocarpi* Racib. 1959; *Rhizopus necans* Massee 1897; *Rhizopus nigricans* Ehrenb. 1821; *Rhizopus nigricans* var. luxurians J. Schröt. 1886 <u>Fruit rot</u>	**Yes** Present in California (Ogawa 1963; Farr and Rossman 2006).	**Yes** Found on berries at harvest (McLaughlin *et al.* 1992). It is also a storage rot (Li 2004).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, NT, QLD and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Rhizopus arrhizus A. Fischer [Mucoraceae] Anamorph: Synonyms: *Rhizopus oryzae* Went & Prins. Geerl. 1895; *Rhizopus tritici* Saito 1904 <u>Fruit rot</u>	**Yes** Present in California (Ogawa 1963; Farr and Rossman 2006).	**Yes** Can infect berries after injury (Flaherty *et al.* 1992). Can also cause storage rot (Li 2004) and can infect intact berries at low rates (Hewitt 1974).	**No for WA** Not present in WA (DAWA 2006a). **Yes for other states** Present in NSW and Vic. (Plant Health Australia 2001).	**Yes** Spores are airborne (Nicholas *et al.* 1994).	**No** There are no reports of *R. arrhizus* being of economic significance on grapes in the states of Australia where it is present.	**No**
Order Mycosphaerellales						

Pest	**Present in California**	**Potential to be on pathway**	**Present in Australia**	**Potential for establishment and spread**	**Potential for economic consequences**	**Pest risk assessment required**
Existing California table grape policy *Mycosphaerella angulata* W.A. Jenkins 1942 [Mycosphaerellaceae] Angular leaf spot			**No records found**			
Order Phyllachorales						
Colletotrichum acutatum J.H. Simmonds 1968 Teleomorph: *Glomerella acutata* Guerber & J.C. Correll [Phyllachoraceae] <u>Anthracnose</u>	**Yes** Present in California (Du *et al.* 2005).	**Yes** Causes ripe rot of berries in field grown grapevines in the USA (Shiraishi *et al.* 2007). It can affect most plant parts from the roots, leaves, blossoms, twigs and fruit, causing crown and fruit rots, defoliation and blossom blight (Wharton and Diéguez-Uribeondo 2004). Fruit infection can occur pre- and post-harvest and fruit affected by post-harvest infections can appear asymptomatic at the time of picking due to latent or quiescent infections (Wharton and Diéguez-Uribeondo 2004).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, QLD, SA, Tas. and Vic. (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Pleosporales						
Alternaria sp. Nees 1816 [Pleosporaceae]	**Yes** Present in California (Farr and Rossman 2006).	**Yes** *A. alternata* (syn. *A. tenuis*) can be present on mature grape bunches (Swart and Holz 1994; Swart *et al.* 1995).	**Yes for WA** **Yes for other states** Species of this genus are present in all states and territories (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phoma sp. Sacc. 1880 Fruit rot	**Yes** Present in the USA (Farr and Rossman 2006).	**Yes** Associated with grape berries (Plant Health Australia 2001).	**Yes for WA** **Yes for other states** Many *Phoma* species have been recorded in all states and territories of Australia (Plant Health Australia 2001).	**Assessment not required**	**Assessment not required**	**No**
Order Pucciniales						
Phakopsora euvitis Y. Ono 2000 Anamorph: *Physopella vitis* (Thüm.) Arthur Synonym: *Aecidium meliosmae-myrianthae* Henn. & Shirae [Phakopsoraceae] Grape rust fungus	**No** Although reported as being present in parts of the USA (Farr and Rossman 2006; Hennessy *et al.* 2007), there is some uncertainty around these records. Chalkley (2010) notes that only a limited number of telial specimens are reported and its occurrence in the USA is largely inferred from *Uredo vitis*. However, records are limited to eastern USA with Californian records being based on old specimens, with no recent supplementary records to support its occurrence in California (CABI-EPPO 2007).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Order Russulales						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Stereum hirsutum (Willd. : Fr.) Gray 1938 Synonyms: *Stereum complicatum* (Fr. : Fr.) Fr.; *Stereum rameale* (Schwein.) Burt 1890; *Stereum styracifluum* (Schwein. : Fr.) Fr. 1838 [Stereaceae] Esca disease complex	**Yes** Present in California (Farr and Rossman 2006).	**Yes** Associated with internal wood rot as part of the esca disease complex. The species is not often associated with decay in grapevine wood, but it tends to colonise the wooden stakes used in trellising in vineyards. Wind-borne basidiospores can then reach the grapevines and could therefore be present on the grape bunches (Mugnai *et al.* 1999).	**Yes for WA** Present in WA (Plant Health Australia 2001). **Yes for other states** Present in NSW, QLD, SA and Vic. (Plant Health Australia 2001)	**Assessment not required**	**Assessment not required**	**No**
Order Uredinales						
Existing California table grape policy ***Phakopsora ampelopsidis*** Dietel & P. Syd. 1898 Synonyms: *Physopella ampelopsidis* (Dietel & P. Syd.) Cummins & Ramachar 1958 [Phakopsoraceae] Rust			**No records found**			
Order Xylariales						
Cryptosphaeria pullmanensis Glawe 1984 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010; Trouillas and Gubler 2010).	**No** Reported as causing grapevine canker disease on wood, bark, shoots, twigs (Glawe 1984; Trouillas *et al.* 2010; Trouillas and Gubler 2010) and dead branches (Farr and Rossman 2006). Although isolates have been taken from *Vitis vinifera*, *Populus* spp. are the primary host (Farr and Rossman 2006; Trouillas *et al.* 2010). It is unlikely to be associated with fresh harvested grape bunches for export.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Diatrype Fr. 1849 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010)	**No** Associated with grapevine cankers (Trouillas *et al.* 2010).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Diatrype oregonensis (Wehm.) Rappaz 1987 Synonym: *Eutypella oregonensis* Wehm. 1930 [Diatrypaceae]	**Yes** Present in California (Farr and Rossman 2006; Trouillas *et al.* 2010; Trouillas and Gubler 2010).	**No** Reported as a wood pathogen in association with trunk disease of grapevine (Trouillas *et al.* 2010; Trouillas and Gubler 2010). Pathogenicity tests have shown low virulence on grapevine and it is suggested that this species is saprophytic rather than pathogenic on grapevine (Trouillas and Gubler 2010).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Diatrype stigma (Hoffm.) Fr. 1849 Synonym: *Sphaeria stigma* Hoffm. 1787 [Diatrypaceae]	**Yes** Present in California (Rolshausen *et al.* 2006; Farr and Rossman 2006; Trouillas *et al.* 2010; Trouillas and Gubler 2010).	**No** Reported from cankered wood of grapevines in California (Trouillas *et al.* 2010; Trouillas and Gubler 2010). Trouillas and Gubler (Trouillas and Gubler 2010) report colonisation of dormant canes/ mature wood causing vascular necrosis (Trouillas and Gubler 2010). Moreover, no perithecia have been found in association with grapevine material, suggesting it may not be capable of completing its life cycle on grapevines (Trouillas and Gubler 2010). It is unlikely to be associated with fresh mature grape bunches harvested for export.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Diatrype whitmanensis J.D. Rogers & Glawe 1983 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010; Trouillas and Gubler 2010).	**No** Occurs as a wood pathogen on its hosts with stromata developing in decorticated wood or bark (Trouillas *et al.* 2010). Only rarely observed on grapevine (Trouillas and Gubler 2010). Unlikley to be associated with fresh mature harvested grape bunches for export.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Diatrypella (Ces. & De Not.) De Not. 1863 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010).	**No** Associated with grapevine cankers (Trouillas *et al.* 2010).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Diatrypella verruciformis (Ehrh.) Nitschke 1867 Synonym: *Sphaeria verruciformis* Ehrh. 1785 [Diatrypaceae]	**Yes** Present in California (Farr and Rossman 2006; Trouillas and Gubler 2010).	**No** Reported in association with cankered wood of grapevines (Trouillas and Gubler 2010). Isolates were unable to produce lesions experimentally, suggesting it is a saprophyte rather than pathogenic on grapevines (Trouillas and Gubler 2010). Perithecia are rarely observed on grapevines, suggesting it is not capable of completing its life cycle on its grapevine hosts (Trouillas and Gubler 2010).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Eutypa lata (Pers.) Tul. & C. Tul. 1863 Anamorph: *Libertella blepharis* A.L. Sm. Synonym: *Eutypa armeniacae* Hansf. & M.V. Carter [Diatrypaceae] <u>Eutypa dieback</u>	**Yes** Present in California (Munkvold 2001; CABI 2011) and considered one of the most important canker diseases of grapevine in California (Trouillas and Gubler 2010).	**No** Primarily a wood pathogen causing trunk disease in older wood of grapevines (Ellis and Nita 2009). Perithecia develop on infected wood and ascospores are generally discharged in winter or early spring, germinating when contacting newly cut wood (Ellis and Nita 2009). Unlikely to be associated with mature fresh grape berries for harvest.	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Eutypa leptoplaca (Mont.) Rappaz 1987 Synonym: *Sphaeria milliaria* var. leptoplaca Mont. 1849 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010).	**No** Associated with grapevine cankers (Gubler *et al.* 2009).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Eutypella (Nitschke) Sacc. 1875 [Diatrypaceae]	**Yes** Present in California (Trouillas *et al.* 2010).	**No** Associated with grapevine cankers (Trouillas *et al.* 2010).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
Rosellinia necatrix Prill. 1902 Anamorph*: Dematophora necatrix* R. Hartig Synonym: As *Rosellinia nacatrix* Berlese in AQSIQ (2006b) [Xylariaceae] White root rot of trees	**Yes** Has a cosmopolitan distribution (Cline 2005) that includes California (Farr and Rossman 2006; Horst 2008; CABI 2011).	**No** Occurs as a root rot (Walker and Wicks 1994; Cline 2005).	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
DOMAIN VIRUSES						
NEGATIVE SENSE SINGLE-STRANDED RNA						
Tomato spotted wilt virus Synonyms: Tomato spotted wilt tospovirus; Pineapple yellow spot virus [Bunyaviridae: Tospovirus]	**Yes** Present in many US states including California (CABI-EPPO 1999).	**Yes** Associated with fruiting stages of hosts, but seed transmission has not been demonstrated (CABI 2011).	**Yes for WA** Present in WA (CABI-EPPO 1999; CABI 2011) **Yes for other states** Present in NSW, NT, SA, Tas., Vic. (CABI-EPPO 1999; CABI 2011) and QLD (Simmonds 1966; CABI-EPPO 1999; CABI 2011)	**Assessment not required**	**Assessment not required**	**No**
POSITIVE SENSE SINGLE-STRANDED RNA						

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Grapevine virus A Synonyms: Grapevine corky bark virus; [Flexiviridae: Vitivirus] Grapevine stem-pitting virus Part of the Rugose Wood Complex	**Yes** Present in California (Brunt *et al.* 1996b).	**Yes** Infects systemically and is probably present in fruit (CIHEAM 2006).	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in Vic. (Plant Health Australia 2001), SA (Habili and Symons 2000) and QLD (Poole and Hammond 2011). The movement of fruit into WA from eastern states where *Grapevine virus A* occurs is regulated.	**No** Not seed transmitted; transmitted by grafting; transmitted by the scale insect *Neopulvinaria innumerabilis* and by the mealybugs *Planococcus citri*, *Pl. ficus*, *Pseudococcus longispinus*, *Ps. affinis* (Martelli *et al.* 2001a; CIHEAM 2006) and *Heliococcus bohemicus* (Martelli *et al.* 2001a). Unlikely to be co-transported with a vector insect or to be transmitted from imported fruit to a suitable host plant given the very low mobility of scales and mealybugs.	**Assessment not required**	**No**
Grapevine fanleaf virus Synonyms: Grapevine arricciamento virus; Grapevine court noué virus; Grapevine fanleaf nepovirus; Grapevine infectious degeneration virus; Grapevine Reisigkrankheit virus; Grapevine roncet virus; Grapevine urticado virus; Grapevine veinbanding virus; Grapevine yellow mosaic virus [Comoviridae: Nepovirus]	**Yes** Present in California (Hewitt *et al.* 1962).	**Yes** Infects systemically; present in fruit and seed. Associated with the endosperm of grape seeds (Habili *et al.* 2001).	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in NSW (Plant Health Australia 2001); SA (Stansbury *et al.* 2000; Habili *et al.* 2001) and Vic. (Habili *et al.* 2001).	**Yes** Transmitted occasionally through seed (Martelli *et al.* 2001b). Also transmitted by a nematode vector (*Xiphinema index*) and by grafting (Habili *et al.* 2001; CABI 2011).	**Yes** Grapevine fanleaf virus is the most serious virus disease of grapevines (Martelli *et al.* 2001b; Andret-Link *et al.* 2004; Varadi *et al.* 2007). The virus causes reduced number and size of bunches (Habili *et al.* 2001; Martelli *et al.* 2001b).	**Yes**
Strawberry latent ringspot virus Synonyms: Aesculus line pattern virus (Schmelzer and Schmidt, 1968); Rhubarb virus 5 [Secoviridae: Unassigned]	**Yes** Present in California (CABI-EPPO 1997a)	**Yes** Grapevine is a host (Dunez 1988) and it affects the fruiting stages of its hosts (CABI 2011).	**No for WA** No records found for WA. **No for other states** Recorded in SA (CABI-EPPO 1997a), but there are no further records, and DAFF considers the virus to be absent from Australia.	**Yes** Has a very wide host range of more than 126 species in 27 families (Murant 1983). Has been demonstrated to be seed transmitted in some hosts, including celery, quinoa, raspberry and some weeds (Murant 1983) and is transmitted by nematode vectors (Murant 1983) and mechanical means (Brunt *et al.* 1996b).	**Yes** Affects crops such as raspberry, strawberry, peach, grapes, olives, celery, parsley and cut flowers (Brunt *et al.* 1996b). Can reduce the quality and quantity of crops (CABI 2011). Causes asymmetric opening of lilies in the cut flower industry (Adekunle *et al.* 2006).	**Yes**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Tomato ringspot virus Synonyms: Blackberry (Himalaya) mosaic virus; Euonymus chlorotic ringspot virus; Euonymus ringspot virus grape yellow vein virus; grapevine yellow vein virus; Nicotiana 13 virus; peach stem pitting virus; prune brown line virus; Prunus stem pitting virus; red currant mosaic virus; tobacco ringspot virus 2; tomato ringspot nepovirus; winter peach mosaic virus [Comoviridae: Nepovirus]	**Yes** Endemic in California (Hoy and Mircetich 1984).	**Yes** Infects systemically; present in fruit and seed (Uyemoto 1975; Gonsalves 1988).	**No for WA** No records found for WA. **No for other states** Recorded in SA (Chu *et al.* 1983; Cook and Dubé 1989), but there are no further records, the infected plants no longer exist, and the virus is believed to be absent from Australia.	**Yes** Seed transmitted by grapevines occasionally (Uyemoto 1975). Also transmitted by nematodes (*Xiphinema* spp.) and by grafting (Stace-Smith 1984).	**Yes** Tomato ringspot virus causes disease in *Gladiolus* spp., *Malus pumila* (apple), *Pelargonium*, *Prunus* spp. (almond, apricot, nectarine, peach, plum, prune and sweet cherry), *Rubus* spp. (blackberry and raspberry), *Solanum lycopersicum* (tomato) and *Vitis* spp. (grapes) (Kim and Choi 1990; Brunt *et al.* 1996c; CABI 2011). Most of these species are commercially produced in Australia (Horticulture Australia Limited 2004).	**Yes**
SINGLE-STRANDED DNA						
Grapevine red blotch associated virus [Geminiviridae: Unassigned]	**Yes** Present in California , including Fresno County (Sudarshana and Wolpert 2012)	**No** The virus has only been isolated from petioles of basal leaves and in dormant canes (Sudarshana and Wolpert 2012)	**Assessment not required**	**Assessment not required**	**Assessment not required**	**No**
VIROIDS						
Australian grapevine viroid [Pospiviroidae: Aspcaviroid]	**Yes** Present in California (Rezaian *et al.* 1992; Hadidi *et al.* 2003a).	**Yes** Infects systemically; present in fruit and seed (Little and Rezaian 2003; Singh *et al.* 2003b; Albrechtsen 2006b)	**Yes for WA** **Yes for other states** Present in all states and territories (Habili 2009).	**Assessment not required**	**Assessment not required**	**No**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Grapevine yellow speckle viroid-1 [Pospiviroidae: Aspcaviroid]	**Yes** Present in California (Wolpert *et al.* 1996; Szychowski *et al.* 1998)	**Yes** Infects systemically; present in fruit and seed (Li *et al.* 2006; Albrechtsen 2006b).	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in Australia (Koltunow *et al.* 1989).	**Yes** Transmitted by grafting, abrasion and through seed (Singh *et al.* 2003b; Li *et al.* 2006; Albrechtsen 2006b).	**Yes** *Grapevine yellow speckle viroid 1* is one of the causative agents of Grapevine yellow speckle disease, individually or in combination with *Grapevine yellow speckle viroid 2* (Koltunow *et al.* 1989). There is no published evidence of significant adverse effects due to Grapevine yellow speckle disease, with many infected clones having acceptable yield and quality and not causing degeneration (Krake *et al.* 1999a). Grapevine viroids are not known to cause noticeable economic effects on winegrape production (Randles 2003). No record of economic losses caused by viroids in table grapes found. However, mixed infection of GYSVd-1 or GYSVd-2 and *Grapevine fanleaf virus* causes vein banding that has detrimental effect on the yield of certain varieties (Szychowski *et al.* 1995).	**Yes**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Grapevine yellow speckle viroid-2 [Pospiviroidae: Aspcaviroid]	**Yes** Present in California (Wolpert *et al.* 1996).	**Yes** Infects systemically; present in fruit and seed (Li *et al.* 2006; Albrechtsen 2006b)	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in Australia (Koltunow *et al.* 1989).	**Yes** Transmitted by grafting, abrasion and through seed (Little and Rezaian 2003; Albrechtsen 2006b).	**Yes** *Grapevine yellow speckle viroid 2* is one of the causative agents of Grapevine yellow speckle disease, individually or in combination with *Grapevine yellow speckle viroid 1* (Koltunow *et al.* 1989). There is no published evidence of significant adverse effects due to Grapevine yellow speckle disease, with many infected clones having acceptable yield and quality and not causing degeneration (Krake *et al.* 1999a). Grapevine viroids are not known to cause noticeable economic effect on winegrape production (Randles 2003). No record of economic losses caused by viroids in table grapes found. However, mixed infection of GYSVd-1 or GYSVd-2 and *Grapevine fanleaf virus* causes vein banding that has detrimental effect on the yield of certain varieties (Szychowski *et al.* 1995).	**Yes**

Pest	Present in California	Potential to be on pathway	Present in Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Hop stunt viroid [Pospiviroidae: Hostuviroid]	**Yes** Present in California (Osman *et al.* 2012). It was found in a survey of the of the USDA National Clonal Germplasm Repository at the University of California, Davis. Also present in hops (*Humulus lupulus*) in Washington state (Eastwell and Nelson 2007).	**Yes** HSVd has been demonstrated to be seed transmitted in grapevines (1999), but not in any other species. Wan Chow Wah and Symons (1999) confirmed that, in grapevines, HSVd can be transmitted by seed to seedlings. (This authority is cited in (Little and Rezaian 2003) which is then cited in (Albrechtsen 2006a)). HSVd infects systemically and is present in all parts of the plant (Yaguchi and Takahashi 1984; Li *et al.* 2006).	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in SA and Vic. (Koltunow *et al.* 1988).	**Yes** Hop stunt viroid variants have been detected in grapevine, hops, sweet cherry, sour cherry, citrus, plum, peach, apricot; almond; pomegranate; common fig; and jujube (Sano *et al.* 2001; Zhang *et al.* 2009)}. The viroid may be transmitted via mechanical means (Sano 2003a), through cuttings and grafting (European Food Safety Authority 2008) or via grape seed (Wan Chow Wah and Symons 1999). Seed transmission has not been demonstrated in any other host and was shown not to occur in hops (Yaguchi and Takahashi 1984) and tomato (Sano *et al.* 1981). It is not pollen transmitted (Yaguchi and Takahashi 1984).	**Yes** No symptoms of disease have been observed when *Hop stunt viroid* infects grapevine (Little and Rezaian 2003) cherry, apricot, almond, pomegranate, fig and jujube (Zhang *et al.* 2009). However hop stunt viroid causes diseases in some hosts including hops (Kawaguchi-Ito *et al.* 2009); citrus (Reanwarakorn and Semancik 1999); and plum and peach (Sano 2003b).	**Yes**
Citrus exocortis viroid [Pospiviroidae: Pospiviroid]	**Yes** Present in California (CABI 2011; Adaskaveg 2012).	**Yes** Grapevine is a host of CEVd (Garcia-Arenal *et al.* 1987) and transmission of the viroid via grape seed has been observed (Wan Chow Wah and Symons 1997).	**No for WA** Not recorded in WA (DAWA 2006a). **Yes for other states** Present in NSW, Qld and SA (Barkley and Büchen-Osmond 1988).	**Yes** Transmitted by grafting, abrasion and through seed (Little and Rezaian 2003; Singh *et al.* 2003b; Albrechtsen 2006a). It can also infect all varieties of citrus (Hardy *et al.* 2008). It can also infect tomatoes, and can be carried asymptomatically in grapevine, broad bean, eggplant, turnip, carrot and ornamental plants including *Impatiens* and *Verbena* species (Singh *et al.* 2009).	**Yes** No record of economic losses caused by CEVd in grapevines was found. However, CEVd causes disease in citrus when infected budwood is grown on susceptible rootsocks (Hardy *et al.* 2008). In Australia, budwood testing for graft-transmissible citrus pathogens has been used to reduce the damage caused by the viroid (Hardy *et al.* 2008). Can also cause disease in tomato (Singh *et al.* 2009).	**Yes**

Appendix B Additional quarantine pest data

Pest assessed	***Harmonia axyridis* Pallas 1773**
Main synonyms and combination changes	*Coccinella axyridis* (Pallas), *Coccinella bisex-notata* (Herbst), *Coccinella conspcua* (Faldermann), *Coccinella aulica* (Faldermann), *Harmonia spectabilis* (Faldermann), *Coccinella succinea* (Hop), *Anatis circe* (Mulsant), *Ptychanatis yedoensis* (Takizawa).
Common name(s)	Harlequin ladybird
Main hosts	Predator of soft bodied insects (e.g. aphids, scales) (Koch 2003; Brown *et al.* 2008) in a wide range of arboreal (broadleaf and conifer) and herbaceous habitats (Ker and Carter 2004; Koch *et al.* 2006). *Cucurbita moschata* (pumpkin), *Malus domestica* (apple), *Pyrus communis* (pear), *Prunus domestica* (plum), *Prunus persica* (peach), *Rubus* sp. (raspberry) and *Vitis vinifera* (grapevine) (Koch and Galvan 2008; EPPO 2009a)
Presence in Australia	No records found
Presence in trading partner	California (Lucas *et al.* 2002; CABI 2011)
Presence elsewhere	Argentina, Austria, Belarus, Belgium, Brazil, Canada, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Japan, Jersey, Korea, Luxemburg, Mexico, Netherlands, Norway, Poland, Portugal, Romania, and eastern Russia (Siberia), Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom (Komai and Chino 1969; de Almeida and da Silva 2002; Koch 2003; Koch *et al.* 2006; Roy and Roy 2008; Brown *et al.* 2008; Su *et al.* 2009; EPPO 2009a)
Pest assessed	***Lygus hesperus* Knight 1917**
Main synonyms and combination changes	
Common name(s)	Western plant bug
Main hosts	Alfalfa, cotton, fruit and vegetables, conifers (Schowalter 2013).
Presence in Australia	No records found
Presence in trading partner	California (Mueller 2003; Mills 2012; Zalom *et al.* 2012).
Presence elsewhere	No records found
Pest assessed	***Lygus lineolaris* (Palisot 1818)**
Main synonyms and combination changes	
Common name(s)	Tarnished plant bug
Main hosts	*Amaranthus cruentus* (redshank), *Apium graveolens* (celery), *Brassica napus* var. *napus* (rape), *Brassica oleracea* var. *botrytis* (cauliflower), *Fragaria ananassa* (strawberry), *Gossypium hirsutum* (Bourbon cotton), *Medicago sativa* (lucerne), *Phaseolus lunatus* (lima bean), *Phaseolus vulgaris* (common bean), *Prunus persica* (peach), *Solanum tuberosum* (potato), *Trifolium incarnatum* (Crimson clover), *Vicia sativa* (common vetch), *Zea mays* subsp. *mays* (sweetcorn) (CABI 2011).
Presence in Australia	No records found
Presence in trading partner	California (Mueller 2003; Mueller *et al.* 2012).
Presence elsewhere	Bermuda, Canada, El Salvador, Georgia, Guatemala, Honduras, Mexico, USA (CABI 2011)
Pest assessed	***Parthenolecanium corni* Bouché 1844**

Main synonyms and combination changes	*Coccus rosarum* Snellen van Volenhoven 1862, *C. tiliae* Fitch 1851, *Eulecanium corni corni* (Bouché), *E. fraxini* King 1902, *E. guignardi* King 1901, *E. kansasense* (Hunter) King 1901, *E. rosae* King 1901, *E. vini* (Bouché) Cockerell 1901, *Lecanium* (*Eulecanium*) *armeniacum* Craw; Cockerell & Parrott 1899, *L. (E.) assimile* Newstead; Reh 1903, *L. (E.) aurantiacum* Hunter 1900, *L. (E.) canadense* Cockerell; Cockerell & Parrott 1899, *L. (E.) caryarum* Cockerell 1898, *L. (E.) corylifex* Fitch; Cockerell 1896, *L. (E.) crawii* Ehrhorn Cockerell & Parrott 1899, *L. (E.) cynosbati* Fitch, Cockerell & Parrott 1899, *L. (E.) fitchii* Cockerell & Parrott 1899, *L. (E.) kingii* Cockerell 1898, *L. (E.) lintneri* Cockerell & Bennett; Cockerell 1895, *L. (E.) maclurarum* Cockerell 1898, *L. (E.) ribis* Fitch; Cockerell & Parrott 1899, *L. (E.) rugosum* Signoret; Cockerell 1896, *L. (E.) rugosum* Signoret; Cockerell 1896, *L. (E.) vini* Bouché, King & Reh 1901, *L. adenostomae* Kuwana 1901, *L. armeniacum* Craw 1891, *L. assimile* Newstead 1892, *L. canadense* Cockerell; Cockerell 1899, *L. caryae canadense* Cockerell 1895, *L. corni* Bouché 1844, *L. corni robiniarum* Marchal 1908, *L. coryli* (Linnaeus) Sulc 1908 (misidentification), *L. corylifex* Fitch 1857, *L. crawii* Ehrhorn 1898, *L. cynosbati* Fitch 1857, *L. fitchii* Signoret 1872, *L. folsomi* King 1903, *L. juglandifex* Fitch 1857, *L. kansasense* Hunter 1899, *L. lintneri* Cockerell & Bennett in Cockerell 1895, *L. maclurae* Hunter 1899, *L. obtusum* Thro 1903, *L. persicae crudum* Green 1917, *L. pruinosum armeniacum* Craw; Tyrell 1896, *L. rehi* King in King & Reh 1901, *L. ribis* Fitch 1857, *L. robiniarum* Douglas 1890, *L. rugosum* Signoret1873, *L. tarsalis* Signoret 1873, *L. vini* Bouché 1851, *L. websteri* King 1902, *L. wistariae* Signoret 1873, *Parthenolecanium corni* (Bouché); Borchsenius 1957, *P. coryli* (Linnaeus); Sulc 1908 (misidentification)
Common name(s)	European fruit lecanium
Main hosts	*Parthenolecanium corni* is highly polyphagous, attacking some 350 plant species placed in 40 families. It attacks a wide range of crops, mostly woody fruit trees and ornamentals. Primary hosts are: *Crataegus* (hawthorns), *Malus* (ornamental species apple), *Prunus domestica* (damson plums), *Prunus persica* (peach), *Ribes nigrum* (blackcurrant), *Ribes rubrum* (red currant), *Rosa* (roses), *Vitis vinifera* (grapevine) (CABI 2011).
Presence in Australia	Vic., Tas. (Plant Health Australia 2001; CSIRO 2005) and NSW (CSIRO 2005).
Presence in trading partner	California (Golino *et al.* 2002; Ben-Dov *et al.* 2010).
Presence elsewhere	Afghanistan, Albania, Algeria, Argentina, Armenia, Austria, Azerbaijan, Belgium, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Denmark, Egypt, Finland, France, Georgia, Germany, Greece, Hungary, India, Iran, Italy, Japan, Kazakhstan, Korea (North), Korea (South), Kyrgyzstan, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malta, Mexico, Moldova, Mongolia, Netherlands, New Zealand, Norway, Pakistan, Peru, Poland, Portugal, Romania, Russian Federation, Serbia/Montenegro, Slovakia, Spain, Sweden, Switzerland, Syria, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, USA, Uzbekistan, Yugoslavia (CABI 2011).

Pest assessed	***Pseudococcus calceolariae* Maskell 1879**
Main synonyms and combination changes	*Dactylopius calceolariae* Maskell, *Erium calceolariae* (Maskell) Lindinger, *Pseudococcus citrophilus* Clausen, *P. fragilis* Brain, *P. gahani* Green
Common name(s)	European fruit lecanium
Main hosts	*Abutilon* (Indian mallow), *Arachis hypogaea* (groundnut), *Brachychiton*, *Brassica* (including cabbage, cauliflower, broccoli, Brussel sprouts), *Ceanothus*, *Chenopodium* (Goosefoot), *Citrus medica* (citron), *Conium maculatum* (Poison hemlock), *Crataegus* (hawthorns), *Cydonia oblonga* (quince), *Daucus carota* (carrot), *Dodonaea viscosa* (switch sorrel), *Eugenia*, *Ficus* (fig), *Fragaria* (strawberry), *Geranium* (cranesbill), *Hedera helix* (ivy), *Helianthus*, *Heliotropium arborescens* (Cherry-pie), *Hibiscus* (rosemallows), *Juglans regia* (walnut), *Laburnum anagyroides* (laburnum), *Ligustrum*, *Lolium* (ryegrass), *Malus sylvestris* (crab apple), *M.domestica* (apple), *Malva* (mallow), *Musa paradisiaca* (plantain), *Nerium oleander* (oleander), *Pelargonium* (pelargoniums), *Pinus radiata* (radiata pine), *Pisum sativum* (pea), *Pittosporum tobira* (Japanese pittosporum), *P. undulatum* (Australian boxwood), *Polyscias* sp., *Prunus* spp. (including plums, cherries, peaches, nectarines, apricots and almonds), *Pyrus communis* (European pear), *Rheum hybridum* (rhubarb), *Rhododendron*, *Ribes sanguineum* (Flowering currant), *Rosa* (roses), *Rubus* (blackberry, raspberry), *Schinus molle* (California peppertree), *Sechium edule*, *Solanum tuberosum* (potato), *Theobroma cacao* (cocoa), *Vitis vinifera* (grapevine) (CABI 2011).
Presence in Australia	QLD, NSW, Vic., Tas. and SA (Plant Health Australia 2001; CSIRO 2005).
Presence in trading partner	California (Ben-Dov 1994).
Presence elsewhere	Chile, China, Czechoslovakia, France, Georgia, Ghana, Italy, Madagascar, Mexico, Morocco, Namibia, Netherlands, New Zealand, Portugal, South Africa, Spain, Ukraine, United Kingdom, USA (CABI 2011)

Pest assessed	***Marmara gulosa* Guillèn and Davis**
Main synonyms and combination changes	
Common name(s)	Citrus peelminer
Main hosts	Almond, acorn winter squash (*Cucurbita pepo*), angled luffa (*Luffa actuangula*) apple, apricot, avocado, cherry, citrus, cotton, cowpeas, eggplant, fig, grape, kiwi, moqua (*Benincasa hispida*), olive, papaya, peach/nectarine, peppers, pistachios, plum/prune, pomegranate, pumpkin, squash, snake gourd (*Trichosanthes anguina*), walnut, watermelon, zucchini, abutilon, ash (*Fraxinus uhdei*.), bougainvillea, chitalpa (*Chilopsis* X *Catalpa*), *Deutzia gracilis,* english laurel (*Prunus laurocerasus*), euonymus, flowering pear, forsythia, *Gardenia veitchii,* gourd, grecian laurel (*Laurus nobilis*), hibiscus, hydrangea, *Itea,* Japanese maple (*Acer palmatum*), mandevilla, mulberry (*Morus albus*), oleander, pachysandra, photinia, poinsettia, *Poplar* sp., red maple (*Acer rubrum*), rose, saucer magnolia (*Magnolia soulangiana*), star jasmin (*Trachelospermum*), sweet potato "Terrace Lime", sycamore, trumpet vine (*Campsis*), tupelo (*Nyssa sylvtica*), willow, wisteria, *Brunfelsia magnifica,* Green Amaranth (*Amaranthus hybridus*), nettleleaf goosefoot (*Chenopodium murale*), ivyleaf morningglory (*Ipomoea hederacea*), tall morningglory (*Ipomoea purpurea*), cheeseweed (*Malva parviflora*), tree tobacco (*Nicotiana glauca*), purslane (*Portulaca oleracea*) (Grafton-Cardwell 2002).
Presence in Australia	No records found
Presence in trading partner	California (Stelinski 2007; Kirkland 2009)
Presence elsewhere	Mexico, USA (University of California 2013a)

Pest assessed	***Phomopsis viticola* (Sacc.) Sacc. 1915**
Main synonyms and combination changes	*Cryptosporella viticola* Shear [teleomorph], *Diaporthe viticola* Nitschke [teleomorph], *Diplodia viticola* Desm., *Fusicoccum viticolum* Reddick, *Phoma flaccida* Viala & Ravaz, *Phoma viticola* Sacc
Common name(s)	Phomopsis cane and leaf spot
Main hosts	*Vitis vinifera* (grapevine) (Flaherty *et al.* 1992)
Presence in Australia	NSW, QLD, SA and Vic. (Plant Health Australia 2001).
Presence in trading partner	California, including the North Coast and the San Joaquin Valley (Gubler *et al.* 2009).
Presence elsewhere	Algeria, Argentina, Austria, Belgium, Bosnia-Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Croatia, Egypt, France, Georgia, Germany, Greece, Hungary, India, Italy, Japan, Jersey, Kenya, Macedonia, Moldova, Netherlands, New Zealand, Poland, Portugal, Romania, Russia, Serbia and Montenegro, Slovenia, South Africa, Spain, Switzerland, Taiwan, Turkey, Ukraine, United Kingdom, USA, Venezuela, Yugosavlia (former), Zimbabwe (CABI 2011)

Pest assessed	**Strawberry latent ringspot virus**
Main synonyms and combination changes	Rhubarb virus 5; Aesculus line pattern virus
Common name(s)	Strawberry latent ringspot virus
Main hosts	*Olea europea* (olive) (Faggioli *et al.* 2002); *Vitis vinifera* (grapevine) (Credi *et al.* 1981; Babini and Bertaccini 1982; Savino *et al.* 2010); *Rosa damascena* (oil rose) (Yardimci and Çulal Kiliç 2012); *Fragaria vesca* (strawberry) (Lister 1964); *Apium graveolens* (celery), *Robinia pseudoacacia*, *Euonymus europaeus* (spindle), *Aesculus carnea*, *Rubus idaeus* (red raspberry), *Rubus fruticosus* (common blackberry), *Ribes nigrum* (black currant), *Ribes rubrum* (red currant), *Asparagus officinalis* (asparagus), *Capsella bursa-pastoris* (shepherd's purse), *Delphinium* spp., *Lamium amplexicaule* (Henbit Deadnettle), *Narcissus* spp. (daffodils), *Prunus domestica* (plum), *P. persica* (peach), *Rheum rhaponticum* (Rhubarb), *Sambucus nigra* (elderberry), *Senecio vulgaris* (common groundsel), *Stellaria media* (chickweed), *Taraxacum officinale* (dandelion), *Trifolium repens* (white clover) and *Urtica dioica* (stinging nettle) (Brunt *et al.* 1996b); *Cucumis sativas* (cucumber) (Walkey and Mitchell 1969); *Petroselinum crispum* (parsley) (Sevik and Akcura 2011).

Presence in Australia	Was recorded in SA (CABI-EPPO 1997a), but there are no further records and DAFF considers the virus to be absent from Australia.
Presence in trading partner	California (Martin *et al.* 2004)
Presence elsewhere	Canada (Martin *et al.* 2004); Italy (Credi *et al.* 1981); India (Kulshrestha *et al.* 2004); Turkey (Yardimci and Çulal Kiliç 2010); Taiwan (Adekunle *et al.* 2006); Belgium, Finland, France, Germany, Ireland, Israel, Luxembourg, Netherlands, New Zealand, Poland, Romania, Spain, Switzerland, United Kingdom, USA, Yugoslavia (former) (Brunt *et al.* 1996b); Jordan (Salem 2011).

Pest assessed	**Grapevine fanleaf virus**
Main synonyms and combination changes	Grapevine arricciamento virus; Grapevine court noué virus; Grapevine fanleaf nepovirus; Grapevine infectious degeneration virus; Grapevine Reisigkrankheit virus; Grapevine roncet virus; Grapevine urticado virus; Grapevine veinbanding virus; Grapevine yellow mosaic virus
Common name(s)	Grapevine fanleaf virus
Main hosts	*Vitis vinifera* (grapevine)
Presence in Australia	NSW (Plant Health Australia 2001); SA (Stansbury *et al.* 2000; Habili *et al.* 2001) and Vic. (Habili *et al.* 2001).
Presence in trading partner	California (Hewitt *et al.* 1962)
Presence elsewhere	Albania, Algeria, Argentina, Armenia, Austria, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, Chile, China, Croatia, Cyprus, Czech Republic, Egypt, France, Germany, Greece, Hungary, Iran, Israel, Italy, Japan, Jordan, Kazakhstan, Lebanon, Macendonia, Madagascar, Malta, Mexico, Moldova, Morocco, New Zealand, Nigeria, Philippines, Portugal, Romania, Russian Federation, Serbia and Montenegro, Slovakia, Slovenia, South Africa, Spain, Switzerland, Syria, Ukraine, USA, Venezuela, Tunisia, Turkey (CABI 2011).

Pest assessed	**Tomato ringspot virus**
Main synonyms and combination changes	Blackberry (Himalaya) mosaic virus; Euonymus chlorotic ringspot virus; Euonymus ringspot virus grape yellow vein virus; grapevine yellow vein virus; Nicotiana 13 virus; peach stem pitting virus; prune brown line virus; Prunus stem pitting virus; red currant mosaic virus; tobacco ringspot virus 2; tomato ringspot nepovirus; winter peach mosaic virus
Common name(s)	Tomato ringspot virus, Ringspot and mosaic (in various hosts), Eola rasp leaf (in cherries), yellow bud mosaic (in peaches), yellow vein (in grapes), stunt or stub head (in Gladiolus), decline, crumby berry and yellow blotch curl (in raspberries), chlorosis (in Pelargonium) (English), Tomatenringfleckenkrankheit (German) (CABI-EPPO 1997b).
Main hosts	*Cornus* sp. (dogwood), *Cucumis sativus* (cucumber), *Euonymus* spp., *Fragaria* x *ananassa* (strawberry), *Fraxinus americana* (ash), *Gladiolus* sp., *Glycine max* (soybean), *Hydrangea* sp., *Lotus corniculatus* (birdsfoot-trifoil), *Malus domestica* (apple), *Nicotiana tabacum* (tobacco), Orchidaceae, *Pelargonium* sp., *Pentas lanceolata* (Egyptian starflower), *Phaseolus vulgaris* (common bean), *Prunus* spp., *Ribes nigrum* (black currant), *Ribes rubrum* (red current), *Ribes uva-crispa* (gooseberry), *Rubus* sp. (blackberry), *Rubus idaeus* (raspberry), *Sambucus canadensis* (elderberry), *Solanum lycopersicum* (tomato), *Solanum tuberosum* (potato), *Vaccinium corymbosum* (blueberry), *Vigna unguiculata* (cowpea), *Vitis Vinifera* (grapevine) (Chu *et al.* 1983; Stace-Smith 1984; Sherf and MacNab 1986; Brown *et al.* 1993; CABI-EPPO 1997b; EPPO 2005; Adaskaveg and Caprile 2010; Adaskaveg *et al.* 2012) and weeds, including *Chenopodium berlandieri* (lambsquarters), *Cichorium intyhus* (chicory), *Euphorbia* spp. (spurge), *Malva parviflora* (little mallow), *Medicago lupulina* (black medic), *Picris echioides* (bristly oxtongue), *Plantago* spp. (plaintain), *Prunella vulgaris* (healall), *Rumex acetosell* (sheep sorrel), *Stellaria* spp. (common chickweed), *Taraxacum officinale* (dandelion), *Trifolium repens* (white clover), *Verbascum* spp. (mullein) and *Verbascum blattaria* (moth mullein) (Powell *et al.* 1984; Tuttle and Gotlieb 1985; Adaskaveg *et al.* 2012).
Presence in Australia	Recorded in SA (Chu *et al.* 1983; Cook and Dubé 1989), but there are no further records, the infected plants no longer exist, and the virus is believed to be absent.
Presence in trading partner	Endemic in California (Hoy and Mircetich 1984).
Presence elsewhere	Argentina, Belarus, Canada, Chile, China, Croatia, Egypt, Finland, France, Germany, Greece, Iran, Ireland, Italy, Japan, Jordan, Korea, Lithuania, Mexico, New Zealand, Oman, Pakistan, Peru, Russian Federation, Serbia and Montenegro, Puerto Rico, Slovakia, Slovenia, Taiwan, Togo, Tunisia, Turkey, UK, USA, Venezuela }(CABI-EPPO 1997b; CABI 2011).

Pest assessed	***Grapevine yellow speckle viroid-1***

Main synonyms and combination changes	*Grapevine viroid-f* (GVd-f), *Grapevine viroid-1* (GV-1) (Little and Rezaian 2003)
Common name(s)	Grapevine yellow speckle disease
Main hosts	*Vitis vinifera* (CIHEAM 2006)
Presence in Australia	Yes (Koltunow *et al.* 1989) but not in WA (DAWA 2006a)
Presence in trading partner	California (Rezaian *et al.* 1992)
Presence elsewhere	Worldwide distribution (Martelli 1993; CIHEAM 2006) including France, Italy, Spain, Albania, Bulgaria, Cyprus, Greece, Germany (Pallás *et al.* 2003b), Tunisia (Hadidi *et al.* 2003b), China (Han *et al.* 2003) and Japan (Sano 2003c).

Pest assessed	***Grapevine yellow speckle viroid-2***
Main synonyms and combination changes	*Grapevine viroid-2* (GV-2), *Grapevine viroid-1B* (GV-1B) (Little and Rezaian 2003)
Common name(s)	Grapevine yellow speckle disease
Main hosts	*Vitis vinifera* (CIHEAM 2006)
Presence in Australia	Yes (Koltunow *et al.* 1989) but not in WA (DAWA 2006a)
Presence in trading partner	California (Rezaian *et al.* 1992)
Presence elsewhere	Worldwide distribution (Martelli 1993; CIHEAM 2006).

Pest assessed	**Hop Stunt Viroid**
Main synonyms and combination changes	None
Common name(s)	Hop Stunt Viroid
Main hosts	*Vitis vinifera* (grapevine) (Little and Rezaian 2003); *Humulus lupulus* (hops) (Sano 2003a); *Prunus armeniaca* (apricots) (Pallas *et al*. 2003); *Prunus persica* (peach) (Sano *et al.* 1989; Hassan *et al.* 2003); *Prunus domestica* (plum) (Sano *et al.* 1989; Yang *et al.* 2006); *Prunus dulcis* (almond) (Pallás *et al.* 2003); *Prunus avium* (sweet cherry) (Gazel *et al.* 2008); *Prunus cerasus* (sour cherry) (Gazel *et al.* 2008); *Ziziphus jujuba* (jujube) (Zhang *et al.* 2009); *Citrus spp*.; *Punica granatum* (pomegranate) (Astruc *et al.* 1996); *Ficus carica* (common fig) (Yakoubi *et al.* 2007)
Presence in Australia	Vic. and SA (Koltunow *et al.* 1988)
Presence in trading partner	California (European Food Safety Authority 2008; Osman *et al.* 2012) and Washington (Eastwell and Nelson 2007)
Presence elsewhere	Bosnia and Herzegovina (Matic *et al.* 2005), Canada (Michelutti *et al.* 2004); China (Guo *et al.* 2008; Zhang *et al.* 2009); Cyprus (Pallas *et al.* 1998); Czech Republic (Hassan *et al.* 2003); Finland (EPPO 2009b), Greece (Pallas *et al.* 1998); India , Italy , Jamaica (Bennett *et al.* 2009); Japan (Kawaguchi-Ito *et al.* 2009); Korea (Lee *et al.* 1988); Lebanon (Choueiri *et al.* 2002; Ghanem-Sabanadzovic and Choueiri 2003), Morocco (Pallas *et al.* 1998), Pakistan, Serbia (Mandic *et al.* 2008); Spain (Pallas *et al.* 1998; Amari K. *et al.* 2007); Tunisia (Hassen *et al.* 2004); Turkey (Gazel *et al.* 2008)

Pest assessed	**Citrus exocortis viroid**
Main synonyms and combination changes	
Common name(s)	Citrus exocortis viroid

Main hosts	*Aster grandiflorus*, *Capsicum annum*, *Chrysanthemum morifolium*, *Cucumis sativus*, *Cucurbita pepo*, *Dalia variabilis*, *Datura stramonium*, *Gomphrena globosa*, *Gynura aurantiaca*, *Gynura sarmentosa*, *Lycopersicon esculentum*, *Lycopersicon peruvianum*, *Oscimum basilicum*, *Petunia axillaris*, *Petunia hybrida*, *Petunia violacea*, *Physalis floridana*, *Physalis ixocarpa*, *Physalis peruviana*, *Solanum aculeatiisium*, *Solanum dulcamara*, *Solanum hispidum*, *Solanum integrifolium*, *Solanum marginatum*, *Solanum melongena*, *Solanum quitoense*, *Solanum topiro*, *Solanum tuberosum*, *Tagetes patula*, *Zinnia elegans* (Duran-Vila and Semancik 2003).
Presence in Australia	NSW, Qld. and SA (Barkley and Büchen-Osmond 1988).
Presence in trading partner	California (CABI 2011; Adaskaveg 2012).
Presence elsewhere	Worldwide distribution. Present in Asia, Africa, North America, Central America, South America, Europe and Oceania (CABI 2011).

Appendix C Biosecurity framework

Australia's biosecurity policies

The objective of Australia's biosecurity policies and risk management measures is the prevention or control of the entry, establishment or spread of pests and diseases that could cause significant harm to people, animals, plants and other aspects of the environment.

Australia has diverse native flora and fauna and a large agricultural sector, and is relatively free from the more significant pests and diseases present in other countries. Therefore, successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is consistent with the World Trade Organization's (WTO's) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

The SPS Agreement defines the concept of an 'appropriate level of protection' (ALOP) as the level of protection deemed appropriate by a WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. Among a number of obligations, a WTO Member should take into account the objective of minimising negative trade effects in setting its ALOP.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through Australian Government policy, is currently expressed as providing a high level of sanitary and phytosanitary protection, aimed at reducing risk to a very low level, but not to zero.

Consistent with the SPS Agreement, in conducting risk analyses Australia takes into account as relevant economic factors:

- the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease in the territory of Australia
- the costs of control or eradication of a pest or disease
- and the relative cost-effectiveness of alternative approaches to limiting risks.

Roles and responsibilities within Australia's quarantine system

Australia protects its human[5], animal and plant life or health through a comprehensive quarantine system that covers the quarantine continuum, from pre-border to border and post-border activities.

Pre-border, Australia participates in international standard-setting bodies, undertakes risk analyses, develops offshore quarantine arrangements where appropriate, and engages with our neighbours to counter the spread of exotic pests and diseases.

At the border, Australia screens vessels (including aircraft), people and goods entering the country to detect potential threats to Australian human, animal and plant health.

The Australian Government also undertakes targeted measures at the immediate post-border level within Australia. This includes national co-ordination of emergency responses to pest and disease incursions. The movement of goods of quarantine concern within Australia's

[5] The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine.

border is the responsibility of relevant state and territory authorities, which undertake inter- and intra-state quarantine operations that reflect regional differences in pest and disease status, as a part of their wider plant and animal health responsibilities.

Roles and responsibilities within the Department

The Australian Government Department of Agriculture, Fisheries and Forestry is responsible for the Australian Government’s animal and plant biosecurity policy development and the establishment of risk management measures. The Secretary of the Department is appointed as the Director of Animal and Plant Quarantine under the *Quarantine Act 1908* (the Act).

The Department takes the lead in biosecurity and quarantine policy development and the establishment and implementation of risk management measures across the biosecurity continuum, and:

- **Pre-border** conducts risk analyses, including IRAs, and develops recommendations for biosecurity policy as well as providing quarantine policy advice to the Director of Animal and Plant Quarantine
- **At the border** develops operational procedures, makes a range of quarantine decisions under the Act (including import permit decisions under delegation from the Director of Animal and Plant Quarantine) and delivers quarantine services
- **Post-border** coordinates pest and disease preparedness, emergency responses and liaison on inter- and intra-state quarantine arrangements for the Australian Government, in conjunction with Australia’s state and territory governments.

Roles and responsibilities of other government agencies

State and territory governments play a vital role in the quarantine continuum. The Department works in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develops appropriate sanitary and phytosanitary measures to account for those differences. Australia’s partnership approach to quarantine is supported by a formal Memorandum of Understanding that provides for consultation between the Australian Government and the state and territory governments.

Depending on the nature of the good being imported or proposed for importation, DAFF may consult other Australian Government authorities or agencies in developing its recommendations and providing advice.

As well as a Director of Animal and Plant Quarantine, the Act provides for a Director of Human Quarantine. The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine and Australia’s Chief Medical Officer within that Department holds the position of Director of Human Quarantine. DAFF may, where appropriate, consult with that Department on relevant matters that may have implications for human health.

The Act also requires the Director of Animal and Plant Quarantine, before making certain decisions, to request advice from the Environment Minister and to take the advice into account when making those decisions. The Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) is responsible under the *Environment Protection and Biodiversity Conservation Act 1999* for assessing the environmental impact associated with proposals to import live species. Anyone proposing to import such material should contact DSEWPC directly for further information.

When undertaking risk analyses, DAFF consults with DSEWPC about environmental issues and may use or refer to DSEWPC's assessment.

Australian quarantine legislation

The Australian quarantine system is supported by Commonwealth, state and territory quarantine laws. Under the Australian Constitution, the Commonwealth Government does not have exclusive power to make laws in relation to quarantine, and as a result, Commonwealth and state quarantine laws can co-exist.

Commonwealth quarantine laws are contained in the *Quarantine Act 1908* and subordinate legislation including the Quarantine Regulations 2000, the Quarantine Proclamation 1998, the Quarantine (Cocos Islands) Proclamation 2004 and the Quarantine (Christmas Island) Proclamation 2004.

The quarantine proclamations identify goods, which cannot be imported into Australia, the Cocos Islands and or Christmas Island unless the Director of Animal and Plant Quarantine or delegate grants an import permit or unless they comply with other conditions specified in the proclamations. Section 70 of the Quarantine Proclamation 1998, section 34 of the Quarantine (Cocos Islands) Proclamation 2004 and section 34 of the Quarantine (Christmas Island) Proclamation 2004 specify the things a Director of Animal and Plant Quarantine must take into account when deciding whether to grant a permit.

In particular, a Director of Animal and Plant Quarantine (or delegate):

- must consider the level of quarantine risk if the permit were granted, and
- must consider whether, if the permit were granted, the imposition of conditions would be necessary to limit the level of quarantine risk to one that is acceptably low, and
- for a permit to import a seed of a plant that was produced by genetic manipulation – must take into account any risk assessment prepared, and any decision made, in relation to the seed under the Gene Technology Act, and
- may take into account anything else that he or she knows is relevant.

The level of quarantine risk is defined in section 5D of the *Quarantine Act 1908*. The definition is as follows:

> reference in this Act to a *level of quarantine risk* is a reference to:
>
> (a) the probability of:
>
> (i) a disease or pest being introduced, established or spread in Australia, the Cocos Islands or Christmas Island; and
>
> (ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and
>
> (b) the probable extent of the harm.

The Quarantine Regulations 2000 were amended in 2007 to regulate keys steps of the import risk analysis process. The Regulations:

- define both a standard and an expanded IRA;

- identify certain steps, which must be included in each type of IRA;
- specify time limits for certain steps and overall timeframes for the completion of IRAs (up to 24 months for a standard IRA and up to 30 months for an expanded IRA);
- specify publication requirements;
- make provision for termination of an IRA; and
- allow for a partially completed risk analysis to be completed as an IRA under the Regulations.

The Regulations are available at http://www.comlaw.gov.au

International agreements and standards

The process set out in the *Import Risk Analysis Handbook 2011* is consistent with Australia's international obligations under the SPS Agreement. It also takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and by the World Organisation for Animal Health (OIE).

Australia bases its national risk management measures on international standards where they exist and when they achieve Australia's ALOP. Otherwise, Australia exercises its right under the SPS Agreement to apply science-based sanitary and phytosanitary measures that are not more trade restrictive than required to achieve Australia's ALOP.

Notification obligations

Under the transparency provisions of the SPS Agreement, WTO Members are required, among other things, to notify other members of proposed sanitary or phytosanitary regulations, or changes to existing regulations, that are not substantially the same as the content of an international standard and that may have a significant effect on trade of other WTO Members.

Risk analysis

Within Australia's quarantine framework, the Australian Government uses risk analyses to assist it in considering the level of quarantine risk that may be associated with the importation or proposed importation of animals, plants or other goods.

In conducting a risk analysis, DAFF:

- identifies the pests and diseases of quarantine concern that may be carried by the good
- assesses the likelihood that an identified pest or disease or pest would enter, establish or spread
- assesses the probable extent of the harm that would result.

If the assessed level of quarantine risk exceeds Australia's ALOP, DAFF will consider whether there are any risk management measures that will reduce quarantine risk to achieve the ALOP. If there are no risk management measures that reduce the risk to that level, trade will not be allowed.

Risk analyses may be carried out by DAFF's specialists, but may also involve relevant experts from state and territory agencies, the Commonwealth Scientific and Industrial

Research Organisation (CSIRO), universities and industry to access the technical expertise needed for a particular analysis.

Risk analyses are conducted across a spectrum of scientific complexity and available scientific information. An IRA is a type of risk analysis with key steps regulated under the Quarantine Regulations 2000. DAFF's assessment of risk may also take the form of a non-regulated analysis of existing policy or technical advice. Further information on the types of risk analysis is provided in the *Import Risk Analysis Handbook 2011*.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2012).
Anamorph	An asexual stage in the life cycle of a fungus. Also known as the imperfect state of a fungus.
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2012).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2012).
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Asexual reproduction	The development of new individual from a single cell or group of cells in the absence of meiosis.
Biosecurity Australia	The previous name for the unit, within the Department of Agriculture, Fisheries and Forestry, responsible for recommendations for the development of Australia's biosecurity policy. These functions are undertaken within the Plant Division of the Department.
Calyx	A collective term referring to all of the sepals in a flower.
Cane (grapevine)	A cane is a ripened shoot of a grapevine that has grown from a new bud located on the cordon. A shoot is called a cane when it changes colour from green to brown during veraison. Shoots give rise to leaves, tendrils and grape clusters.
Certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 2012).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2012).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2012).
Crawler	Intermediate mobile nymph stage of certain Arthropods.
Diapause	Period of suspended development/growth occurring in some insects, in which metabolism is decreased.
Disease	A condition of part or all of an organism that may result from various causes such as infection, genetic defect or environmental stress.
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2012).
Endemic	Belonging to, native to, or prevalent in a particular geography, area or environment.
Endocarp	The hard inner layer of the pericarp, such as pit or stone of a cherry, peach or olive.
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2012).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2012).
Exocarp	The outer most layer of the fruit wall.
Fecundity	The fertility of an organism.
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2012).
Fumigation	A method of pest control that completely fills an area with gaseous pesticides to suffocate or poison the pests within.
Genus	A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species
Grape bunch	A bunch or cluster of grapes is attached to a cane (or stem). The bunch is the entire collection of parts which starts at the peduncle and includes the laterals, rachises, pedicels and berries.

Term or abbreviation	Definition
Host	An organism that harbours a parasite, mutual partner, or commensal partner, typically providing nourishment and shelter.
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2012).
Hybridisation	The production of offspring of genetically different parents.
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2012).
Import risk analysis	An administrative process through which quarantine policy is developed or analysised, incorporating risk assessment, risk management and risk communication.
Infection	The internal 'endophytic' colonisation of a plant, or plant organ, and is generally associated with the development of disease symptoms as the integrity of cells and/or biological processes are disrupted.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2012).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 2009).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2012).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2009).
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPCC (FAO 2012).
Introduction	The entry of a pest resulting in its establishment (FAO 2012).
Larva	A juvenile form of animal with indirect development, undergoing metamorphosis (for example, insects or amphibians).
Lateral	The part of a grape bunch that subtends from the peduncle and gives rise to the rachises.
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2012). Within this analysis a 'lot' refers to a quantity of fruit of a single variety, harvested from a single production site during a single pick and packed at one time.
Mature fruit	Commercial maturity is the start of the ripening process. The ripening process will then continue and provide a product that is consumer-acceptable. Maturity assessments include colour, starch, index, soluble solids content, flesh firmness, acidity, and ethylene production rate.
Mesocarp	The middle, usally fleshy layer of a fruit wall.
Mortality	The total number of organisms killed by a particular disease.
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2012).
Nymph	The immature form of some insect species that undergoes incomplete metamorphosis, It is not to be confused with larva, as its overall form is already that of the adult.
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2012).
Orchard	A contiguous area of mangosteen trees operated as a single entity. Within this analysis a single orchard is covered under one registration and is issued a unique indentifying number.
Parthenognesis	Production of an embryo from unfertilised egg.
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2012).
Pedicel	The part of a grape bunch to which the berries are directly attached.
Peduncle	The first part of a grape bunch that is directly attached to the cane. All other parts of the bunch branch from the peduncle.
Pericarp	The tissue that arises from the ripen ovary wall of the fruit.

Term or abbreviation	Definition
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2012).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2012).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2012).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2012).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2012).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2012).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2012).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2012).
Phloem	In vascular plants, the tissue that carries organic nutrients to all parts of the plant where needed.
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC (FAO 2012).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2012).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2012).
Polyphagous	Feeding on a relatively large number of hosts from different plant family and/or genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2012).
Production site	In this analysis, a production site is a continuous planting of mangosteen trees treated as a single unit for pest management purposes. If an orchard is subdivided into one or more units for pest management purposes, then each unit is a production site. If the orchard is not subdivided, then the orchard is also the production site.
Pupa	An inactive life stage that only occurs in insects that undergo complete metamorphosis, for example butterflies and moths (Lepidoptera), beetles (Coleoptera) and bees, wasps and ants (Hymenoptera).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2012).
Rachis	This is the part of a grape bunch that branches into the pedicels to which the berries are then attached.
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (WTO 1995).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Saprophyte	An organism deriving its nourishment from dead organic matter.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2012).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures.
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Stamen	The male reproduction organ of a flower.

Term or abbreviation	Definition
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests.
Teleomorph	The sexual stage of the life cycle of a fungus. Also called the perfect stage.
Tendril	A slender, coiled modified leaf or part of a leaf. They usually help plants attach to something.
Trash	Soil, splinters, twigs, leaves, and other plant material, other than fruit stalks.
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.
Vector	An organism that does not cause disease itself, but which causes infection by conveying pathogens from one host to another.
Viable	Alive, able to germinate or capable of growth.

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