



Apple & Pear Australia Ltd

**THE AUSTRALIAN APPLE AND PEAR INDUSTRY'S
TECHNICAL RESPONSE**

TO

IMPORTATION OF APPLES FROM NEW ZEALAND

REVISED DRAFT IRA REPORT

DECEMBER 2005

COMMISSIONED BY

**APPLE & PEAR AUSTRALIA LTD
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GLOSSARY OF ABBREVIATIONS

ALCM	Apple Leafcurling Midge
ALPP	Area of Low Pest Prevalence
APAL	Apple and Pear Australia Limited
AQIS	Australian Quarantine and Inspection Service
BA	Biosecurity Australia
BHL	Brownheaded Leafroller
CM	Codling Moth
CMB	Citrophilus Mealybug
DAFF	Department of Agriculture Fisheries and Forestry
DFAT	Department of Foreign Affairs and Trade
DIRA	Draft Import Risk Analysis
DSB	Dispute Settlement Body
E. amylovora	Erwinia amylovora
ERM	European Red Mite
GBC	Grey Brown Cutworm
GFF	Garden Featherfoot
GHL	Greenheaded Leafroller
Handbook	Import Risk Analysis Handbook DAFF 2003
IFP	Integrated Fruit Production
IGR	Insect Growth Regulator
(the) Industry	The Australian apple and pear industry
IPM	Integrated Pest Management
IRA	Import Risk Analysis
IRAAP	Import Risk Analysis Appeals Panel
IRAT	Import Risk Analysis Team
ISPM	International Standard Phytosanitary Measure
LBAM	Light Brown Apple Moth
N. galligena	Nectria galligena
NLR	Native Leafroller
NZFT	New Zealand Flower Thrips
OFM	Oriental Fruit Moth
OSS	Oystershell Scale
QUT	Queensland University of Technology
PFA	Pest Free Areas
R&D	Research and Development
RAP	Risk Analysis Panel
RDIRA	Revised Draft Import Risk Analysis
REB	Registered Export Block
TWG	Technical Working Group
WB	Wheat Bug
WTO	World Trade Organisation

EXECUTIVE SUMMARY:

The Australian Apple and Pear Industry has undertaken extensive consultation with the apple and pear growers, scientific and technical personnel and representatives of Biosecurity Australia to initially understand the document and then to undertake and extensive analysis of all aspects of the *“Revised draft Import Risk Analysis Report for Apples from New Zealand, December 2005” (2005 DIRA)*.

The *“Australian Apple and Pear Industry’s Technical Response to the Importation of Apples from New Zealand revised Draft IRA Report”* has been commissioned by Apple and Pear Australia Limited and has been prepared by representatives of APAL using the advice, assistance and knowledge of a range of industry and technical experts from throughout Australia and overseas.

The Australian Apple and Pear Industry would acknowledge that the Risk Analysis Panel (RAP) has spent an enormous amount of time and effort in considering a large amount of technical and scientific information and data. In addition the RAP has considered the material presented by stakeholders from the previous rounds of consultation.

Apple and Pear Australia Limited acknowledge that Biosecurity Australia has improved the level of consultation and communication with the relevant stakeholders through the exchange of information and reports and the implementation of face-to-face meetings that have allowed the exchange of ideas and processes. This has resulted in a better understanding of the issues and ultimately gone some way to improving this *“Revised Draft Import Risk Analysis Report for Apples from New Zealand”*, dated December 2005.

Notwithstanding these points, the Australian Apple and Pear Industry has a range of concerns with the information presented, the manner in which that information has been assessed and the ultimate conclusions presented by the RAP.

This submission prepared and submitted by Apple and Pear Australia Limited, for and on behalf of the Australian Apple and Pear Industry raises a range of issues arising from sections of the 2005 DIRA that

- Are ambiguous and require further clarification
- Lack sufficient scientific information, data and/or rigour
- Present conflicting scientific results.

In addition the submission presents the considerations of the major components of the document in detail resulting in positions at variance to those offered by the RAP.

The Industry has presented a strong scientific case, utilising supporting evidence, to clearly demonstrate that the risks from importing apples from New Zealand are greater than Australia’s Appropriate Level of Protection allows.

Industry further believes that if the issue of New Zealand imports is to be impartially judged on known science, imports will not be allowed even with the protocols recommended by the RAP.

Some of the specific issues recommended by the Australian Apple and Pear Industry are as follows:-

ALOP:

While the Australian Apple and Pear Industry does not oppose the conduct of the IRA, the Industry does not accept that the IRA is an occasion for shifting the level or nature of Australia's risk acceptance with respect to pome fruit pests and diseases. If there is to be any shift in Australia's ALOP that is a matter for the government at ministerial level and not for Biosecurity Australia or the RAP.

The Australian Apple and Pear Industry understands that Table 1 below may well be a product of work which has been undertaken over the last several years

Table 1 Risk estimation matrix

Likelihood of 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 entry, establishment and spread

The Industry notes that Table 1 on its own does not and cannot describe a level of risk tolerance. In order for Table 1 to have any content it is necessary to define what is meant by each of the descriptors of "consequences of entry, establishment and spread" and what is meant by each of the descriptors of "the likelihood of entry, establishment and spread".

The Australian Apple and Pear Industry recommends that it is inappropriate for Biosecurity Australia to proceed on the basis that Table 1 is a representation of Australia's ALOP. Table 1 cannot be a representation of Australia's ALOP unless and until a responsible government official indicates that it reflects Australian government policy. The Industry suggests that the proper official to make that decision is the Minister for Agriculture Fisheries and Forestry.

Further, once the content to the descriptors used in Table 1, and found elsewhere in the 2005 DIRA is considered, it is clear that Table 1 does not reflect Australia's ALOP as it is understood by Australian policymakers, with whom the Industry through APAL has had detailed discussions.

RISK MODEL

A key criticism of the revised 2005 DIRA (BA 2005) is that the so-called "bucket model" is used throughout to interpret and assist with the elicitation of model probabilities. This has the effect of ignoring the natural variation inherent in pest and disease rates. Disease and pest transmission processes typically have hot-spots in time

and space where the prevalence is much higher than the overall average rate associated with the bucket model, and it is these hot spots that represent the greatest threat of disease or pest incursion. The bucket model ignores this important source of variation which affects risk calculations.

The Australian Apple and Pear Industry recommends that given the comments and/or criticisms relating to the Risk Model the Model must be adjusted to reflect these comments/criticism OR a more effective Risk Model must be utilised by Biosecurity Australia to continue any further consideration of the application to import apples from New Zealand.

FIRE BLIGHT:

The Australian Apple and Pear Industry finds that the modelling used by the RAP is, in the case of Fire Blight, overly sensitive to single probabilities which are assessed by the RAP to be very small. However, these small probabilities cannot be judged with any accuracy, and are not based on any actual data. Industry finds the model to be unduly sensitive to relatively small changes to these small probabilities, so much so that it places the conclusions of the model with respect to Fire Blight in grave doubt makes them and scientifically unsound.

The Industry believes that the protocol proposed by the RAP with a single inspection carried out 4 – 7 weeks after full bloom, is considered by Industry as inadequate.

Measures recommended by Industry include:

- Three inspections: one in spring before bud break, one at full flowering and one at harvest
- Orchard inspection after specific climatic events including hail, rain and/or wind storms.
- Exclusions of export orchards in close proximity to Fire Blight hosts showing symptoms
- Exclusion of orchards that have exhibited symptoms in the two previous years
- Sanitation of packing house equipment
- Separation of the washing operations of export fruit from non-export fruit.
- No removal of symptoms prior to inspections

EUROPEAN CANKER:

The Australian Apple and Pear Industry conclude that European Canker is a disease that could be as devastating to the Industry as Fire Blight. The Industry recommends that any exported fruit must be only accepted from orchards that have been subject to active surveillance and from export blocks that are demonstrably free of cankers.

Measures recommended by industry include:

- Banning importation of fruit from Auckland and Waikato areas where European canker is endemic and severe.
- Export orchards subject to twice yearly inspections (winter pre-pruning and summer pre-harvest).
- Insisting on active surveillance of export orchards for European canker.
- Detection of any cankers would disqualify the orchard from export for that season.

- Annual inspection of host plants in close proximity of export blocks
- Inspection of Pear and Nashi trees in close proximity to export blocks.
- Orchard inspection after specific climatic events including hail, rain and/or wind storms.
- No removal of symptoms prior to inspection.
- The implementation of a protocol controlling the movement of host plant material between New Zealand apple regions.

ARTHROPODS:

The Australian Apple and Pear Industry concludes that the proposed inspection regimes protocols will be inadequate for the major pests including Apple Leafcurling Midge, Leafrollers, Mealybugs, Codling Moth, Garden Featherfoot and Grey-brown Cutworm and recommend mandatory fumigation of all export fruit.

TRASH:

The Australian Apple and Pear Industry believe that while the RAP has supported the possible importation of mature apples from New Zealand trash free, the RAP has failed to offer a risk mitigation/management protocol for ensuring no trash enters with New Zealand apples.

Measures recommended by industry include:

- Inspection of 600 boxes per lot must be inspected for the presence of trash.
- Appropriate remedial action must be taken if trash is found

RESEARCH GAPS:

Throughout the Industry submission the Australian Apple and Pear Industry has highlighted that there is no or insufficient science supporting a particular proposition. In these situations the RAP has inferred an outcome which favours New Zealand. Under the SPS Agreement, Australia is in fact entitled to adopt SPS measures protecting Australia based on the available information while having an obligation to seek out science.

The Australian Apple and Pear Industry recommends that the RAP commission all appropriate research in all critical areas highlighted within Part B of the Industry submission before undertaking any further consideration of the application to import apples from New Zealand.

The Australian Apple and Pear Industry, in considering all the scientific and technical information and/or data, concludes that the Risk Mitigation/Management measures while considered by the RAP to be the least trade restrictive fail to ensure Australia's ALOP would be met.

Full details of the review of the *“Revised draft Import Risk Analysis Report for Apples from New Zealand, December 2005” (2005 DIRA)*, the associated and relevant science and the conclusions of the Australian Apple and Pear Industry are provided within Parts A, B and C of the Industry submission.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS:

SPECIAL GENERAL RECOMMENDATIONS

1. The Australian Apple and Pear Industry recommends that given the comments and/or criticisms relating to the Risk Model the Model must be adjusted to reflect these comments/criticism OR a more effective Risk Model must be utilised by Biosecurity Australia to continue any further consideration of the application to import apples from New Zealand.
2. The Australian Apple and Pear Industry believe that while the RAP has supported the possible importation of mature apples from New Zealand trash free, the RAP has failed to offer a risk mitigation/management protocol for ensuring no trash enters with New Zealand apples.
The Australian Apple and Pear Industry recommends that based on the principle of 600 fruit per lot being inspected for specific pests and/or diseases the equivalent of 600 boxes per lot must be inspected for the presence of trash. If trash is found then the appropriate remedial action must be taken.
3. The Australian Apple and Pear Industry recommends that the RAP commission all appropriate research in all critical areas highlighted within Part B of the Industry submission before undertaking any further consideration of the application to import apples from New Zealand.

RECOMMENDATIONS TAKEN FROM PART B OF THIS SUBMISSION

THE MODEL:

1. The Australian Apple and Pear Industry recommend that there should be three pathways depicted in Figure 2 (2005 DIRA) with the third pathway being directly to a wholesaler in the 'central market system' as utilised within Australia.
2. The Australian Apple and Pear Industry would recommend that
 - (1) an additional pathway be included for the wholesaler in the central market system,
 - (2) greater definition be given to orchard and urban packinghouses, and
 - (3) the use of worst case scenarios be utilised to better plot the potential movement of apple fruit and the generation of waste.
3. The Australian Apple and Pear Industry recommends that the current P4 (page 25) have some rating other than zero (0) and that the appropriate adjustments be made in all following calculations.

4. The Australian Apple and Pear Industry recommends that the linkage of “*wild and amenity plants*” be deleted and that “*wild*” and “*amenity*” be treated and defined within Figure 3 (Page 27) as two separate exposure groups.
5. The Australian Apple and Pear Industry recommends that the RAP undertake a formal modelling of one or more of the specific growing regions to develop a true understanding of the linkages between all of the utility points and the exposure groups. The Adelaide Hills or the Goulburn Valley would be ideal regions to undertake such modelling.
6. The Australian Apple and Pear Industry recommend that the figures relating to orchard wholesalers and urban wholesalers be amended to more realistic numbers.
7. The Australian Apple and Pear Industry recommend that a range of regional/district based scenarios are run through the modelling process rather than the broad based scenarios around how much fruit might go to orchard packinghouses/wholesalers versus urban packinghouse/wholesalers.
8. The Australian Apple and Pear Industry recommends that further comprehensive data is collected and fed into the model before any further steps are undertaken within the IRA process.
9. Given that the RAP indicates that “*in each case, consequence assessments do not extend to considering the benefits or otherwise of trade in a given commodity, or the impact of import competition on industries or consumers in the importing country*”.
The Australian Apple and Pear Industry recommend that “*the benefits or otherwise of trade in a given commodity, or the impact of import competition on industries or consumers in the importing country*” be included within the consequence assessments.
10. The Australian Apple and Pear Industry recommends that the RAP accurately define each of the apple growing regions against the four levels so that the industry is better able to make consideration of each of the assessments made within the 2005 DIRA. Using this information the RAP needs to model a range of specific growing regions to better establish and define the worst case scenario.

EUROPEAN CANCKER:

11. The Australian Apple and Pear Industry recommend that inspection of orchards after high rainfall occurrences, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European cancker.
12. Part of “*standard commercial agronomic practices*” should be the supply of nursery trees that are free of disease. As a result the Industry recommends that MAFNZ ensure testing of nursery trees is undertaken and audited as part of the risk management/mitigation protocol for European cancker.

13. Given that the RAP indicates that *“McCracken et al. (2003b) state that sporulation, dispersal and infection of N. galligena are strongly encouraged by mild, wet conditions”*.
The Australian Apple and Pear Industry recommend that inspection of orchards after *“mild, wet conditions occur”*, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European canker.
14. The Australian Apple and Pear Industry recommend that host plants to be removed from areas in close proximity to the export blocks/orchards and recommends that this be part of the risk management/mitigation protocol for European canker.
15. While the RAP indicates that *“this range takes into account the variations in climatic conditions across New Zealand, and the information indicating that about 95% of the apple export production in New Zealand comes from orchards in areas where the disease has either never been recorded or the disease occurs only sporadically in very wet seasons”*.
The Australian Apple and Pear Industry believe that this is an underestimation particularly based on the data presented.

Based on data within the Industry submission, the Australian Apple and Pear Industry recommends that the summary statement above be amended to be at best 55%.
16. The Australian Apple and Pear Industry seek clarification as to when the latest time for the removal of diseased wood will be allowed before the inspection?
17. The Australian Apple and Pear Industry recommend that inspection of orchards after spring flowering and before harvest, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European canker.
18. The Australian Apple and Pear Industry believe that given the scientific data presented by the RAP the minimum *“the number of conidia required to initiate an infection”* would be 10.
19. The Australian Apple and Pear Industry recommend that any risk management/mitigation protocol for European canker must include
 - (i) extensive detection and delineating surveys of export ‘blocks’,
 - (ii) the removal of host plants around export ‘blocks’, and
 - (iii) the control of nursery material into areas in which export ‘blocks’ are established, and
 - (iv) as part of *“standard commercial agronomic practices”* nursery trees should be the supplied ‘free of disease’. As a result, MAFNZ must ensure testing of nursery trees is undertaken and audited.

APPLE LEAFCURLING MIDGE:

20. Given that the RAP indicates that *“the mated female lays several eggs on each leaf, with each female laying up to 200 eggs over about three days (CABI, 2002). A population can be started from a small group of viable eggs”*.

The Australian Apple and Pear Industry believe that is a highly significant statement and highlights the low population level required to start a population.

As a result Industry believes that a zero population of eggs as well as adult, larva and pupa stages of the life cycle is required on any imported fruit. The only way to achieve this would be through mandatory fumigation of all imported apples from New Zealand.

21. The Australian Apple and Pear Industry believe that *“mandatory treatment such as fumigation to all export lots”* should be the minimum risk mitigation protocol for the control of Apple leafcurling midge.

GREY-BROWN CUTWORM:

22. The Australian Apple and Pear Industry believe that the statement *“that the larvae can survive cold storage during distribution”* is highly significant. More importantly it highlights that the risk mitigation process put in place in the orchard, during harvest, transportation, storage and packing have not controlled the larvae of the Grey-brown cutworm.

The Australian Apple and Pear Industry would therefore recommend that if the trading of apples from New Zealand is allowed, there be mandatory fumigation of all imported apples from New Zealand as the only acceptable risk mitigation protocol.

LEAFROLLERS:

23. Given that the RAP indicates that *“the minimum on-arrival border procedures as described in the method section would not be effective in detecting the larvae”* the Australian Apple and Pear Industry would believe that the RAP has, using the precautionary principle, no option but to reject the importation of apples from New Zealand.
24. The Australian Apple and Pear Industry believe that the proposed risk mitigation/management protocol of *“inspection and remedial action based on 600-fruit sample from each lot”* is totally inadequate.
25. The Australian Apple and Pear Industry believe the minimum risk mitigation/management protocol for Leafrollers is mandatory fumigation of all lots entering Australia.
26. Given that the RAP indicates that *“because of the uncertainty about the level of internal infestation of apple fruit by brownheaded and greenheaded leafrollers. New Zealand is requested to provide additional information that addresses those issues”*.

The Australian Apple and Pear Industry believe that any additional information

- (i) must be presented before the RAP gives any further consideration to the application for the importation of apples from New Zealand, and
- (ii) the collection of any additional information be supervised by Biosecurity Australia.

RISK MANAGEMENT AND DRAFT OPERATIONAL FRAMEWORK:

- 27. The Australian Apple and Pear Industry recommend that Biosecurity Australia is involved from the beginning in the processes of developing a draft work plan.
- 28. The Australian Apple and Pear Industry would seek clarification as to what role either or both the New Zealand and Australian Industries would have in the development of the draft work plan.
- 29. The Australian Apple and Pear Industry recommend that Apple and Pear Australia Limited be consulted and involved from the beginning in the development of the appropriate draft work plan.
- 30. The Australian Apple and Pear Industry recommend that pre-clearance arrangements be in place for the longevity of any trade of apples between New Zealand and Australia.
Notwithstanding this the Industry recommends that pre-clearance arrangements be put in place for a minimum mandatory five year period and that a comprehensive review be undertaken in the fifth year to consider how the issue of pre-clearance will progress at the end of the 5 year period.
- 31. The Australian Apple and Pear Industry recommend that
 - (i) any orchard registration must be listed on an approved computer data base and made available for access to the Australian Industry,
 - (ii) identification of orchards and/or blocks must be through aerial photographs and GIS and such information must be placed on the data base.
- 32. Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the “*start of each apple season*” be defined as at the commencement of autumn leaf fall.
- 33. Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the growers must “*notify MAFNZ of their intention to register an orchard or orchard block*” at the commencement of autumn leaf fall.

34. Given that the RAP indicates that *“each export orchard or orchard block must be allocated a unique identification number by MAFNZ. This unique identification number will be used to enable traceback”*.

The Australian Apple and Pear Industry would support this requirement but in doing so recommends that

- (i) the information must be include on the computer based registration database, and
 - (ii) the number(s) must be on each carton of fruit before it can be considered for export to Australia.
35. The Australian Apple and Pear Industry recommend that ALL information relating to *“standard commercial practice”* must be included within the *“standard operating procedure (SOP) or manual”* developed and implemented by MAFNZ/AQIS.
36. The Australian Apple and Pear Industry recommend that any records of confirmed Fire Blight and European canker detections must be recorded and registered on an approved computer data base and made available for access to the Australian Industry.
37. Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the *“start of each apple season”* be defined as at the commencement of autumn leaf fall. This is the time when exporters and export packing houses should be registered. This is essential to *“maintain quarantine integrity of the commodity, and provide for traceability of consignments should non-compliance with import conditions occur”*.
38. The Australian Apple and Pear Industry recommend that any registration of exporters and export packing houses must be listed on an approved computer data base and made available for access to the Australian Industry.
39. Given that the RAP indicates that *“each export packing house must be allocated a unique registration number by MAFNZ”*.

The Australian Apple and Pear Industry would support this requirement but in doing so recommends that

- (i) the information must be include on the computer based registration database, and
 - (ii) the number(s) must be on each carton of fruit before it can be considered for export to Australia.
40. The Australian Apple and Pear Industry recommends that any new disinfection agents submitted for consideration must be presented to the Australian Apple and Pear Industry and Biosecurity Australia for review before approved by AQIS.

41. The Australian Apple and Pear Industry recommend that a continuous form of monitoring chlorine and chlorine levels be required for each and ever export packing house.
42. The Australian Apple and Pear Industry recommend that “*apple fruit inspected and certified by MAFNZ for export*” must be stored in separate clean storage facilities that contain no other apples.
43. The Australian Apple and Pear Industry DOES NOT support any consideration of “*low pest prevalence*” and/or “*pest free places of production*” as acceptable risk management measures.
44. The Australian Apple and Pear Industry recommend that 3000 samples must be taken from each individual supplying orchard and/or orchard block with a lot comprising apples from a number of different orchards and/or orchard blocks.
45. The Australian Apple and Pear Industry recommend that all 3,000 fruit must be cut no matter what their status.
46. The Australian Apple and Pear Industry recommend that “*lots that pass MAFNZ/Agency phytosanitary inspection*” must be stored in separate clean storage facilities that contain no other apples.
48. The Australian Apple and Pear Industry recommend that once “*one orchard block is found to be non-compliant*” the lot cannot be reconfigured and the whole lot must be rejected.
49. The Australian Apple and Pear recommend that on the “*detection of any significant pests or quarantine concern*” and/or pests that have not previously been assessed all trade must be suspended until new measures are developed and implemented to provide the appropriate level of phytosanitary protection for Australia.
The Industry also recommends that the produce be re-exported or destroyed.
50. The Australian Apple and Pear Industry recommend that 600 samples must be taken from each individual supplying orchard and/or orchard block with a lot comprising apples from a number of different orchards and/or orchard blocks.
51. The Australian Apple and Pear Industry recommend mandatory fumigation as the only acceptable risk management protocol for “*Leafrollers and quarantine pests including contaminant pests*” to provide the appropriate level of phytosanitary protection for Australia.
52. The Australian Apple and Pear Industry recommend that all accredited agents and agency agreements are registered on a computer based data-base to which the Australian Industry has access.

53. The Australian Apple and Pear Industry recommend that upon the “*detection in Australia of live quarantinable arthropods including contaminant pests*” the produce must only be re-exported or destroyed.
Industry does not support the treatment of the consignment.

AUSTRALIA’S APPROPRIATE LEVEL OF PROTECTION

TECHNICAL CONSIDERATION OF THE ALOP

1. The Australian Apple and Pear Industry believe from the longstanding Australian government policy on the ALOP the following points can be made:-
 - a) The rejection of a "no risk" approach to quarantine does not mean the acceptance of any particular quantity or quality of risk.
 - b) The statement that Australian governments have consistently adopted a highly conservative approach tells us that Australia's ALOP is "highly" risk averse. However it does not tell Industry, with any precision, where a risk acceptance line is to be drawn.
 - c) It can be accepted from very long established quarantine policies Australia places a high value on its pome fruit industries and the communities which are dependent upon them, and has not been prepared to accept any significant level of risk that pome fruit pests which could not be contained would establish and spread in Australia.
 - d) There is nothing in the 2005 DIRA which suggests that changes in technology or new information require any changes to Australia's established level of risk acceptance with respect to pome fruit pests.
 - e) There has never been a suggestion by Biosecurity Australia, any of its predecessors or any officer of Biosecurity Australia or its predecessors that the existing policies with respect to pome fruit pests are "outliers" or otherwise outside the "ALOP zone".
 - f) Nor has there ever been a suggestion that Australia's existing policies with respect to pome fruit pests evidence a level of risk acceptance which is inconsistent with the level of risk accepted in a comparable area by Australia.

It follows that while the Australian Apple and Pear Industry does not oppose the conduct of the IRA, the Industry does not accept that the IRA is an occasion for shifting the level or nature of Australia's risk acceptance with respect to pome fruit pests and diseases. If there is to be any shift in Australia's ALOP that is a matter for the government at ministerial level and not for Biosecurity Australia or the RAP.

2. The Australian Apple and Pear Industry understands that Table 1 below may well be a product of work which has been undertaken over the last several years.

The Industry recommends that great caution is needed to ensure that in providing "better guidance" and a "clearer view" as to Australia's ALOP, officials do not abrogate to themselves a role properly preserved to Government at ministerial level -- by changing Australia's ALOP.

The Industry notes that Table 1 on its own does not and cannot describe a level of risk tolerance. In order for Table 1 to have any content it is necessary to define what is meant by each of the descriptors of "consequences of entry, establishment and spread" and what is meant by each of the descriptors of "the likelihood of entry, establishment and spread".

Unless the meaning of each of those descriptors is clearly and consistently defined Table 1 cannot provide either a transparent or a consistent (or indeed, any) definition of ALOP.

The following statement which appears immediately below Table 1 on page 4 is not consistent with the authoritative statements of Australia's ALOP set out on page 3 of the 2005 DIRA and analysed more fully above:

"The band of cells in Table 1 marked "very low risk" represents Australia's ALOP or tolerance of loss."

There is no statement of Australian government policy which refers to Table 1 or anything like it. There is no statement of Australian government policy which endorses Table 1 or anything like it as a representation, description or definition of Australia's ALOP.

		Table 1 Risk estimation matrix					
Likelihood of 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 entry, establishment and spread							

3. The Australian Apple and Pear Industry recommends that it is inappropriate for Biosecurity Australia to proceed on the basis that Table 1 is a representation of Australia's ALOP. Table 1 cannot be a representation of

Australia's ALOP unless and until a responsible government official indicates that it reflects Australian government policy. The Industry suggests that the proper official to make that decision is the Minister for Agriculture Fisheries and Forestry.

Further, once the content to the descriptors used in Table 1, and found elsewhere in the 2005 DIRA is considered, it is clear that Table 1 does not reflect Australia's ALOP as it is understood by Australian policymakers, with whom the Industry through APAL has had detailed discussions.

4. The 2005 DIRA allocates the descriptor of "*high*" to the consequence of Fire Blight. The Australian Apple and Pear Industry considers it inconceivable that any Australian policymaker would classify those consequences as anything less than "*extreme*" which is the most severe descriptor of consequence contemplated in Table 1.
5. The Australian Apple and Pear Industry considers that Australian policymakers would generally classify the consequences of European canker as at least "*high*" if not "*extreme*". However the 2005 DIRA classifies the consequences of European canker as "*moderate*".
6. The 2005 DIRA reports an assessment that the direct impact on plant life and health will be "*highly significant*" at the level of an Australian State but only "*significant*" at the national level. The Australian Apple and Pear Industry cannot understand how an impact which is "*highly significant*" in each of the States and one of the two internal Territories of Australia could be anything other than "*highly significant*" at the national level.
7. The Australian Apple and Pear Industry believe there is no articulation of Australian Government policy which relevantly touches on the form of categorisation of consequence used in the 2005 DIRA.
8. The Australian Apple and Pear Industry opposes any change to Australia's ALOP. Further, the Industry submits that if any change is to occur that should only be through a decision of the Australian Government at ministerial level. As Biosecurity Australia's predecessor properly informed the Senate committee, the making of such changes to policy is for Ministers, not officials.

A PRACTICAL CONSIDERATION OF THE ALOP:

1. If the ALOP is set correctly and maintained through appropriate measures then incursions would also be 'very low', but how do we know that the measures put into place to maintain the ALOP and keep out pests and diseases are successful?
2. The lack of success in maintaining the ALOP is easier to judge. If a disease or pest that Australia wished to exclude has entered and become established and spread in Australia then clearly the measures in place to manage the risk of its

entry establishment and spread in line with Australia's highly conservative ALOP were not successful.

3. In the 25 years to 1995, the Nairn Review of Quarantine found:
 - Animal pests and diseases – 11 incursions that resulted in the recent establishment of viable populations. Control costs of at least \$500,000 were incurred for control of each population. For example blue-tongue control costs were more than \$9 million for the years 1989 to 1991;
 - Pathogens of plants – 652 incursions that resulted in establishment of pathogens (fungi, viruses, viroids, bacteria, nematodes, etc) previously unknown in Australia. In addition there were a further nine incursions specifically related to forest pathogens. A single nematode outbreak in WA, 1982 to 92 cost \$300,000 to control;
 - Pests of plants – 40 insect pests of economic significance established viable populations in the period 1971 to 1995. Warehouse beetle control, NSW 1978-82 cost \$991,500.
 - Weeds – 290 new species established populations in Australia between 1971 and 1995. Combellack (1989, in Nairn 1996) estimated that the total annual cost of weeds was more than \$3 billion, without including so-called environmental weeds.
4. In the years since the Nairn Review the Australian Apple and Pear Industry has found 16 instances of high risk imports and systems failures that have exposed Australia to major pest and disease risk.
5. This number of exposures suggests that there might have been errors in the recent application of Australia's highly conservative ALOP. The magnitude of the risks posed to the pome fruit industries makes it essential that there be no repetition of those errors.[TJBrennan1]
6. In 1997 there was an outbreak of Fire Blight in the Melbourne Royal Botanical Gardens. As Fire Blight was unknown in Australia before that time it would seem to be important to seek a source for the disease. The disease was either deliberately or accidentally introduced into the gardens.
7. This event is one that indicates two things. The first is that Australia's ALOP had been breached through some breakdown of the quarantine system. The second is that an event that is so unlikely to happen, that Biosecurity Australia feels it possible to commence commercial shipments (with protocols involved), actually did happen when the number of apples entering Australia must have been negligible.
8. The outbreak of Fire Blight in the Royal Melbourne Botanical Gardens shows just how easy it is for Fire Blight to enter Australia and just how cautious the approach must be to commercial apple shipments if Fire Blight is to be kept out of Australia.

9. Importing fruit, under any set of risk-lowering protocols cannot possibly meet Australia's ALOP of 'very low' because the current situation, with no imports, does not reach that ALOP standard.
10. If a bacterial infection can be spread by air currents then the coincidence of source of infection, susceptible host and means of transfer would appear not to be a situation of 'low' or 'very low' risk.

ECONOMIC CONSEQUENCE

1. The Australian Apple and Pear Industry believe that the area of **"Plant Life or Health"** consideration should be rated at the maximum possible level – **'G'** – even assuming that the data in the DIRA is accurate. However we point out that many of the research bases of this finding are now quite old and revision would actually increase the estimate of the consequences in this category.
2. Since 1991 the variety mix in Australia has changed dramatically. Of most importance here is the introduction of Cripps Pink (Pink Lady™) to the Australian industry. In 1991 there were virtually no Cripps Pink trees in Australian orchards. By 1995 there were just over 800,000 and in 2004 there were more than 2.3 million Cripps Pink trees in Australian orchards.
3. As Cripps Pink is highly susceptible to Fire Blight the losses in Australia will be far worse than predicted in the 2005 DIRA.
4. The costs of removing host amenity plants and replacing them in areas where there is a Fire Blight outbreak only add to the consequences.
5. There are no known direct impacts on **"Human Life or Health"** from Fire Blight outbreaks and as a result Industry would question the need to include this section within the Model.
6. The Australian Apple and Pear Industry believe that the economic consequences of **'Control or Eradication'** of Fire Blight in Australia would be significant and that the costs of control or eradication are significantly underestimated. The rating for this section should be upgraded to **'F'**.
7. Fire Blight has been categorised under the Emergency Plant Pest Response Deed such that the government share of costs will be 80% so the costs incurred by the Governments will certainly be significant. This includes the costs of compensating growers, so the Government contribution would be very large indeed if the outbreak occurred in a major apple and pear growing region.
8. Replanting a hectare of apples was estimated to be \$10,000 in the DIRA (p. 91). However the process of replanting an orchard seems not to have been taken into account. The steps involved are:
 - Removal of trellis and watering systems,
 - Removal and destruction of existing trees,
 - Soil treatment with methyl bromide to avoid replant disease*,

- Purchase of trees (1500 to 2,500 @ \$10 each): \$15,000 to \$25,000,
- Replacement of infrastructure, and
- Planting trees

These steps would lead to costs well over \$40,000 per hectare. Add to that cost the loss of production over time to optimal cropping, and costs are really escalating. The \$10,000 quoted in the 2005 DIRA would not even come close to the cost of replanting a modern orchard.

9. The experiences of the Victorian Apple and Pear Industry during the Fire Blight outbreak in the Royal Melbourne Botanical Gardens and the South Australian Apple and Pear Industry during the alleged outbreak in the Adelaide Botanic Gardens, when the state borders were immediately closed and all interstate trade ceased were such that the rating for **“Domestic Trade or Industry”** of ‘E’ is considered to be appropriate for this area of consequence.
10. Loss of export markets and export opportunities would be of significant cost to the industry. A rating of ‘D’ is considered to be appropriate for **“International Trade”**.
11. The rating of ‘A’ for the **“Environment”** assessment needs to be reconsidered in the light of the costs of the impact on amenity plants and the unknown impact and costs that would be incurred should fire blight become established in Australian native flora.
12. The direct impact of Fire Blight on the **“Environment”** is described as “unknown” and the consequences on native flora dismissed with the assurance that very few native plants are closely related to known hosts of Fire Blight. The Australian Apple and Pear Industry would suggest that “unknown” leaves much room for error and the possible impact of Fire Blight on native flora is another reason not to lower the consequence rating from ‘F’.

Further, this treatment of risks to the environment is inconsistent with s11B of the Quarantine Act which provides:

“Before making a decision under this Act, the implementation of which is likely to result in a significant risk of harm to the environment, a Director of Quarantine must comply with the requirements of this section”.

That section requires the Director to decide whether importation of apples is or is not likely to result in a significant risk of harm to the environment. The answer that it is not known whether such a risk is likely is not a response permitted by the section. At the very least, compliance with this section will require the conduct of experiments to determine whether the native plants in the Rosaceae family are susceptible to *E. amylovora*.

12. The extent of loss to **“Communities”** and therefore to the entire country could be extreme and the rating here deserves to be increased from ‘D’ to ‘E’.

13. The Australian Apple and Pear Industry agrees that the “**overall consequences**” rating for Fire Blight should be “**high**” however it is also of the opinion that some of the sub-sets of the consequences equation have been underestimated. There is not doubt at all that the consequences rating cannot be anything less than “**high**”.

THE MODEL IN CONTEXT:

SUMMARY:

1. This Australian Apple and Pear Industry through Apple and Pear Australia Limited examined the statistical methodology and modelling of the 2005 DIRA (BA 2005), in particular to examine whether the statistical methodology and modelling is appropriate to the task, and correctly executed within the document; whether the conclusions drawn are consistent with the methodology and modelling, and soundly based; and whether conclusions are robust to the many uncertainties inherent in the modelling.
2. A key criticism of the revised 2005 DIRA (BA 2005) is that the so-called bucket model is used throughout to interpret and assist with the elicitation of model probabilities. This has the effect of ignoring the natural variation inherent in pest and disease rates. Disease and pest transmission processes typically have hot-spots in time and space where the prevalence is much higher than the overall average rate associated with the bucket model, and it is these hot spots that represent the greatest threat of disease or pest incursion. The bucket model ignores this important source of variation which affects risk calculations.
3. The Australian Apple and Pear Industry finds that the modelling used by the RAP is, in the case of Fire Blight, overly sensitive to single probabilities which are assessed by the RAP to be very small. However, these small probabilities cannot be judged with any accuracy, and are not based on any actual data. Industry finds the model to be unduly sensitive to relatively small changes to these small probabilities, so much so that it places the conclusions of the model with respect to Fire Blight in grave doubt and scientifically unsound.
4. The Australian Apple and Pear Industry finds that uncertainty about model parameters is not transparently documented, but seems to be selected arbitrarily in many cases; that expert uncertainty about a model parameter is not clearly distinguished from natural variation in the parameter, from year to year and place to place; that the assessment of consequences seems arbitrary and overly simplistic; that uncertainty is thrown away in the assessment of risk and therefore not appropriately considered; that the 50th percentile is used in risk estimation without sufficient appreciation of the implications for risk management of the distribution of likelihoods for entry establishment and spread; that the systems approach to risk reduction is applied without sufficient justification that the separate measures will act independently to

reduce risk; and that as a result of these factors and the other issues discussed below, it is highly likely that the risk associated with the import of apples from New Zealand has been substantially under-estimated.

REVIEW OF PREVIOUS CRITICISMS:

5. The Australian Apple and Pear Industry observes that there are many cases where estimates are made of low probability events that appear to be no more than re-statements of the qualitative categories of the February 2004 draft (BA 2004), and in these cases the same criticism applies. That is, uncertainty is assigned arbitrarily, and low probability events are given undue precision.
6. The Australian Apple and Pear Industry was critical of the 2004 RDIRA (BA, 2004) for basing the modelling on a single apple, both in regard to the estimation of probabilities of establishment and spread, and because clustering effects were ignored. This criticism remains unaddressed for non-insect pests in the 2005 DIRA. Our comments in Sections 10.2.3.2.2 and 10.4.8 of the June 2004 APAL submission (APAL 2004) remains pertinent. Changes made to the treatment of insect pests do not adequately address these concerns.
7. The Australian Apple and Pear Industry notes that explicit consideration of interception data from the Pest and Disease Information Database is no longer mentioned, and clarification should be sought that such data is still considered in determining whether a pest is associated with mature apple fruit.
8. The Australian Apple and Pear Industry notes that an appendix by the Bureau of Rural Sciences (pp 307-310, BA 2005) asserts that input distributions were chosen to reflect the actual uncertainties in each case. Methodologically, this is a substantial improvement, in line with Industry's previous criticism. However whether this methodological improvement translates to better and more reliable conclusions depends on how well the input likelihood distributions actually represent both the natural variability in the likelihood, and the uncertainty about its exact value. Unfortunately, there is no way that this can be assessed from the 2005 DIRA (BA 2005), because justifications for the parameters of these input distributions are rarely given, and the reasoning behind their choice is not detailed. The appendix by the Bureau of Rural Sciences invites Industry to take it on trust that these input distributions were appropriately chosen given the state of uncertainty in expert knowledge, however transparency requires that the reasoning behind these choices should be made clear.
9. The Australian Apple and Pear Industry repeats its previous criticism that *"...uncertainty should be meaningful, expressing as appropriate natural variability and/or lack of precise knowledge. It should be based on the state of scientific and expert knowledge and opinion, rather than arbitrarily assigned..."*
10. In the previous criticism, in Section 10.4.11.2 of the APAL submission (APAL 2004), Industry discussed the importance of considering the uncertainty in the

distribution of the probability of entry establishment and spread. The 2005 DIRA (BA 2005) fails to address this criticism. It continues to use the 50th percentile (the median) of this distribution to assign a risk by way of the risk estimation matrix (Table 11, p 39, BA 2005) discarding the important information contained in the spread of this distribution.

11. The Australian Apple and Pear Industry believe that whether the mean, median or some other percentile is used as a single summary statistic of a probability distribution for the purpose of risk estimation has implications for the assumed loss function for estimation of the likelihood and therefore overall risk assessment. This has not been appreciated in the 2005 DIRA (BA, 2005).
12. The Australian Apple and Pear Industry noted in the previous criticism (APAL 2004) that without a clear appreciation of the conditional nature of importation and distribution steps, technical experts may tend to under-estimate the conditional probabilities, by treating them as marginal probabilities. The appendix by the Bureau of Rural Sciences makes it clear that there is still work to done in this area, as it states that *“while additional steps could have been conditioned it was considered that mixing would lead to the marginal estimates being sufficient for the later steps, given the other approximations in the model”*. It is quite clear that marginal estimates are most certainly not sufficient in the later stages of the model. Marginal estimates are incorrect.
13. The Australian Apple and Pear Industry believe where the same or similar environmental conditions have been used to justify a restriction to both probabilities of establishment and spread, the overall probability of exposure, establishment and spread will be underestimated.
14. The Australian Apple and Pear Industry criticised the way consequences were assessed and risk estimated (Sections 10.2.4 and 10.2.5, APAL 2004) on the grounds that consequences reflected political and economic value judgements, and that more rigorous economic modelling is quite feasible, and desirable. Industry has since formed the view that the operation of the rules for calculating consequences are contrived and arbitrary, and do not provide the transparency and rigour necessary of import risk assessments which potentially place large industry sectors at risk of adverse consequences.
15. The risk estimate itself, based on Table 19 of the 2004 RDIRA (BA, 2004), Industry criticised as unsophisticated, and pointed out that a large body of long standing work deals with the estimation of risk in a more rigorous and quantitative fashion, based on utility and probability distributions. A major criticism is that uncertainty had no formal role in the estimation of risk, and was discarded at the choice of a qualitative likelihood category for the entry establishment and spread of a pest. These criticisms have not been addressed in the 2005 DIRA (BA, 2005), and the treatment of consequences and the estimation of risk remains substantially unchanged from the February 2004 revised draft (BA 2004).

16. The Australian Apple and Pear Industry believes that since the original appraisal of the 2004 RDIRA (BA 2004), further critical weaknesses of the risk estimation scheme have become apparent. These are that (i) when the likelihood of entry, establishment and spread is high, multiple incursions may be expected to occur per year, whereas consequences are estimated based on a single incursion; and (ii) the risk estimation matrix assigns the same risk to events with likelihoods of 1 and 0.3, suggesting it needs to be redefined and recalibrated.
17. The Australian Apple and Pear Industry was critical of the way flying insect pests were modelled in the 2004 DIRA (BA, 2004). The criticisms appeared in Section 10.4.9 of APAL (2004), and were that
 - flying insects do not need to be discarded with apple waste, but may escape at any stage of the distribution network, from either waste or non-waste streams.
 - accommodations reputedly made for flying insects are impractical, are likely to be misleading, and were not described in any substance.
 - No evidence of these accommodations appeared in values for proportions in the distribution model.

Consideration of various scenarios has been added to the distribution model for flying insect pests in the 2005 DIRA (BA, 2005), in an attempt to address these criticisms. While Industry agrees that this is a methodological improvement, Industry is concerned that these scenarios are still based on a flawed model.

APPROACH TO MODELLING FLYING PESTS:

18. The Australian Apple and Pear Industry believe that the 2005 DIRA is largely missing sound evidence to support the values of partial probabilities of entry, establishment and spread. This is certainly the case for apple leafcurling midge.

CONSEQUENCE ASSESSMENT:

19. The Australian Apple and Pear Industry strongly argues for an economic impact analysis on the industry as a whole, taking into account both direct and indirect costs, across the full spectrum of categories defined in the 2005 DIRA (BA, 2005). This is especially important for pests such as Fire Blight which have serious consequences. Otherwise the consequence analysis is out of step with the rest of the modelling – and the risk is found by combining a relatively sophisticated estimate of the probability of entry establishment and spread with a simplistic estimate of the consequences.

COMMENTS ON APPENDIX 1:

20. The Australian Apple and Pear Industry believe that the “bucket model” eliminates the natural variability that is to be found in infection rates and accordingly reduces the range of variability of values such as Imp2. The

variability of the $U(10^{-3}, 5 \times 10^{-2})$ value only represents the RAP's uncertainty about average rates and has nothing to say about the variability to be observed between bins for example of actual infection rates. Such a restriction is a weakness of the 2005 DIRA (BA, 2005) and should be corrected.

The "bucket model" essentially assumes a linear model as it distributes apples to locations for establishment in a uniform way with respect to infestation. A clustering model would have clusters of infested apples at given locations. Industry doubts whether the RAP has taken into account such important factors.

21. From the Australia Apple and Pear Industry point of view a cautious approach with a higher loss for underestimating the risk than overestimating it gives support to use of the 95th percentile estimate and certainly a percentile greater than the 50th in the estimation of likelihood for incorporation into risk estimation.
A further reason for using a percentile greater than the 50th is that 2005 DIRA (BA, 2005) fails to take into account natural variability and therefore underestimates overall uncertainty.

ASSESSMENT OF PROBABILITIES IN THE IMPORTATION SCENARIO:

22. The Australian Apple and Pear Industry believe no consideration was given in 2005 DIRA (BA, 2005, Part B) to giving different values to Imp5 to take into account sourcing from uninfected/uninfested orchards. This would seem to be unsound and lead to inaccuracies in the model outcomes.

HANDLING UNCERTAINTY:

23. The Australian Apple and Pear Industry concludes that to represent the full variability one needs to take a range which is beyond values reported in the literature. Generally, the RAP did not do this and consequently the uncertainty in assessment of values is misrepresented. The 2005 DIRA (BA, 2005, Part B) does not appear to represent the uncertainty of given values in an accurate manner consistent with the descriptions in the text.

DISCUSSION ON INSPECTION STANDARDS:

24. The Australian Apple and Pear Industry concludes that trees to be inspected need to be carefully selected according to a sampling scheme that takes proper account of the tendency for trees which show symptoms to be clustered in time and space. Trees must be located close enough together so that significant outbreak clusters can be detected before they grow too large. Also geographical coverage is important, so that samples are taken from all regions. This is required to prevent an undetected outbreak occurring in an un-sampled section of an orchard or production area. These requirements can be conflicting, and their adequate satisfaction may require a larger sample size than that implied by the requirement to detect the presence of the disease with 95% confidence if the underlying rate of symptom visibility is 1%. As typically used to indicate sample size, this implies a sample of 300. However this implies that the same probability of showing visible symptoms applies to

every tree, independently of the status of its neighbours, or indeed any other tree, which is almost certainly incorrect. The choice of sample scheme must be adequately informed by the nature of the pest or disease, and the manner of its spread.

25. The Australian Apple and Pear Industry recommend that the choice of sample size, sampling scheme, and timing of inspections must be based on an understanding of the pest or disease in question, and while purely statistical considerations establish a useful baseline, they should always be interpreted in the light of the nature of each particular pest. Thus an inspection regime which may appear to satisfy the criteria, 95% confidence of detection with an underlying 1% rate of symptom visibility, may be completely invalidated by issues such as clustering and timing.
26. The Australian Apple and Pear Industry recommends that an additional issue that must be considered is the fact that inspections will not be 100% reliable. Inspection sensitivity, which quantifies the chance that an inspected tree's visible symptoms will be missed, must be quantified, and its affect on the required sample size analysed.
27. The Australian Apple and Pear Industry observes that if all areas have the same rate of disease prevalence, inspection will not reduce the proportion of infected trees in accepted areas. Accepted areas of symptom freedom will still have the same rate of disease prevalence.
28. The Australian Apple and Pear Industry conclude that the standard specified in the 2005 DIRA of "*at a 95% confidence level, detect visual symptoms if shown by 1% of the trees*" has a number of implications of concern. These implications include an assessment that a rate of 1% of trees with visible symptoms is the appropriate level for determining whether the import risk is sufficiently reduced; that a 95% confidence interval is appropriate, implying a 5% chance that blocks will be judged symptom free when in fact visual symptoms are present in 1% of trees; that a sample size of 300 trees is implied, assuming perfect inspections; and that the sample size will increase as inspection sensitivity decreases from 100%. This last point requires any protocol to provide some justification for the sensitivity of inspections. Industry notes that the above framework is based on the assumption that trees show symptoms independently of any other trees, including their neighbours. However this is most unlikely to be true for most pests and diseases, which means that the nature of the pest or disease must also be considered when establishing a meaningful sampling or inspection scheme. In particular, its means of spread, and timing issues such as the time between inspections, and the time between inspection and harvest, and any other relevant factors, must form part of an inspection protocol, based on the attributes of each particular pest. Finally, without a detailed definition of "visible symptom", no protocol can be effectively assessed against the standard specified in the 2005 DIRA, and indeed, the standard is virtually meaningless.

FIRE BLIGHT – RISK MANAGEMENT

29. The Australian Apple and Pear Industry is concerned that no mention in the 2005 DIRA (BA, 2005, Part B) is made of the number of trees in a symptom-free area. This is required to assess any inspection protocol for areas of symptom freedom.
30. The Australian Apple and Pear Industry concludes that given that there is no explicit evidence in 2005 DIRA (BA, 2005, Part B) to suggest what the proportion of trees with Fire Blight symptoms is in New Zealand, although pages 49 – 50 of 2005 DIRA (BA, 2005, Part B) give data on the proportion of orchards with Fire Blight symptoms, it is impossible to quantify the effect of the “*areas free from disease symptoms*” risk management measure. To do this requires data on the incidence of Fire Blight symptoms at the tree level in order to assess the efficacy of the statistical inspection scheme described above in reducing the average incidence by tree of Fire Blight symptoms. It also requires the proportion of diseased fruit coming from trees with and without symptoms.
31. The Australian Apple and Pear Industry conclude that it should be noted that the (risk management) proposal does not guarantee that apples are sourced from orchards free of Fire Blight symptoms. The implemented statistical sampling scheme could allow orchards with quite possibly 1% or more of trees infected with Fire Blight and having symptoms and possibly all apples picked carrying Fire Blight bacteria. This would give a value of Imp 2 equal to 1% because apples would be sourced from 1% of trees being diseased. The risk management measure (Table 24, p97; BA2005) reduces Imp 3 by a factor of 27 and Imp 5 by a factor of 17. The same remarks given above for Imp 2 apply to Imp 3 and Imp 5 because without providing further information at the tree level the effect of the measure “*areas free from disease symptom*” is not possible to quantify at the level given in 2005 DIRA (BA, 2005, Part B). These remarks above with respect to symptom free areas carry through to the systems approach for risk management (pages 100 – 104; BA, 2005) with the consequence that the values of Imp 2, Imp 3 and Imp 5 used in Tables 27, 28 and 30 are not substantiated in the text. The consequence is that the calculations made to determine that Australia’s ALOP has been met are not sound.
32. The Australian Apple and Pear Industry concludes that when the various risk reduction measures are applied in isolation, none of them manages to meet Australia’s ALOP, prompting the use of a “Systems Approach” based on combining risk reduction measures. A basic assumption behind this approach appears to be that the different measures can be combined independently, that is the application of one measure does not influence the effectiveness of a second measure. However this assumption should be thoroughly investigated in each case and is generally questionable.
33. The Australian Apple and Pear Industry concludes that; the median probability of entry, establishment and spread for the recommended risk management

measure is only a factor of two away from placing the risk outside Australia's ALOP; that uncertainty in this probability has not been considered; that clustering has not been considered, which almost certainly will give rise to atypical import lots with rates of infestation much higher than the average; that independence between risk reducing measures has been assumed without careful consideration of how these factors might impinge on each other; and that the effect of inspections on reducing the rate of infestation has been overstated, the assessment of the risk management methods does not convince us that Australia's ALOP will be met in the case of Fire Blight. The conclusion on page 104 that a combination of chlorine treatment and symptom free areas would be sufficient to reduce the risk presented by Fire Blight to below Australia's ALOP is in the opinion of Industry unsound when the margin is so small.

EUROPEAN CANCKER:

34. The Australian Apple and Pear Industry concludes that there is little quantitative information on pages 109 – 111 of the 2005 DIRA (BA, 2005, Part B), relating to European canker which supports an average proportion value of 1.65×10^{-5} or 0.00165% (implied by Imp1 x Imp2) of apples being infected/infested.
35. The Australian Apple and Pear Industry concludes that the evidence presented in the 2005 DIRA (BA, 2005, Part B), relating to European canker gives weight to an incidence rate of 0.063% whereas the value implied by the values of Imp 1 and Imp 2 gives a rate of 0.00165%. It would therefore appear that the RAP has incorrectly assigned a value to Imp 2 which is too small. The available data in the 2005 DIRA (BA, 2005, Part B) suggest that Imp 2 should be increased by a factor of at least 0.063%/0.00165% or about 40 times, and significantly more if clustering is pertinent as suggested by the data presented.

APPLE LEAFCURLING MIDGE:

36. The Australian Apple and Pear Industry concludes that the risk management measures suggested for apple leafcurling midge suggested on pp168 – 173 of the 2005 DIRA (BA, 2005, Part B) would appear to be reasonable provided that sampling is prescribed as a random sample of size 3000 from the lot.
37. The Australian Apple and Pear Industry concludes that in the relevant part of the text (page 171, last paragraph) there appears to be little, if any, support or discussion given to the value of the partial probability of entry, establishment and spread but its value is absolutely crucial to the risk estimation in this case.
38. The Australian Apple and Pear Industry concludes that there is no text in the 2005 DIRA (BA, 2005, Part B) to support this single choice of the $U(10^{-2}, 0.3)$ distribution for the partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops for this risk management scenario in Table 54.

38. The Australian Apple and Pear Industry concludes that the text on p162 of the 2005 DIRA (BA, 2005 Part B) in the section headed 'Probability of entry, establishment and spread - orchard wholesalers' presents no quantitative information to support the $U(0.3, 0.7)$ distribution and this choice is unsubstantiated by the text.
40. The Australian Apple and Pear Industry concludes that there is no support given in 2005 DIRA (BA, 2005) that if there were about 30 insects arriving each week at 7 commercial packing houses then the probability of entry, establishment and spread has an average value of 0.155 (or a distribution $U(10^{-2}, 0.3)$). It would therefore be reasonable to conclude that there is not a solid basis for the risk estimation of Table 56 (p172, BA 2005 Part B) meeting Australia's ALOP as this is highly dependent upon the value of $U(10^{-2}, 0.3)$ for partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops given in Table 54 (p172; BA 2005, Part B). Thus to declare that Australia's ALOP is being met by these risk management methods is unsound.

MODEL SENSITIVITY

41. In the Australian Apple and Pear Industry's assessment of the spreadsheet model associated with the 2005 DIRA (BA, 2005), Industry found that the outcomes with respect to Fire Blight were highly dependent on the values assigned to the model parameter "probability of exposure", which is given as a uniform distribution between zero and 10^{-6} , for all exposure groups and utility points (BA 2005, part B, p81). This corresponds to a qualitative category of negligible as given in the 2004 RDIRA (BA, 2004). However changing just one of these exposure probabilities, the probability that a discarded apple from the consumer utility point will cause infection in household plants, has profound consequences for the ultimate risk determination. In the case of Fire Blight, changing this from Uniform($0, 10^{-6}$) to Uniform($10^{-7}, 5 \times 10^{-5}$), the corresponding value in Roberts *et al* (1998), results in a median probability of entry establishment and spread of 1.76×10^{-2} , in the Very Low qualitative probability range, and a risk estimate of Low – above Australia's ALOP.

Based on the paucity of available evidence for this model parameter, and the failure to consider the effect of clustering and natural variation, and the very low probabilities being considered, the distribution for probability of exposure proposed in Roberts *et al*. (1998) is no less plausible than the Negligible distribution adopted in the 2005 DIRA (BA, 2005). To base firm decisions on the resulting risk estimate under these conditions is unsound.

GENERAL CONCLUSIONS:

42. The Australian Apple and Pear Industry concludes that the 2005 DIRA (BA, 2005), while containing much that is improved over the previous draft, retains several important methodological flaws which seem very likely to result in

underestimating the risk of importing apples from New Zealand to Australia. A key criticism of the 2005 DIRA (BA 2005) is that the so called bucket model is used throughout to interpret and assist with the elicitation of model probabilities. This has the effect of ignoring the natural variation inherent in pest and disease rates. Disease and pest transmission processes typically have hot-spots in time and space where the prevalence is much higher than the overall average rate associated with the bucket model, and it is these hot spots that represent the greatest threat of disease or pest incursion. This effect has not been considered in the construction and documentation of the model, and attempts to deal with it through consideration of scenarios are not convincing, as these scenarios are themselves generated by the same deficient model.

Industry found that the modelling used by the RAP is in the case of Fire Blight sensitive to single probabilities which are very small. These small probabilities cannot be judged with any accuracy, and are not based on any actual data. Industry found the model to be unduly sensitive to relatively small changes to these small probabilities, so much so that in the case of Fire Blight the conclusions of the model are dubious and unsubstantiated by evidence cited in the 2005 DIRA (BA, 2005).

In addition Industry found that uncertainty about model parameters is not transparently documented, but seems to be selected arbitrarily in many cases; that expert uncertainty about a model parameter is not clearly distinguished from natural variation in the parameter, from year to year and place to place; that the assessment of consequences seems arbitrary and overly simplistic; that uncertainty is thrown away in the assessment of risk and not properly considered; that the 50th percentile is used in risk estimation without sufficient appreciation of the implications for risk management of the distribution of likelihoods for entry establishment and spread; that the systems approach to risk reduction is applied without sufficient justification that the separate measures will act independently to reduce risk; and that as a result of these factors and the other issues discussed, it is highly likely that the risk associated with the import of apples from New Zealand has been substantially underestimated.

THE IRA STANDARD OF INSPECTION OF AREAS FOR FIRE BLIGHT FREEDOM.

1. The Australian Apple and Pear Industry conclude that the standard specified in the IRA of “*at a 95% confidence level, detect visual symptoms if shown by 1% of the trees*” has a number of implications of concern including:-
 - that a rate of 1% of trees with visible symptoms is the appropriate level for determining whether the import risk is sufficiently reduced,
 - that a 95% confidence interval is appropriate, implying a 5% chance that blocks will be judged symptom free when in fact visual symptoms are present in 1% of trees,
 - that a sample size of 300 trees is implied, assuming perfect inspections, and

- that the sample size will increase as inspection sensitivity (ie., the chance of correctly detecting disease) decreases. This last point requires any protocol to provide some justification for the sensitivity of inspections.
2. Without a detailed definition of “visible symptom”, no protocol can be effectively assessed against this standard, and indeed, the standard is virtually meaningless.

FIRE BLIGHT:

SUMMARY:

The extremely devastating nature of Fire Blight in countries where it is already known to exist is a fact that horticulturists as well as plant pathologists all over the world readily accept. If the disease is introduced into Australia its potential to cause very serious losses to the pome fruit industry has been clearly acknowledged in all the import risk analyses that have hitherto been carried out by Biosecurity Australia (BA) with respect to the importation of apples and pears. Fire Blight has the nature of causing devastating losses not only in the initial stages of its introduction into an area or a country but also periodically in cycles thereafter.

Since Fire Blight was first observed in the USA in 1793 it has progressively spread now to 46 other countries with a large majority of the introductions having occurred after the 1950's. However, the exact means by which the disease has been introduced to any of these countries, with the exception of only Egypt, still remains unknown.

Yet fruit, which in nature does get infested and infected, does bear disease symptoms, and exported around the world in millions of tones is not even speculatively suspected by authorities in apple exporting countries as being able to introduce the disease to countries where it has not been previously known. The infestations that apple fruit carry could be either on the surface, in the calyx or in the stem-end cavity (epiphytic); the infections are internal and could be endophytic, without exhibiting any symptoms, or with discernible symptoms.

The Australian Apple and Pear Industry response has considered a wide range of issues and is based on relevant scientific evidence that has already been published; however, where such evidence is not available in the literature relevant research published on other species of bacteria or other related scientific works will be cited to support the points made. Where no evidence whatsoever is available a conservative approach will be taken to drive home the point on the lines that *“absence of evidence does not necessarily mean evidence of absence”*.

Basically, the broad purpose of this part of the response is to show that if New Zealand apples were to be imported the three risk management measures (plus consignments free of trash) proposed in the 2005 DIRA do not lower the risk of introducing Fire Blight into Australia. This would mean that the level of risk that

Australia would accept, if the import of apples is allowed, will be above the Appropriate Level of Protection (ALOP) stipulated in the 2005 DIRA.

In the light of current understanding of the disease the Australian Apple and Pear Industry cannot visualise or imagine a set of risk mitigation measures (with or without a systems approach) that would lower the Unrestricted Annual Risk to a level that would not exceed Australia's ALOP.

The presentation of material in all three parts of the document is good, although the Australian Apple and Pear Industry does not necessarily agree with the RAP with respect to several areas. These will become evident when the Industry response is examined in detail. However, the Australian Apple and Pear Industry was pleased to find that a good proportion of the literature cited by Industry in its response to the 2004 RDIRA has been adopted by the RAP in the 2005 DIRA, even though the interpretation of the papers may not have been the same in some cases. Anyway, citing those papers has certainly made the Industry's task in responding to the new IRA much easier.

The detailed review on the disease and the pathogen, *E. amylovora*, in Part C of the document, gives a balanced picture with an exhaustive coverage of the literature. It was quite noticeable that the review extensively discusses the "epiphytic" phase of the life cycle of the pathogen, by citing numerous papers describing the epiphytic existence of the organism.

In assessing the unrestricted risk as "**Moderate**", after factoring in "Consequences" as "**High**", the RAP has taken a more realistic approach compared to that taken by them in 2004 RDIRA. However, the conclusion it has arrived at in assessing the restricted risk as "**Very Low**" is not sustainable as the risk mitigation measures considered, taken singly or in the form of a systems approach, cannot deliver the stated outcome.

Quite apart from the risk of introducing Fire Blight into Australia there is another risk that is as important as introducing Fire Blight. This is the likelihood of importation of strains of *E. amylovora*, with infested/infected apples, that are resistant to streptomycin.

The RAP has identified the importation of trash (Part B, page 48) as a potential pathway for the introduction of *E. amylovora* into the country. The Industry believes the evidence from the literature demonstrate that trash in the form of small stem pieces, twigs and leaves may be infected or infested with *E. amylovora* and would pose a real risk in introducing Fire Blight into countries free of the disease.

A pathogen is said to exist as an endophyte when it resides within its host tissue without necessarily causing symptoms of the disease. Apples carrying endophytic infections cannot be distinguished externally from healthy fruit. However, they may begin to show symptoms of fruit blight several weeks after harvest under conditions favourable for disease development and may act as potent sources of inoculum as it happens in Missouri (Goodman 1954). As it is with calyx infestations there are no treatments available for eliminating these endophytic infections.

More recently, Azegami *et al* (2006) experimentally demonstrated the systemic movement of Fire Blight bacteria from the stem into the fruit. These results show that bacteria can pass through the abscission layer into the fruit, even though the mature fruit lack symptoms.

2005 DIRA has made reference to the following areas of new science which were discussed in considerable detail in the APAL's response to 2004 RDIRA:

- (a) Viable but non-culturable bacteria (VBNC),
- (b) Biofilms/aggregates,
- (c) Sigma factor.

2005 DIRA does not seem to consider these areas of new science as relevant to the assessment of risk with respect to the importation of apples from countries having fire blight. In this response the Australian Apple and Pear Industry has discussed in considerable detail the subject of VBNC and its relevance to conclusions drawn on the basis of results obtained by culturing the pathogen on or in culture media.

The significance of the occurrence of the VBNC state of *E. amylovora* on the surface of the mature apple fruit or in the calyx of the fruit is primarily with respect to the detection of the pathogen using solid media. As the organism is non-culturable it will not be detected on culture media. Biosca *et al* (2006) conclude that the existence of such viable but non-culturable (VBNC) cells of *E. amylovora* could lead to an underestimation of the pathogen population from environmental sources when using only cultural methods.

Ordax *et al* (2006a; 2006b) found that the removal of copper ions with copper complexing agents was effective in all cases of restoring the culturability of copper-induced VBNC cells, but their ability to recover such cells varied depending on the time after the entry of *E. amylovora* into the VBNC state.

E. amylovora cells in apple calyces exist under adverse conditions especially with respect to nutrients. Under such conditions *E. amylovora* cells are very likely to enter the VBNC state as a mechanism for survival. Use of copper based bactericides in late autumn, winter and particularly in spring about 10 days prior to flowering, as practised in New Zealand, in the management of black spot, would also contribute to *E. amylovora* cells entering the VBNC state. Consequently, they may not be detectable by culture plating methods.

Thus, this physiological cell state could be involved in the recurrent infections of Fire Blight, and therefore, be responsible of its difficult control. In fact, the occurrence of phytopathogenic bacterial cells in the VBNC state could have serious implications in plant pathology, since epidemiological studies are usually based on plate counts of culturable cells (Wilson and Lindow, 2000)" (Ordax *et al* (2005; 2006a; 2006b).

Following a review of the more recent literature on pest survival the Australian Apple and Pear Industry is convinced that the RAP should carefully consider the following areas of new science with respect to the import risk analysis on the importation of apples from New Zealand: multicellular behavior, biofilms/aggregates, sigma factor and quorum sensing.

There is increasing evidence that *E. amylovora* engages in multicellular behaviour. Bacterial multicellular behaviour begins when free living planktonic bacteria engage in quorum sensing.

Although it is not yet documented that *E. amylovora* is capable of developing a particular multicellular structure like biofilm, *E. amylovora* utilizes mechanisms associated with multicellular behaviours such as quorum sensing and the multidrug efflux system and has demonstrated characteristics which are common to biofilm producing bacteria viz the presence of flagella, the production of EPS as well as presence of particular genes that participate in TTSS and expression of sigma factors. In the short time since the relatively recent discovery of bacterial biofilm on plant surfaces, the capacity of *E. amylovora* to produce identified biofilm precursors has been demonstrated. It is in this context that the incomplete but developing understanding of this new science invites caution, so as to not be misled by the present absence of observed biofilm associated with *E. amylovora*.

The protocol proposed by the RAP (2005 DIRA), with a single inspection carried out 4-7 weeks after full bloom, is considered by the Industry as inadequate. This is an enormous task that is difficult to achieve though essential to reduce the risk to the importing country; the practical difficulty here would be, in the first place, to detect from ground level small (3-5 mm in diameter) but active cankers found on twigs and branches at the top of the tree.

It is evident that epiphytic bacteria in the calyx sinus and endophytic bacteria pose the greatest risk with respect to importation of fruit from New Zealand. The scientific evidence presented below clearly indicates calyx infestations and endophytic infections are present in mature fruit even in the absence of any apparent disease symptoms in orchards; this is because there are no areas in New Zealand that are free of Fire Blight. Thus, although it is not possible to harvest fruit that are totally free of such infestations/infections, a protocol comprising a minimum of 3 orchard inspections is required.

The occurrence of *E. amylovora* in apple fruit calyces or internal fruit tissue has been reported by Sholberg *et al* (1988), van der Zwet *et al* (1990) and Clark *et al* (1993) from trees free of Fire Blight symptoms but they were in close proximity to trees with symptoms.

The examples cited clearly demonstrate that the presence of Fire Blight symptoms on pome fruit or other alternative hosts in close proximity to symptom free apple trees could result in both endophytic infections and epiphytic calyx infestations/infections in immature as well as mature fruit.

In countries having Fire Blight the disease may occur in an orchard that did not show any apparent symptoms in the previous year or years; similarly, an orchard may not exhibit any apparent symptoms in the current year although symptoms have appeared in the preceding year or years. This is quite a common phenomenon and Fire Blight researchers are still perplexed by this as it cannot be explained simply by the present knowledge of the epidemiology of the disease (van der Zwet and Keil, 1979). Van der Zwet *et al* (1988) attributed it to the lack fundamental knowledge of the causal bacterium and its mode of infection.

The Industry believes that there is sufficient scientific evidence to prove that

- (a) fruit harvested from orchards or trees free of Fire Blight symptoms in close proximity to host plants showing disease symptoms carry fruit infestations/infections;

- (b) orchards free of symptoms in the current season but had symptoms in previous years carry fruit infestations/infections.

Thus, in selecting export orchards a protocol which excludes

- (i) orchards in close proximity to Fire Blight hosts showing symptoms
- (ii) orchards that have exhibited symptoms in the two previous years

would at least to some extent reduce the proportion of these infestations/infections. Coupled with these steps and the 3 orchard inspections recommended, statistically representative samples of immature and mature fruit at harvest should be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004).

The Australian Apple and Pear Industry fully agrees with the concerns expressed by 2005 DIRA as to the difficulty which aggregates/biofilms pose to the efficacy of washing apples. The Industry also agrees with the 2005 DIRA statement (on page 63) that *“epiphytic bacteria, especially those in the protected calyx cavity, would not be removed in dump tanks, at least in close calyx cultivars”*.

The Industry does not have enough information to be satisfied that even those 53% of packing houses that use the chlorine based system or alternative are able to maintain the crucial parameters that contribute to some level of sanitation. Even if chlorination levels were scrupulously maintained at 5-50 ppm, the expected efficacy of sanitation is likely to be marginal.

In terms of importation steps, chlorine may affect low levels of reduction in bacterial numbers in Importation Steps 4 and 5, but will not reduce Importation Step 3 (contamination during picking and transport) even with a 100 ppm level as the RAP assumes.

The biggest challenge for washing apples would be to maintain the quality of the sanitizing water in the tanks. When batches of apples are processed in dump tanks, the level of available chlorine would be expected to quickly deteriorate as organic matter would react with the chlorine in dump tanks. Non automatic systems cannot guarantee maintenance of the required chlorine level. With respect to automated systems it is necessary that the contact time is sufficient to achieve the expected disinfection rate.

The Australian Apple and Pear Industry concludes that epiphytic populations of *E. amylovora* are highly fluctuating and that fluctuations are driven by a variety of environmental and other factors, including weather and the size of transient populations and the survival advantage conferred by common surface variability and trauma.

Under Importation Step 4 there is no mention in the 2005 DIRA of the sanitation of equipment in packing houses that export apples would come into contact with during packing house operations. Unless measures are taken regularly to ensure sanitation of this equipment there is a very high possibility that export apples will get cross contaminated from non-export apples *via* such equipment.

The Australian Apple and Pear Industry would like to point out that the washing operations of export apples and non export blocks are not separated, therefore the sources of cross-contaminations are multiple.

The Australian Apple and Pear Industry's assessment is that trash or soil as well as apples will introduce *E. amylovora* to the wash waters. The contamination of water has a cumulative effect. In the unrestricted scenario where the pest is present in the source orchard, it is fair to assume that *E. amylovora* would accumulate in the wash waters and that they would become a source of inoculum.

Theoretically *E. amylovora* should be able to enter its hosts through any surface either through natural openings like stomata or lenticels or through wounds caused by wind damage, hailstorms etc. Infection of blossoms occurs through natural openings, including stigmas, anthers, stomata on the styles, fruit surfaces and sepals, hydathodes, nectarhodes (Thomson, 2000). In shoots invasion of the host tissue following entry occurs largely in actively growing young leaves. Entry into mature tissue is predominantly through wounds. However, infections occurring in apple or pear orchards in late summer following hailstorms are known to cause severe symptoms and inflict serious damage to the trees.

The exact mode of infection of the host by *E. amylovora* is still not properly understood.

It is apparent that the means by which Fire Blight has been introduced to over 95% of the countries where it is currently known to occur is based on pure speculation. Apple and pear fruit may have been exported to numerous pome fruit growing countries from the time the disease was first reported in the USA in 1793. However, it is a mystery as to why among these suspected means of introductions fruit has not been to date implicated, especially when it is known that fruit could be both infected (without exhibiting external symptoms) and infested (calyx).

Using the information below, fruit from orchards apparently free of Fire Blight symptoms have been shown to have calyx infestations and endophytic infections. For this reason and for reasons stated above, Industry considers the restricted likelihoods given by the RAP in Table 24 of the 2005 DIRA, implying a 10 to 10⁵ fold reduction of the unrestricted likelihoods for Imp 2, 3 and 5, is excessive with this mitigation measure.

Although the Australian Apple and Pear Industry acknowledges that some reduction in the likelihoods for Imp 2 and Imp 3 would occur the magnitude of the reductions for the two Imps in the 2005 DIRA is considered excessive (Table 24 in the 2005 DIRA document). Industry's median values for unrestricted risk are 0.2, 0.175 and 0.5 respectively for Imp 2, Imp 3 and Imp 5. It may be noticed that these values are marginally lower than those allocated by APAL in 2004 (in its response to 2004 RDIRA) as a result of allowance being made for inspections done from spring to mid-summer even in the case of unrestricted risk. Similarly, Industry would assess the restricted likelihoods as 0.16, 0.125 and 0.5 respectively for Imp 2, Imp 3 and Imp 5 (Table 3). It is apparent that the effect of "areas free from disease symptoms" has been overstated in 2005 DIRA.

CONCLUSIONS AND RECOMMENDATIONS:

1. The Australian Apple and Pears Industry's estimations of likelihoods given for the Importation Steps under Unrestricted and Restricted Risk, presented below, have been worked out against the backdrop of the scientific evidence.
2. The Australian Apple and Pear Industry believe that currently, there are no known methods that could eliminate the bacteria in the calyces and those deep in the stem-end cavity.
3. The Australian Apple and Pear Industry is fully convinced of the significance of epiphytic populations of *E. amylovora* in the import risk analysis of New Zealand apples, especially with respect to Importation Steps 2, 3 and 5.
4. The Australian Apple and Pear Industry believe that in some of the earlier research done in the USA, when commercial trade in apples with other countries was not an issue, the importance of epiphytic bacteria in the epidemiology of Fire Blight and, therefore, of the disease cycle was consistently emphasized.
5. The 2005 DIRA states that at the time of harvest epiphytic populations of bacterial numbers are likely to be very small. The Australian Apple and Pear Industry believe this statement is not entirely accurate. Rapid decline was observed in reports with poor harvesting techniques (Ceroni 2004) or in short inoculation studies (Norelli 2004). When the results of more sensitive techniques used by Thomson and Gouk (1999) were examined, it was found that towards the end of the season as much as 90% of leaves were infested with *E. amylovora*.
6. The Australian Apple and Pear Industry believe that streptomycin resistance are of two type's viz. chromosomal based resistance and plasmid based resistance. Although plasmid based resistance is less common than the chromosomal type it is more dangerous than the chromosomal type as the resistance genes could be easily transferred to other bacteria, some of which may be important human and animal pathogens.
7. The Australian Apple and Pear Industry believe that in the absence of validation of the efficacy of the harvesting techniques which incorporates the current state of knowledge with respect to bacterial behaviour, the absence of bacterial detection can tell very little. There is an urgent need to evaluate the harvesting techniques to establish the reliability of previously published results and the relevance of those results as a foundation for the conclusions drawn by 2005 DIRA.
8. The Australian Apple and Pear Industry believe that the physiological cell state – VBNC - could be involved in the recurrent infections of Fire Blight, and therefore, be responsible of its difficult control. In fact, the occurrence of phytopathogenic bacterial cells in the VBNC state could have serious implications in plant pathology, since epidemiological studies are usually

based on plate counts of culturable cells (Wilson and Lindow, 2000)” (Ordax *et al* (2005; 2006a; 2006b).

9. The Australian Apple and Pear Industry believe that for inspections to have any effect at least three inspections must be carried out during the growing season outlined as follows:
 - a) **The first inspection would be in spring just before bud break.**
The purpose of this inspection is to exclude from the export program those orchards having any obvious overwintering cankers on the trees.
 - b) **The second inspection would be at full flowering.**
The purpose of this inspection is to exclude those orchards with any primary blossom blight symptoms and also any overwintering cankers that may have escaped attention in the first inspection.
 - c) **The third inspection would be at time of harvest.**
The purpose of this inspection is to exclude those orchards with any secondary blossom blight symptoms, shoot blight symptoms on suckers or water shoots and any cankers that may have escaped attention during the first and second inspections.
10. The Australian Apple and Pear Industry recommend that an extra orchard/block inspection be carried if hail, excessive rain or wind storms are experienced in the orchard/block area.
11. The Australian Apple and Pear Industry recommend that coupled with orchard inspections statistically representative samples of immature and mature fruit must be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004).
12. The Australian Apple and Pear Industry believe that there are problems that are likely to be encountered in using ISPM 22 with respect to the export of New Zealand apples to Australia and need to be considered within the risk mitigation protocols:
 - (1) The definition of the term “area” used in the context of ALPP in ISPM 22 appears to be much broader and covers a larger area than just an orchard or a block in an orchard.
 - (2) How would MAFNZ determine the levels of *E. amylovora* populations (pest population) in a given area in order to designate it as an ALPP?
 - (3) What specific *E. amylovora* population level would MAFNZ consider a given area would qualify to be declared an ALPP?
 - (4) If MAFNZ is to consider low disease prevalence as equivalent to low pathogen/pest prevalence what specific Fire Blight symptoms level would qualify a given area to be declared as an ALPP?

- (5) To consider low disease prevalence as equivalent to low pathogen/pest prevalence is strictly not correct. How would MAFNZ circumvent this problem?
 - (6) Under the primary specific requirement “phytosanitary measures” for establishing ALPP is the secondary requirement “reducing pest levels and maintaining low prevalence”. This would entail regular inspection of export orchards/blocks (ALPP) and removal of any diseased material found. Such action is in conflict with any protocol the RAP would agree to with respect to risk mitigation measures (2005 DIRA), because the purpose of the protocol inspections are to eliminate orchards/blocks that show disease symptoms.
13. The Australian Apple and Pear Industry recommend that in selecting orchards/blocks for sourcing apples for export, it will be essential not to include orchards/blocks that are in close proximity to host plants or orchards showing disease symptoms.
14. The Australian Apple and Pear Industry recommend that in selecting orchards/blocks for the export program those showing symptoms must be strictly excluded from the program at least for a period of two years.
15. The Australian Apple and Pear Industry believe that bacterial internalization may offer the bacteria additional protection from sanitation during subsequent processing and have the opposite effect with respect to risk mitigation.
16. The Australian Apple and Pear Industry is concerned that some of the Orchard Management practices in New Zealand listed in the 2005 DIRA (page 50) if carried out routinely in source orchards would lead to erroneous results on Restricted Risk. The practices in question are:
 - (1) pruning out infected shoots; this would lead to wrong conclusions by inspectors in regard to the disease status of the orchard.
 - (2) frequent inspections of the orchard (*and pruning and burning infected material*). If these are done under assessment of unrestricted risk then it should not be considered again under assessment of restricted risk; it amounts to double counting.
17. The Australian Apple and Pear Industry have assessed the risks relating to the Importation Steps and recommend the following:-
 - a) The Australian Apple and Pear Industry agrees with the assessment of Imp1, likelihood for this importation given in the 2005 DIRA (likelihood – 1).
 - b) The Australian Apple and Pear Industry are assigning to Imp 2 a most likely value of 2×10^{-1} , a minimum value of 2×10^{-2} and a maximum value of 5×10^{-1} .
 - c) The most likely value assigned by the Australian Apple and Pear Industry for Imp 3 is 1.75×10^{-1} ; the minimum value assigned is 2×10^{-2} and the maximum value 5×10^{-1} .
 - d) The Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 4.

- e) The Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 5.
 - f) The Australian Apple and Pear Industry agrees with the values assigned in the 2005 DIRA for Importation Step 6 viz a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1).
 - g) The Australian Apple and Pear Industry agrees with the values assigned in the RDIRA –2005 for Importation Step 7 viz a most likely value of 5×10^{-7} , a minimum value of 0 and a maximum value of 5×10^{-7} .
 - h) The Australian Apple and Pear Industry agree with the value of 1 assigned in the 2005 DIRA for Importation Step 8.
18. The Australian Apple and Pear Industry recommend that sanitation of packing house equipment should be included in any protocol drawn up in connection with export of apples to Australia.
 19. The Australian Apple and Pear Industry believe that the washing operations of export apples and non export blocks are not separated, therefore the sources of cross-contaminations are multiple and as a result recommend that separation of washing operations be part of the risk mitigation protocol
 20. In view of the higher costs for the control of Fire Blight worked out by the Australian Apple and Pear Industry in comparison to that given in the 2005 DIRA, Industry considers it more appropriate to assess the Consequences as “**Certain**” (1) rather than “**High**” as given by the RAP. However, as the range for “**High**” according to Table 12 in the 2005 DIRA is from 0.7 to 1, the rating of “**High**” allocated for Consequences is acceptable for convenience of comparison with the 2005 DIRA estimation of Unrestricted risk.

EUROPEAN CANKER:

SUMMARY:

The Australian Apple and Pear Industry conclude that exports would be only accepted from orchards that have been subject to active surveillance and demonstrated that any export block was free of cankers.

The risk of importation of apple fruit carrying latent infections of *Nectria galligena* can be reduced by:

- a. Banning importation of fruit from Auckland and Waikato areas where European canker is endemic and severe.
- b. Permitting export from the Nelson area where European canker is reported to be sporadic, subject to twice yearly inspections (winter pre-pruning and summer pre-harvest). The exact timing of those inspections will need to be determined.
- c. Insisting on active surveillance of export orchards for European canker. Detection of any cankers would disqualify the orchard from export for that season.

RECOMMENDATIONS:

1. The Australian Apple and Pear Industry concludes that inspection of apple trees is essential to determine freedom but inspection must be carried out twice annually even if infected trees have not been found in the previous season.
2. The Australian Apple and Pear Industry recommend that host plants in close proximity of export blocks must be inspected annually.
3. The Australian Apple and Pear Industry recommend that if Pear or Nashi trees are present in the same orchard or in close proximity to export blocks they must also be inspected.
4. The Australian Apple and Pear Industry recommend that the areas from which imports will be acceptable should be formally defined according to the WTO-SPS either as Pest Free Areas (PFAs) or as Areas of Low Pest Prevalence (ALPPs). An ALPP is an area 'in which a specific pest (in this case European canker) occurs at low levels and which is subject to effective surveillance, control or eradication measures'.
5. The Australian Apple and Pear Industry recommend that in the case of European canker ALPPs should be defined as areas in which occurrence of the disease is sporadic and dependent on occasional favourable weather conditions, and in which disease is effectively controlled by a combination of fungicide use and eradication pruning. Effective surveillance would consist of winter inspections carried out prior to winter pruning and a pre-harvest inspection... Any cankers detected would be pruned out immediately after the inspection.
6. The Australian Apple and Pear Industry recommend that MAFNZ must declare both PFAs and ALPPs for European canker. In accordance with ISPM 7, an ALPP should not be defined without provision of survey data for a number of years prior to declaration of the ALPP. It may be possible to define areas such as Otago as PFA's, providing sufficient surveillance data can be demonstrated.
7. The Australian Apple and Pear Industry recommend that MAFNZ must also be asked to declare how they intend to maintain those areas as PFA & ALPP, in particular with respect to movement of propagating material from areas of high occurrence levels. ICPM 7 (2005) section 3.1.4.3 '*Reducing the risk of entry of specified pests*' may be invoked here.
8. The Australian Apple and Pear Industry recommend that in light of the available evidence, and subject to adequate definition of ALPP's, the above conditions would appear to allow for importation from all areas other than Auckland province and the Waikato, although there is considerable doubt about Nelson.
 - a) This is justified by the assumption that properly defined ALPP's would have such low incidence of disease on trees and that occurrence of fruit rots would be extremely unlikely. Given that we expect to be dealing

with dessert varieties, the likelihood of latent infection of fruit is even lower.

- b) It seems unlikely that Auckland/Waikato could ever be defined as ALPPs, even under best practice management of the disease.
 - c) More information from more reliable surveys is required for the Nelson area and should be obtained before imports are accepted from the Nelson area.
9. The Australian Apple and Pear Industry concludes that a weakness of the above conditions is that in years when environmental conditions are particularly favourable for development of European canker, winter inspections will not reflect the likely disease levels leading up to harvest. McCracken et al. (2003) reported a trial undertaken in heavily infected orchards where rainfall varied throughout the study from 653 – 791 mm. The Industry would believe that it is essential that orchard inspection occur after specifically defined environmental events eg., high spring or summer rainfall.

Detection of active cankers in either the winter inspection or the summer/pre-harvest would lead to removal of export permission from that export block/orchard.

ARTHROPODS.

SUMMARY AND CONCLUSIONS:

1. The Australian Apple and Pear Industry does not consider Biosecurity Australia should have excluded Wheat Bug from the analysis by reclassifying it as a contaminant. The evidence suggests that importation of fruit from New Zealand represents a high risk pathway for this pest, such that specific risk management strategies are required for fruit imports from New Zealand. Appropriate risk management options are suggested.
2. The Australian Apple and Pear Industry accept that it is appropriate to consider New Zealand Flower Thrips as a contaminant species.
3. A review of the ten insect species that have existing PRAs, as a result of the 2005 Draft Extension of Existing Policy for Stone Fruit into Western Australia, indicates that two species, Codling Moth and Citrophilous Mealybug should not be approved under existing policy. This is because their pest status on apples and stone fruit is not comparable; both are negligible or minor pests on stone fruit, but are major pests on apples with much higher risks of entry, establishment and spread.
4. The Australian Apple and Pear Industry commends Biosecurity Australia for the quality of its reanalysis of Apple Leafcurling Midge, and the risk

mitigation measures proposed, which are in line with the recommendations of The Australian Apple and Pear Industry in its response to the 2004 IRA.

5. The Australian Apple and Pear Industry considers that the 2005 DIRA has underestimated the risk for Grey-brown Cutworm, Garden Featherfoot, Leafrollers, Mealybugs and Oystershell Scale.
6. The Australian Apple and Pear Industry supports the proposed pre-clearance regime in New Zealand, but is concerned that it may be discontinued following a review after a trial period.
7. The Australian Apple and Pear Industry is concerned that the Apple Leafcurling Midge analysis shows that in some circumstances the standard AQIS on-arrival fruit sample of 600 is inadequate to reliably detect low levels of quarantine insects. The Industry considers the inadequacy of the standard 600 fruit sample is a major flaw in Australia's quarantine security. By comparison with the levels of sampling undertaken on fruit entering the USA, Canada, and Korea for example, the AQIS sampling rate is miniscule and leaves a major hole in Australia's quarantine net. As such, the Industry considers the AQIS 600 fruit sample is completely inadequate as a risk mitigation measure.
8. The AQIS standard 600 fruit sample is the only risk mitigation measure in the 2005 IRA for Leafrollers, Mealybugs, Codling Moth and Wheat Bug. The Industry considers this is totally inadequate to reduce the risk of these species to within Australia's ALOP.
9. The Australian Apple and Pear Industry considers that risk management for pests on imported New Zealand apples should include mandatory post-entry monitoring for escaped pests at major distribution and repacking centres and compulsory treatment of waste fruit and packaging to destroy pests and diseases.

RECOMMENDATIONS:

The Australian Apple and Pear Industry recommend that:

1. Wheat Bug be subjected to the full semi-quantitative analysis on account of the high risk pathway for this pest into Australia provided by fruit imports from New Zealand.
2. Codling Moth be subjected to the full semi-quantitative analysis because it is highly inappropriate to use the extension of existing policy for New Zealand stone fruit into Western Australia for this apple pest, which has negligible status in stone fruit, but is the key pest of apples worldwide.
3. Citrophilous Mealybug be subjected to the full semi-quantitative analysis because apples represent a much higher risk than stone fruit for this species and the use of existing policy is inappropriate.

4. Biosecurity Australia conducts a critical review of the standard AQIS 600 fruit on-arrival sample for its statistical adequacy in detecting low, but threatening levels of quarantine pests.
5. The Australian Apple and Pear Industry insists that any review of the pre-clearance regime in New Zealand be conducted with full industry consultation and that this be formally agreed.
6. Pre-clearance inspections of 3000 fruit in New Zealand should include dissection of the calyx of all fruit to obtain a true indication of the levels of cryptic pest species hidden in the calyx.
7. Wheat Bugs should be included as a targeted pest in pre-clearance and on-arrival inspections.
8. Biosecurity Australia initiates a review of the statistical adequacy of the standard AQIS 600 fruit sample, in view of evidence that it is inadequate for at least some pests and that many other countries have much more robust quarantine sampling regimes.
9. **In the absence of satisfactory risk mitigation measures for Grey-brown Cutworm, Leafrollers, Mealybugs, Codling Moth and Wheat Bug, the Australian Apple and Pear Industry considers that all New Zealand apples bound for Australia should be fumigated before leaving New Zealand.**
10. Biosecurity Australia and AQIS develop protocols for post-entry monitoring of moth pests at major distribution and repacking facilities, and for the treatment of waste fruit and packaging to destroy pests and diseases contained thereon.

PART A.

SECTION 1: **Preamble**

SECTION 2: **Introduction**

SECTION 1:

PREAMBLE

PREAMBLE:

The Apple and Pear Industry is a major primary production industry within Australia having an economic value of \$472 million (Apples - \$367 million and Pears \$10 million). There are in excess of 1,800 growers (ABS, 2006) in regions throughout the six states of Australia, with the major growing regions being:-

Stanthorpe in Queensland,

Batlow and Orange in New South Wales

Goulburn Valley, Yarra Valley and Mornington Peninsula in Victoria

Huon Valley in Tasmania

Adelaide Hills in South Australia

Perth Hills, Manjimup and Donnybrook in Western Australia.

This highlights the wide spread of production areas throughout Australia and the many regional, districts and local communities that are highly reliant on the industry. Additionally, these major growing areas represent only the largest concentration of apple and pear growing establishments. In some states, especially South Australia, New South Wales and Tasmania there is a significant proportion of production that takes place in more widely dispersed areas across the state (ABS, 2006).

Within these regions there is a range of infrastructure in addition to the orchards including cool storage, packing, transport and retail facilities. In addition there is a range of 'allied' industries that are linked with the production of apples and pears including chemical, equipment, irrigation, packaging, and transport suppliers and services.

Apple & Pear Australia Limited (APAL) is the peak industry body representing all commercial apple and pear growers in Australia.

It is a key influencer on the direction of research and development projects and the marketing and promotions strategies for advancing the industry domestically and internationally.

APAL also represents the industry on an agri-political level, including the protection of the Australian pome fruit industry against quarantine risks posed by unsafe imports.

APAL is responsible to all growers through the statutory levy process.

In the consideration of the 2005 *“Revised Draft Import Risk Analysis Report for Apples from New Zealand”* and the preparation this Technical Response, APAL has co-ordinated and funded this response for and on behalf of the Australian Apple and Pear Industry.

The *“Australian Apple and Pear Industry’s Technical response to the Importation of Apples from New Zealand revised Draft IRA Report”* has been commissioned by Apple and Pear Australia Limited and has been prepared by representatives of APAL using the advice, assistance and knowledge of a range of industry and technical experts from throughout Australia and overseas.

The Australian Apple and Pear Industry through Apple and Pear Australia Limited, as a stakeholder in the process of considering the request by New Zealand to import mature apples into Australia acknowledges the work undertaken by Biosecurity Australia in preparing the *“Revised Draft Import Risk Analysis Report for Apples from New Zealand”* dated December 2005.

In the past the Apple and Pear Australia Limited has actively participated in the preparation of technical and non-technical submissions to the number of previous Draft Import Risk Analysis Reports and at has at times been highly critical of the process and the draft reports prepared and presented for stakeholder comment.

Apple and Pear Australia Limited acknowledge that the Risk Analysis Panel (RAP) has spent an enormous amount of time and effort in considering a large amount of technical and scientific information and data. In addition the RAP has considered the material presented by stakeholders from the previous rounds of consultation.

Apple and Pear Australia Limited acknowledge that Biosecurity Australia has improved the level of consultation and communication with the relevant stakeholders though the exchange of information and reports and the implementation of face-to-face meetings that have allowed the exchange of ideas and processes. This has resulted in a better understanding of the issues and ultimately gone some way to improving this *“Revised Draft Import Risk Analysis Report for Apples from New Zealand”*, dated December 2005.

Notwithstanding these points, the Australian Apple and Pear Industry has a range of concerns with the information presented, the manner in which that information has been assessed and the ultimate conclusions presented by the RAP.

This submission prepared and submitted by Apple and Pear Australia Limited, for and on behalf of the Australian Apple and Pear Industry raises a range of issues from sections of the 2005 DIRA that

- Are ambiguous and require further clarification
- Lack sufficient scientific information, data and/or rigour
- Present conflicting scientific results.

In addition the submission presents the considerations of the major components of the document in detail resulting in positions at variance to those offered by the RAP.

The Technical Response is presented in three major parts

- 1) PART A is the introductory section that includes

- a) Preamble
 - b) Introduction
- 2) PART B is a chronological review of Part B of the document.
This review considers aspects of the 2005 DIRA that
- a) industry supports and recommends as ongoing actions,
 - b) industry rejects and recommends deletion and/or change,
 - c) lack sufficient science and/or technical research and/or data,
 - d) present conflicting scientific and/or technical information and/or data,
 - e) are based on judgement/ personal assessment of the RAP, and
 - f) build a different scenario than that presented by the RAP within the document.
- 3) PART C is a presentation of more detailed comments and information on a range of issues including:-
- a) Australia's Appropriate Level of Protection
 - b) Economic Consequence
 - c) The Model in Context
 - d) The IRA standard of inspection of areas for Fire Blight symptom freedom.
 - e) Fire Blight
 - f) European Canker
 - c) Arthropods

SECTION 2:

INTRODUCTION

INTRODUCTION

2.1 TECHNICAL PANEL

With the release of the RDIRA in December 2005, APAL established a panel of experts to assist with the technical review of the document, including the risk matrix, the relevant pests and diseases and suggested import measures and the science related to each of these areas.

In addition, the technical review panel has considered gaps in the science and any new science that has not been considered within the RDIRA.

The individuals that have contributed to the discussions and preparation of this industry technical report are:

Technical Experts

Dr Colin Bower PhD

Dr Irena Carmichael BSc Hon, PhD

Ian Pascoe

Professor Tony Pettitt

Consultant Entomologist

Consultant Microbiologist

Consultant Mycologist

Head, School of
Mathematical Science

QUT

QUT

Consultant Plant

Pathologist (Plant

Bacteriology)

Dr Robert Reeves PhD

Dr Satish C Wimalajeewa, PhD (Calif)

Project Manager

Trevor Ranford B.Sc, DipMP (AIMSA), CPMgr.

Additional Members

Additional input was received from:

John Corboy

Chair, Fire Blight Task
Force

Jon Durham

Managing Director, Apple
and Pear Australia
Limited

Tony Russell

Business Manager, Apple
and Pear Australia
Limited

Alma Reynolds

Industry Services
Manager,
Apple and Pear Australia
Limited

2.2 REVIEW PROCESS

This review was conducted at the request of Apple and Pear Australia Limited. It provides an independent appraisal of the scientific and logical basis for the conclusions reached in the 2005 DIRA for the proposed importation of apples from New Zealand. In particular, the aims of this review were:

1. to evaluate the scientific basis for estimates of risks of entry for quarantine pests / diseases used in the risk analysis equations
2. to determine whether the risk analysis methodology has been applied consistently within and between analyses
3. recommend any changes needed to the risk values for entry, establishment, spread and consequences
4. recommend any additional risk mitigation measures required to reduce the risk levels to meet the ALOP of very low

2.3 OVERVIEW

Australia is free of many pests and diseases that attack important food and ornamental plants in other parts of the world. In large part this has been due to the isolated nature of Australia as an island continent, but also to quarantine policies and procedures that have limited the numbers of exotic pests and diseases able to establish in this country. However, in recent years it has become increasingly difficult and costly to maintain effective quarantine barriers to the entry of unwanted organisms. Increased air travel by Australians to and from overseas, rising tourism and greater trade have all made it more difficult to exclude pests and diseases. Despite the best efforts of the Australian Quarantine and Inspection Service (“AQIS”), there is a long list of economically significant organisms that have breached Australia’s quarantine barriers in the last 20 years.

Among the most serious of these are the

- Red Imported Fire Ant,
- Western Flower Thrips,
- Poinsettia White Fly,
- Oriental Fruit Fly,
- Palm Thrips,
- Red-banded Mango Caterpillar,
- Currant Lettuce Aphid,
- Giant African Snail,
- Black Sigatoka of bananas,
- Wheat Streak Mosaic Virus,
- Potato Spindle Tuber Viroid, and
- Olive Knot disease.

Some pests and diseases are amenable to eradication if caught early enough, but others are not and quickly become fully established.

More recently, moves to free up world trade have increased pressures to allow entry of food products that have historically been excluded because they come from areas infested with serious pests and diseases. Australia, as a champion of the free trade movement through the Cairns Group and other fora, must be seen to be freeing up its

own borders as well as seeking greater access through others. The resulting inevitable increase in importation of foreign grown food carries increased risks for the introduction of unwanted organisms. It is undeniable that over time these processes will lead to the entry of new pests, diseases and weeds into Australia. International trading rules and phytosanitary agreements allow countries to reduce, but not eliminate, these risks through quarantine protocols.

This appraisal of the 2005 DIRA will commence with PART B that looks at Part B of the *“Revised Draft Import Risk Analysis Report for Apples from New Zealand”* in a chronological manner resulting in a range of comments on the issues, science and conclusions made by the RAP.

PART C, more specific information is presented on the Risk Model and Methodology and each pest of quarantine concern in detail following the process adopted in the 2005 RDIRA. At the same time differences between the conclusions reached in the earlier 2000 DIRA, 2004 RDIRA and the current 2005 DIRA will be evaluated.

PART B.

SECTION 1: Introduction

**SECTION 2: Review of Part B of the
2005 DIRA**

PART B:

SECTION 1: INTRODUCTION:

The Australian Apple and Pear Industry through Apple and Pear Australia Limited, as a stakeholder in the process of considering the request by New Zealand to import mature apples into Australia acknowledges the work undertaken by Biosecurity Australia in preparing the “Revised Draft Import Risk Analysis Report for Apples from New Zealand” dated December 2005.

In the past the Apple and Pear Australia Limited has actively participated in the preparation of technical and non-technical submissions to the number of previous Draft Import Risk Analysis Reports and at has at times been highly critical of the process and the draft reports prepared and presented for stakeholder comment.

Apple and Pear Australia Limited acknowledge that the Risk Analysis Panel (RAP) has spent an enormous amount of time and effort in considering a large amount of technical and scientific information and data. In addition the RAP has considered the material presented by stakeholders from the previous rounds of consultation.

Apple and Pear Australia Limited acknowledge that Biosecurity Australia has improved the level of consultation and communication with the relevant stakeholders though the exchange of information and reports and the implementation of face-to-face meetings that have allowed the exchange of ideas and processes. This has resulted in a better understanding of the issues and ultimately gone some way to improving this “Revised Draft Import Risk Analysis Report for Apples from New Zealand”, dated December 2005.

Notwithstanding these points, the Australian Apple and Pear Industry has a range of concerns with the information presented, the manner in which that information has been assessed and the ultimate conclusions presented by the RAP.

This submission prepared and submitted by Apple and Pear Australia Limited, for and on behalf of the Australian Apple and Pear Industry raises a range of issues arising from sections of the 2005 DIRA that

- Are ambiguous and require further clarification
- Lack sufficient scientific information, data and/or rigour
- Present conflicting scientific results.

In addition the submission presents the considerations of the major components of the document in detail resulting in positions at variance to those offered by the RAP.

The material detailed below is based on the consideration of the 2005 DIRA by ‘lay people’ with input from growers from around Australia.

SECTION 2: PART B (2005 DRIA)

BIOSECURITY FRAMEWORK.

1. Page 2, Development of Biosecurity policy.

The RAP indicates that *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*.

While the Australian Apple and Pear Industry supports this basic principle it believes that while this “Revised Draft Import Risk Analysis Report for Apples from New Zealand”, dated December 2005, has gone some way in achieving this there are still many components that are not ‘characterised by sound science’ are not ‘transparent’ and are not ‘consistent’.

With regards the aspect of ‘fairness’ the Industry would question what the parameters to fairness are and fair to whom.

There is no clarity within the document relating to ‘fairness’.

2. Page 3, Australia’s international rights and obligations.

- a) The RAP indicates that *“where the relevant scientific evidence is insufficient, an importing member may provisionally adopt SPS measures on the available pertinent information. In such circumstances, members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the SPS measure accordingly within a reasonable period of time”*.

Given there are a number of areas in which the scientific evidence is insufficient the Australian Apple and Pear Industry would have assumed that the RAP would have sought to obtain additional information. Such recommendations are not obvious within this “Revised Draft Import Risk Analysis Report for Apples from New Zealand”, dated December 2005.

- b) The RAP indicates that *“an importing member shall accept the measures of other countries as equivalent, if it is objectively demonstrated that the measures meet the importing member’s ALOP”*.

This statement lacks clarity.

Is the equivalence related to the particular pest or is it related to equivalence of a requirement within another protocol?

For example Australia has a requirement for a specific buffer around orchards for pears being imported from China. The use of buffers relating to establishment of pest free areas for *Erwinia amylovora* could be seen as equivalence.

3. Page 4, Australia’s appropriate level of protection (ALOP)

The Australian Apple and Pear Industry would again challenge the reasoning for the varying terminology utilised within Table 1 – Risk estimation Matrix.

For instance the inclusion of ‘extremely low’ for likelihood of entry, establishment and spread and the deletion of ‘extreme’ from the same area.

Where is the scientific and statistical data that continues to support this Risk estimation matrix?

BACKGROUND:

1. Page 9, Scope.

- a) It is important that there is an unambiguous understanding as to the scope of the request from New Zealand to import apples to Australia given the many past changes to the request.
The current scope is ***“the importation of mature apple fruit free from trash, either packed or sorted and graded bulk fruit from New Zealand”***.

Also it is important that there us an unambiguous understanding that the formal request included ***“a request that AQIS review available risk mitigation management options with view to establishing phytosanitary measures that are the least trade restrictive in respect of New Zealand apple exports while ensuring the level of protection deemed appropriate by Australia is met”***.

While the Australian Apple and Pear Industry believes that this is the basis on which the process is being undertaken it does not believe that the risk management options proposed by the RAP within the “Revised Draft Import Risk Analysis Report for Apples from New Zealand”, dated December 2005 meet the level of protection deemed appropriate by Australia.

The material within Industry’s submission will highlight that the RAP has failed to meet the level of protection deemed appropriate to Australia.

- b) The Australian Apple and Pear Industry is concerned that Biosecurity Australia has discussed the issue of the mode of export with New Zealand ***“on several occasion but has not received any clear indication of the mode of trade”***.

This has made the process of considering the request by Biosecurity Australia more complex and difficult. The end result is that it is more difficult for stakeholders to consider the “Revised Draft Import Risk Analysis Report for Apples from New Zealand”, dated December 2005.

Given ***“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”***, it is the view of the Australian Apple and Pear Industry that this current IRA process has failed to achieve these requirements.

METHOD OF IMPORT RISK ANALYSIS:

1. Page 11, Approach to pest risk analysis (PRA)

- a) The RAP has indicated that *“like most quarantine agencies, Biosecurity Australia generally undertakes pest risk analyses using a qualitative approach where the likelihoods of various events are considered and evaluated using descriptive terms that are linked to probability intervals. However in responding to issues raised by some stakeholders, Biosecurity Australia adopted a semi-quantitative risk analysis of New Zealand apples in the previous Draft import risk analysis on the importation of apples from New Zealand (BA, 2004) report to reinforce the transparency and objectivity of the analysis wherever possible”*.

The stakeholder comment and criticism of the process used and presented in the 2004 DIRA was well documented in the submissions. This was particularly so within the *“Technical industry response to Importation of Apples from New Zealand, revised draft IRA Report, February 2004”* (APAL, June 2004).

One of the results of this information detailed in this submission was for the relevant parties (APAL technical panel representatives and Biosecurity Australia representatives) to meet in Canberra on the 18th May 2005 to discuss the issues, learn from each other and allow a useful exchange of information.

The result of this meeting and other input the Australian Apple and Pear Industry is aware, although not fully aware, that Biosecurity Australia has made changes to the Risk Matrix Model to better reflect the semi-qualitative process.

- b) The RAP indicates that *“this draft has continued to use the semi-quantitative framework supplemented where appropriate with qualitative analysis”*.

The Australian Apple and Pear Industry believe that the process does not offer clear and concise results particularly for stakeholders to adequately assess. The relevant issues will be further expanded with this submission.

Given *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*, it is the view of the Australian Apple and Pear Industry that this current IRA process has failed to achieve these requirements.

- c) The RAP indicates that *“in some cases there may be no need to undertake a new risk analysis but an existing analysis or policy can be used where this is relevant or appropriate”*.

While the RAP highlights ISPM No 2 and quotes that *“prior to proceeding with anew PRA,”*, the Australian Apple and Pear Industry would contend that this is not a new PRA but the continuation

of an on-going PRA and therefore full and comprehensive risk assessments should be made as they relate to the pests and diseases that were established many years ago when this current process commenced in January 1999.

- d) The RAP indicates that *“existing risk assessment or policies can be validated by examining the pest records associated with continued trade in horticultural commodities from various countries. A relevant example is the continued importation of New Zealand stone fruit into Australia”* but the Australian Apple and Pear Industry rejects this as being an inappropriate process.
Industry cannot access the pest records associated with continued trade and therefore is not in an informed position to make comment on the process.

Given *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*, it is the view of the Industry that the use of existing risk assessment or policies for non related commodities has failed to achieve these requirements.

- e) The RAP indicates that *“in this report several different approaches have been used to assess the risk of pests and consider risk management measures”*.
The use of different approaches has resulted in a confusing and complicated document making it more difficult for stakeholders to understand the process utilised by the RAP and then make the best possible assessments.

Given *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*, it is the view of the Australian Apple and Pear Industry that the use of several different approaches has failed to achieve these requirements.

2. Page 12, Containment Pests.

- a) Are the containment pests of New Zealand flower thrips, burnt pine longhorn beetle, what bug and click beetle covered within the New Zealand Integrated Fruit Production Manual?
Are the containment pests of New Zealand flower thrips, burnt pine longhorn beetle, what bug and click beetle covered within the New Zealand *“standard commercial agronomic practice”*?

The Australian Apple and Pear Industry would contend that if they are considered within either or both of these contexts then they should be treated as relevant to apple production and therefore treated as pests of mature apples

The Industry would further contend that as these are pests that can ‘hitch-hike’ on apples then they are pests of mature apples and should be treated in the same manner through a full risk assessment.

- b) The RAP indicates that *“if they were to be detected within apple consignments (assuming importation is approved) they would be treated as any other contaminant”*.
The RAP has not, within this section, detailed what treatment would be undertaken.

Given *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*, it is the view of the Australian Apple and Pear Industry that the *“contaminant pests”* have been inadequately dealt with in the 2005 Draft IRA and that the RAP has failed to achieve these requirements of the IRA process.

- c) The RAP indicates that *“for more information on these commodities the reader is directed to the AQIS Import Conditions database”*.

The Australian Apple and Pear Industry would contend that the RAP has a responsibility to include such material in this DIRA. For many stakeholders they have neither the time nor the resources to access such information as part of considering and preparing a response.

Given *“the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency”*, it is the view of the Industry that the inability of the RAP to present all relevant information within the 2005 DIRA has failed to achieve these requirements of the IRA process.

3. Page 12, Pests that have been assessed previously.

- a) The Australian Apple and Pear Industry believes that as the following pests were included in the 2004 Draft IRA they must be again reviewed in a full manner within the 2005 Draft IRA given that this is a continuation of the initial request by New Zealand made in January 1999:-
- Grey-brown cutworm
 - Leafrollers
 - Codling moth
 - Mealy bugs
 - Oriental fruit moth
 - Oystershell scale.
- b) The RAP indicates that *“these pests have the potential to be present on stone fruit from New Zealand”*.

While they have the *'potential'* have they ever been associated with stone fruit? Are there records of their interception on New Zealand stone fruit?

It is obvious that the material within the 2005 DIRA is only a partial analysis.

The Australian Apple and Pear Industry believes that, as a minimum, the 2005 DIRA should have included the full risk analysis previously prepared so that all stakeholders had the opportunity to fully review the material within the context of this ongoing application.

Given *"the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency"*, it is the view of the Industry that the inability of the RAP to present all relevant information relating to these pests, the 2005 DIRA has failed to achieve these requirements of the IRA process.

4. Page 17 and 18, Projected volume of trade in New Zealand apples.
 - a) The RAP indicates that *"the period that was chosen for the purpose of this analysis was 12 months. A 12-month period is a convenient interval to estimate the possible volume of trade and the risk analysis methodology uses a one year volume as an input value"*.
Further in the document the RAP indicates that *"most apple imports will arrive over as-x-month period from March to August"*.
Has there been an analysis of the trade only occurring within a six-month period and where are the results presented?
 - b) The RAP indicates that *"in this IRA, the experts assumed a market penetration of approximately 20% of the domestic fresh market if New Zealand apples were permitted entry"* but does not offer any technical or scientific data to substantiate this assumption.
The RAP gives no indication of who they sought the *'expert'* advice from.
 - c) The RAP utilises production figures on the 2002 production as a basis of its determination.
The reality is that this may have changed dramatically particularly with the diminishing exports and the changing nature of the processing industry and the diminishing demands in this area.
With less apples being exported and less used for processing the Australian Apple and Pear Industry would believe that more than 52 % of production, as predicted by the RAP, will be placed on the domestic market. 20% of an increasing level of domestic fresh production would be greater than 200 million apple fruit.
 - d) Based on conflicting information relating to the *"potential volume"* of trade predicted the RAP has been forced to make an assumption relating to this important aspect of the 2005 DIRA.

5. Page 23, 24 and 25, Utilisation of apple fruit in Australia and generation of waste.

- a) The RAP indicates that *“the pathways of distribution, utilisation and waste generation are shown in Figure 2. There are five key points (termed ‘utility points’ at which apples are distributed and at which waste will be generated. These include two pathways from importers/wholesalers (which have been delineated because of the proximity of orchard-based premises to high density commercially grown fruit) to retailers, then to the food service industries and finally to individual consumers”*.

The Australian Apple and Pear Industry would indicate that this is an over simplification of the process and the RAP has failed to fully understand the processes of the market chain.

For instance fruit could be imported to an orchard packinghouse/wholesaler, an urban packinghouse/wholesaler or directly to a wholesaler within the central markets within any of the major capital cities and/r regional cities.

The Australian Apple and Pear Industry recommends that there should be three pathways depicted in Figure 2 with the third pathway being directly to a wholesaler in the ‘central market system’ as utilised within Australia.

- b) The RAP has not adequately defined orchard packinghouses/wholesalers and/or urban packinghouses/wholesalers.

The Australian Apple and Pear Industry would believe there is, in many areas of Australia a very grey area in defining these facilities. For instance those packinghouses in the Adelaide Hills that are defined as being in the Outer Metropolitan Region and within a peri-urban zone, are they classified as orchard or urban. If they are orchard packinghouses then they are in a near urban region.

The Australian Apple and Pear Industry believes that the RAP has failed to adequately look at the worst case situation of where packinghouses are associated and utilised that situation as the basis of utilising the precautionary principle. Instead there is a superficial blanket approach to this process of defining utility points and in what environment they are located.

The Australian Apple and Pear Industry would recommend that

- (1) an additional pathway be included for the wholesaler in the central market system,**
- (2) greater definition be given to orchard and urban packinghouses, and**

(3) the use of worst case scenarios be utilised to better plot the potential movement of apple fruit and the generation of waste.

- c) Within P4 the RAP indicates that *“the proportion of imported fruit that might be channelled by wholesalers (orchard-based or urban) to fruit processes = 0 (considered a low volume pathway or rare occurrence)”*.

The RAP offers no supporting evidence for this assumption. More importantly the RAP indicates that it is considered to be a low volume or a rare occurrence. Based on that assumption alone the rating cannot be zero (0).

The Australian Apple and Pear Industry recommends that the current P4 (page 25) have some rating other than zero (0) and that the appropriate adjustments be made in all following calculations.

- d) There is no adequate definition of the food service industry within the 2005 DIRA. Some descriptor is required to give the stakeholders a better understanding of what sectors are included within this utility point. In some parts of the document the RAP reference airline catering services. The actual relevance of this sector of food services over any other sector is not explained.

6. Page 26 and 27, Exposure groups.

The RAP makes reference to household plants, garden plants, amenity plants and wild plants but the only formal definition within the list of terms is for amenity plants.

In addition there are linkages made between household and garden plants and also between wild and amenity. Again there is no explanation and/or technical reasoning for these groupings.

Wild or pest plants within the environment are much different to those within the located in a public place and intended for public use. The spread of *Crataegus* spp. (hawthorn) within the creeks, parks and/or native vegetation are a far greater potential problem to the spread of *Erwinia amylovora* than a *Cotoneaster* spp in a public park.

Industry believes that the RAP has failed to appreciate and extrapolate the work of Creeper, D et al, 2005 in relation to derelict orchards and wild or feral pest plants within the Adelaide Hills.

The Australian Apple and Pear Industry recommends that the linkage of wild and amenity plants be deleted and that they be treated and defined within Figure 3 (Page 27) as two separate exposure groups.

7. Page 27, Proximity.

The RAP indicates that *“orchard based wholesalers will be very close to commercial fruit crops but consumers who live in cities will not be close to commercial fruit crops but a proportion of them will be close to household and plants that are pest hosts”*.

This example does not hold true with regards the growing regions within the Adelaide Hills, Perth Hills, and Sydney Basin of other like growing regions which are part of the peri-urban concept.

The commercial apple growing region and the orchard based wholesalers are effectively intertwined with urban dwellers, hobby farmers and rural livers all of whom are consumers.

The Australian Apple and Pear Industry recommends that the RAP undertake a formal modelling of one or more of the specific growing regions to develop a true understanding of the linkages between all of the utility points and the exposure groups. The Adelaide Hills or the Goulburn Valley would be ideal regions to undertake such modelling.

8. Page 28, Probability of establishment.

Within this section the Australian Apple and Pear Industry believes that insufficient focus has been given to one or more areas in which a full modelling process could be undertaken to establish a ‘worst case scenario’ for a high risk regional (or district PRA area) within Australia.

9. Page 31 and 32, Step 3 Scenario analysis.

The RAP indicates that *“the number of infested apples per establishment per utility point were calculated using the proximity values and the following assumptions:*

- *Apple imports will arrive over a six-month period from March to August (26 weeks)*
- *The number of orchard wholesalers is seven*
- *The number of urban wholesalers is six”*.

The Australian Apple and Pear Industry believes these assumptions are poorly conceived and are an under estimation of the data.

There is absolutely no guarantee that the trade in apples will be only six months. Given the ability of the New Zealand apple industry to store apples in Controlled Atmosphere there is no reason why they would not look at maintaining apple imports for the longest possible period. This would make the maximum value of the trade.

There are more than seven orchard wholesalers. Within the Adelaide Hills region (only 35 kilometres from the central business district of Adelaide) there are at least ten (10) orchard packinghouses/wholesalers. At least seven of them are suppliers to at least one of the two major supermarket retail chains as well as many independent retailers. Other regions within Australia would have similar or greater numbers.

There are in excess of 50 agents/wholesalers within the Adelaide Produce Markets that could become urban wholesalers of imported apples and in Sydney, Melbourne and Brisbane there are even larger numbers.

The Australian Apple and Pear Industry recommends that the figures relating to orchard wholesalers and urban wholesalers be amended to more realistic numbers.

The Australian Apple and Pear Industry recommends that a range of regional/district based scenarios are run through the modelling process rather than the broad based scenarios around how much fruit might go to orchard packinghouses/wholesalers versus urban packinghouse/wholesalers.

10. Page 32, Step 4 Estimation of the partial probabilities of entry, establishment and spread for each utility point exposure group combinations.

The RAP indicates that *“the alternative approach to trying to calculate these probabilities fully quantitatively was considered impractical because of the complexity and the lack of comprehensive data representing all the necessary relationships. Making assessments at the utility point scale allowed the experts to use their relevant knowledge rather than being constrained to the limited structure provided by the simple model”*.

The Australian Apple and Pear Industry believe that the decision not to use a fully quantitative approach is unacceptable and not within the requirements of the Australian IRA process.

“The lack of comprehensive data” is of major concern to the Industry and all endeavours should be undertaken by the RAP to gather such data before proceeding further with the IRA process.

The information detailed within the points above and further developed within this submission will highlight that the experts did not have adequate knowledge at utility point scale to make assumptions. The number of orchard wholesalers being listed as seven by the RAP highlights the inadequacy of the relevant knowledge.

The Australian Apple and Pear Industry recommends that further comprehensive data is collected and fed into the model before any further steps are undertaken within the IRA process.

11. Page 33, Assessment of consequence.

The RAP indicates that *“in each case, consequence assessments do not extend to considering the benefits or otherwise of trade in a given commodity, or the impact of import competition on industries or consumers in the importing country”*.

The Australian Apple and Pear Industry believes these are important issues and recommends that “*the benefits or otherwise of trade in a given commodity, or the impact of import competition on industries or consumers in the importing country*” be included within the consequence assessments.

12. Page 34, Human life or health.

The Australian Apple and Pear Industry believes that this factor has no relevance to the scope of the 2005 DIRA and as a result should be deleted from all of the individual Import Risk Analysis presented within this document.

13. Page 35 and 36, Describing the impact of a pest.

The RAP indicates that “*the impact of a pest or disease on each direct and indirect consequence criterion is estimated at four levels – local, district, regional and national – and the values derived are translated into a singular qualitative score, A-G*”.

The RAP then defines each of the four levels.

The Australian Apple and Pear Industry believes that the definitions are too simplistic and do not adequately cover the variances that occur within Australia.

The apple and pear production within the Adelaide Hills is more than likely considered as a District by the RAP but in real terms it is more likely to be considered a region as there are a range of ‘districts’ within the Adelaide Hills. Given that the Adelaide Hills produces approximately 85% of the apples and pears within South Australia the industry would argue that it is an area of high importance and should be designated a ‘region’.

Similarly, other areas could be designated differently than what is covered within the 2005 DIRA.

The Australian Apple and Pear Industry recommends that the RAP accurately define each of the apple growing regions against the four levels so that the industry is better able to make consideration of each of the assessments made within the 2005 DIRA. Using this information the RAP needs to model a range of specific growing regions to better establish and define the worst case scenario.

As we set out in Part C, the use of geopolitical categorisations of “regions” contributes to clearly arbitrary and irrational outcomes in the assessment of consequences.

14. Page 39, Stage 3: Pest risk management.

The RAP indicates that “*the ALOP is considered a societal value judgement that reflects the maximal risk (or expected loss) from a disease incursion that Australia considers acceptable*”.

The Australian Apple and Pear Industry again express concern at the fact that the ALOP is still based on “value judgements”.

15. Pages 40 and 41, Representing quantitative information.

The RAP indicates that *“the approach used in the 2004 draft was to assign descriptive terms to quantitative ranges, (high, moderate, low, etc. These terms were used throughout the text to represent these quantitative ranges. However, this caused some confusion with stakeholders applying their own interpretation to the terms rather than the meanings set out in the methodology. In order to overcome this problem, in this draft, the descriptive terms are only used for qualitative values. Numbers are given for quantitative values”*.

The Australian Apple and Pear Industry question the terminology being used and the methodology in the 2005 DIRA as they did with the 2004 RDIRA. Within Tables 12 and 13, the Industry question the use of a high number of descriptive terms in the lower end of the scale, in particular the addition of ‘extremely low’.

The Industry also questions the ‘rules’ used to combine descriptive likelihoods. For instance the combination of a ‘moderate’ by ‘moderate’ giving a ‘low’ rating or a ‘low’ by ‘low’ giving a ‘very low’ rating are not adequately clarified.

16. Pages 41 and 42, The model in context.

The RAP indicates that *“the model was then used to estimate the unrestricted risks using input values developed by the IRA team taking into account relevant scientific information and expert opinion. The efficacy of different risk management options was assessed by modifying appropriate input values to take account of the effect of different options. The model was then re-run to give the restricted risk values.*

In considering the outputs of the model the IRA team was aware that the model is based on various assumptions and has limitations that must be considered. In reaching conclusions on the risk and possible risk management measures the IRA team took into account the outputs of the model, the limitations of the model and the full range of technical information available.”

The Australian Apple and Pear Industry expresses concern that the IRA process is based on ‘expert opinion’ when there is a lack of relevant ‘scientific information’.

The Australian Apple and Pear Industry expresses concern that the IRA process is based on a model that uses ‘various assumptions and has limitations that must be considered’.

The Australian Apple and Pear Industry again believes that the model being used for the 2005 DIRA is flawed and presenting results and conclusions that are underestimating both the unrestricted and restricted risks.

Given “*the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency*”, it is the view of the Industry that given the flaws within the model, the 2005 DIRA has failed to achieve these requirements of the IRA process.

PEST CATEGORISATION RESULTS:

1. Page 43, Summary of apple pests categorised

The Australian Apple and Pear Industry believes that the precautionary principle has failed in that only 16 pests and/or diseases are being considered within the 2005 DIRA when there are

- 213 pests that are “*not in Australia, uncertain or of regional concern*”
- 38 pests that have the “*potential for being on pathway*”
- 38 pests that have the “*potential for establishment or spread*”.

Given “*the purpose of the IRA process is to deliver a policy recommendation to the Director of Animal and Plant Quarantine that is characterised by sound science, transparency, fairness and consistency*”, it is the view of the Industry that the inability of the RAP to present all relevant information relating to these pests, the 2005 DIRA has failed to achieve these requirements of the IRA process.

FIRE BLIGHT:

1. Page 47, Introduction.

The RAP indicates that “*although the mode of introduction of fire blight into the Royal Botanic Gardens in Melbourne is unknown, it is unlikely this disease detection was associated with the introduction of planting material*”.

What technical and scientific information supports this statement or is it an assumption by the RAP?

If the RAP believes that the disease was not associated “*with the introduction of planting material*” then what mode of introduction do that consider was responsible?

Is it in fact possible that the disease was introduced through fruit being discarded within the Melbourne Botanic Gardens?

2. Pages 47 and 48, Biology

- a) The RAP indicates that “*E. amylovora is capable of growing between 3°C - 37°C with optimum temperature for growth being 25°C - 27°C (Billing et al., 1961) although minor variations have been reported concerning these temperature requirements*”.

The Australian Apple and Pear Industry believes that these minor temperature variations need to be presented and consideration be given to the significance of such information.

- b) The RAP indicates that *“the potential for flowers of non-host plants to support epiphytic growth of E. amylovora has also been reported (Johnson, 2004)”*.

The Australian Apple and Pear Industry believes that this is highly significant new science that requires further scientific investigation particularly if there is the possibility that *E. amylovora* could be supported by a range of Australian native non-host plants.

- c) The RAP indicates that *“non-oozing cankers can also harbour bacteria (Miller and Schroth, 1972. An outbreak of fire blight may be caused by as few as one to four cankers per hectare (Brooks, 1926)”*.

The Australian Apple and Pear Industry believes that these points are highly significant and need to be taken into consideration in the development of the risk management protocols, particularly relating to orchard inspection.

- d) The RAP indicates that *“often the first symptoms accompanied by ooze are seen on the outer surface of the receptacle of fruitlets and stalks (Beer, 1990)”*.

The Australian Apple and Pear Industry believes this point is highly significant and needs to be taken into consideration in the development of the risk management protocols, particularly relating to orchard inspection and fruit inspection.

- e) The RAP indicates that *“leaves are rarely infected, but prone to infection after hail damage (Beer, 1990)”*.

The Australian Apple and Pear Industry believe that this indicates that leaves carry the bacteria and express the symptoms when there is an event like a hailstorm.

This would support the notion that leaves as trash can carry the bacteria.

Also this information further supports the need for an additional orchard inspection after a hail storm event to check for fire blight symptoms.

- f) The RAP indicates that *“bacteria could be present at the stalk-end of mature fruit or the fruit surface, (van der Zwet et al., 1990)”*.

APAL believes that as the bacteria can be present at the stalk-end this part of the fruit needs to be given similar consideration as the calyx-end of the fruit as a possible area in which the fire blight might survive during the production, packing and transporting stage.

3. Page 48, Risk Scenario.

- a) The RAP indicates that *“there is a significant body of literature (see later sections) confirming the potential presence of fire blight bacteria on mature symptomless apple fruit”*.

The Australian Apple and Pear Industry believe that this is highly significant science which proves that apples carry the bacteria and are a potential vector for the movement of the bacteria.

- b) The RAP indicates that *“E. amylovora cannot be detected by visual inspection”*.

The Australian Apple and Pear Industry believes that this fact makes it imperative that testing of fruit is required as part of the inspection procedure.

- c) The RAP indicates that *“it was concluded that leaves and small twigs taken from apple trees at the time of harvest are no more likely to be carrying E. amylovora than fruit and therefore do not present a special risk over and above that presented by fruit”*.

The Australian Apple and Pear Industry believes that given the detail within points 2 e) and 3 a) that the assumption by the RAP is very much understated.

4. Page 50, Orchard Management.

The RAP indicates that as part of the New Zealand Integrated Fruit Production Program Manual the following measures are recommended
“frequently inspecting the orchard; especially from blossoming to mid-summer for signs of infected blooms or shoots, pruning and burning any infected material upon detection”
and

“identifying and removing alternative hosts from within 100 m of the orchard block, and applying copper fungicide if hosts cannot be removed”.

The Australian Apple and Pear Industry believes that these are integral components of the *“standard commercial agronomic practice”* and as a result must be built into the work practices of the risk management protocol for achieving any low pest prevalence as recommended under the restricted risk section of the 2005 DIRA.

5. Pages 50 and 51, Importation step 2.

The RAP indicates that *“the available literature in the context of this assessment is divided – some data supports the presence of E. amylovora as infestation (external) or infection (internal), while other data supports its absence from the fruit”*.

The Australian Apple and Pear Industry believes that this divided data makes it impossible for the RAP to make a sound decision based on science and as a result must implement the precautionary principle and increase the rating for the Importation step 2.

6. Page 51, 52, 53 and 54, Infestation of mature fruit.

- a) The RAP indicates that *“the use of data from a single study reported by Hale et al. (1987) to derive the expected proportions and applying these across other studies was an approach questioned by stakeholders. The Hale et al. (1987) study was conducted in New Zealand and is the only one to examine E. amylovora infestation from fruitlet stage right through to maturity”*.

The Australian Apple and Pear Industry would question the use of a single piece of scientific literature and believes there is a need for additional scientific research *“to examine E. amylovora infestation from fruitlet stage right through to maturity”*.

- b) The RAP indicates that *“the studies of Biosca et al. (2004) and Ordax et al. (2004) were conducted under artificial conditions (sterile mineral medium and sterile water microcosms) with high inoculum doses. These conditions differ significantly from those present on apple trees under natural conditions”*.

The Australian Apple and Pear Industry believe that the difference between *“artificial conditions”* and *“natural conditions”* is highly significant and creates concerns as to the final judgements made base on a high level of science conducted under *“artificial conditions”*. The 2005 DIRA does not adequately define which science is conducted under *“artificial conditions”* versus that conducted under *“natural conditions”*.

- c) The RAP indicates that *“according to the information presented by several authors (Rahman et al., 1996; Ericsson et al., 2000; Bogosian and Bourneuf, 2001; van Overbeek et al., 2004) the significance of VBNC in relation to bacterial survival is not yet clearly established”*.

AND

“Furthermore, the ability of E. amylovora to enter into a VBNC state in or on any apple tissue is yet to be demonstrated.”

The Australian Apple and Pear Industry believes that given *“preliminary studies indicate that E. amylovora can enter a VBNC state”* but *“the significance of VBNC in relation to bacterial survival is not yet clearly established”* the RAP must commission further studies on VBNC before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- d) The RAP indicates that “*E. amylovora* in biofilms are over 250 times more resistant to quaternary ammonium compounds than the same bacteria in suspension (Marques et al., 2005)”.

The Australian Apple and Pear Industry believe that this is a significant scientific result that requires greater consideration than offered by the RAP within the 2005 DIRA.

- e) The RAP indicates that “*the contribution of biofilm related genes to pathogenicity is still unknown (Charkowski et al., 2005)*”.

The Australian Apple and Pear Industry believes that given “*the contribution of biofilm related genes to pathogenicity is still unknown*” the RAP must commission further studies on biofilm before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- f) The RAP indicates that “*the role of sigma factor in E. amylovora is not yet fully investigated*”.

The Australian Apple and Pear Industry believes that the RAP must commission further studies on the role of the sigma factor before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- g) The RAP indicates that “*the rare detection of E. amylovora in the core of naturally infested apple fruit (van der Zwet et al., 1990) and on the seeds by Mundt and Hinkle (1976) may explain that such events could occur under exceptional circumstances*”.

The Australian Apple and Pear Industry believe that this statement is an assumption made by the RAP that has no justification. There are other decisions within the 2005 DIRA based on limited science which are not considered as occurring “*under exceptional circumstances*”. Such science may not be considered as important particularly by those countries with *E. amylovora* but this is no reason to disregard the science that has been put forward.

7. Page 56, Infection of mature fruit.

- a) The RAP indicates that “*Erwinia amylovora* was isolated from internal tissues of fruit harvested from blighted orchards in Utah, USA (van der Zwet et al., 1990). These authors recovered 1 to 300 colonies of *E. amylovora* from internal tissues. However, a statement provided to the to the WTO Japan-USA apple dispute by two of the four authors of this report more than 10 years after the work was published, indicated that the internally contaminated fruit harvested for testing was immature [WT/DS245/R, 4.94; WTO (2003)]”.

In Part C we set out in detail why this interpretation (drawn from a paragraph which records the submissions of the USA and not the conclusions of the panel) should not be accepted. Further, the Australian Apple and Pear Industry expresses concern that what appears to be political pressure can result in scientists making changes to scientific research some 10 years after the event. We expand on this in Part C.

- b) The RAP indicates that *“that several stakeholders have cited work on E. coli and extrapolate these findings to E. amylovora, as both species belonging to the family Enterobacteriaceae. The studies conducted on E. coli report artificial inoculations using very high inoculum doses on injured fruit (Buchanan et al., 1999; Burnett et al., 2000). These conditions do not reflect the situation that exists naturally in orchards. Therefore, strict comparison or extrapolation of results relating to the behaviour of E. amylovora may not be applicable”*.

The Australian Apple and Pear Industry believe that the RAP is using a selective process to accept and/or reject science within the 2005 DIRA. There are instances whereby research using artificial conditions is being used to substantiate a position. Also there are instances whereby extrapolation has been used to substantiate a position.

APAL believes that the RAP must commission further studies on *E. amylovora*, using the methodology developed in the *E. coli* studies before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- c) The RAP indicates that *“rapid multiplication of E. amylovora occurs when the bacteria escape from the xylem vessels into intercellular spaces of the cortical parenchyma, resulting in symptom development (Vanneste and Eden-Green, 2000). Sudden outbreaks of fire blight without any evidence of inoculum have been attributed to this phenomenon (Thomson, 2000)”*.

The Australian Apple and Pear Industry believe that this phenomenon highlights the volatile nature of the organism and its ability to produce sudden and unexplained outbreaks.

- d) The RAP indicates that *“the lack of evidence of endophytic infection in mature fruit suggests that if endophytic infection does take place it must be a rare event”*.

The Australian Apple and Pear Industry believe that defining *“endophytic infection”* as a *“rare event”* is an assumption being made by the RAP. For countries with Fire Blight there would be no value in undertaking such research. If more research was undertaken it may be found to be more than a *“rare event”*.

8. Page 57, No infection of mature fruit.

The RAP indicates *“it would be incorrect to directly apply Salmonella studies to E. amylovora and tomato studies to apple, as these experiments bear very little relationship to the field situation for apple fruit”*.

The Australian Apple and Pear Industry believe that the RAP is using a selective process to accept and/or reject science within the 2005 DIRA. There are instances whereby research using artificial conditions is being used to substantiate a position. Also there are instances whereby extrapolation has been used to substantiate a position.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on *E. amylovora*, using the methodology developed in the *Salmonella* studies before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

9. Page 58, Summary.

The RAP indicates that *“this review took into account those studies carried out in North America and New Zealand”*.

What does the RAP mean by this statement? What influence did the research from these countries have within the context of the 2005 DIRA?

10. Page 59 60 and 61, Bacteria on the plant surface.

- a) The RAP indicates that *“few studies have tested E. amylovora populations on leaves around the time apples are harvested”*.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on the existence of *“E. amylovora populations on leaves around the time apples are harvested”* before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- b) The RAP indicates that *“the bacterial numbers in the calyx of mature fruit under natural conditions would be much lower than what Ceroni et al. (2004) observed”*.

The Australian Apple and Pear Industry believe that there is no science to support this statement.

- c) The RAP indicates that *“they detected a positive only in one sample. While their observation may have some relevance to spread of the disease through planting material, it is not a clear demonstration of the bacterium’s epiphytic survival”*.

The Australian Apple and Pear Industry believe that as there was one positive detection and given it requires only a small level of the bacterium to cause an outbreak, the RAP should commission further studies on the possible epiphytic survival of *E. amylovora* on dormant buds.

- d) The RAP indicates that *“the ecological niches of the two bacteria are very different and therefore it is questionable as to whether E. coli studies can be directly extended to E. amylovora”*.

The Australian Apple and Pear Industry believe that in other aspects of the 2005 DIRA extrapolation of material has been utilised by the RAP. Also the Industry believes that the RAP must commission further studies on *E. amylovora*, using the methodology developed in the *E. coli* studies before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

11. Page 61, Cankers and ooze.

- a) The RAP indicates that *“with all export orchards required to adhere to a pest and disease management program, thereby maintaining good orchard hygiene, there will be extremely small numbers of cankers, infected shoots and fruitlets present on trees”*.

Industry members that have previously visited New Zealand have experienced visiting orchards, from which fruit was exported overseas, that had a high number of cankers and infected shoots. In fact one grower was very open in his discussions with the Australian industry delegates about this situation.

The Australian Apple and Pear Industry believe that the above statement is an assumption not supported by science.

- b) The RAP indicates that *“any ooze present in summer would be dry with most surface bacteria dead”*.

The Australian Apple and Pear Industry believe that this statement is an assumption and not supported by any science.

12. Page 61, Bacteria on bins.

The RAP indicates that *“Keck et al. (1996) found that hydrophobic surfaces (for example, Plastic bins) appear to favour survival of the pathogen for four months but, conversely, Ceroni et al. (2004) showed that plastic surfaces were not suitable for survival of E. amylovora”*.

This statement highlights the conflicting nature of the much of the science within the 2005 DIRA resulting it very difficult for the RAP to make decisions based on sound science.

13. Page 62, Transfer from contaminated sources to clean fruit.

- a) The RAP indicates that *“hailstorms can also cause injuries to leaves and fruit and such injuries may play a role in infections and outbreaks*

(Brooks, 1926). However, the likelihood of these events occurring during the harvesting and transport period in late summer and increased chances for contamination would be highly unlikely”.

The Australian Apple and Pear Industry believe that this statement is highly significant in supporting the need for a further orchard inspection after such events like hailstorms, heavy rain and high winds. APAL believes that the second part of the quote is an assumption not supported by any physical weather data.

- b) The RAP indicates that *“wind-driven rain carrying bacteria can also be a source of contamination for clean fruit during harvesting and transport”.*

The Australian Apple and Pear Industry believe that this statement is highly significant in supporting the need for a further orchard inspection after such events like wind-driven rain.

- 14. Page 63, Summary.

The RAP indicates that *“this range allows for fruit to be infected at picking through wounds as well as surface contamination that may occur by contact with contaminated bins, pickers’ hands, leaves, twigs, etc”.*

The Australian Apple and Pear Industry believe this statement is in conflict with other sections of the 2005 DIRA that reports that leaves and twigs are not of concern with regards the transmission of the bacteria.

- 15. Page 63, Washing.

The RAP indicates that *“there is no experimental evidence that bacteria infesting fruit, particularly those in protected sites, will be reduced by washing the fruit with high-volume high-pressure water”.*

The Australian Apple and Pear Industry is concerned at the lack of evidence available and believes that the RAP must commission further studies on the use of washing fruit *“with high-volume high-pressure water”* before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- 16. Page 64, 65 and 66, Disinfection.

- a) The RAP indicates that *“both chemicals are used in some packing houses in New Zealand, but no experimental data is available that is directly relevant to fire blight”.*

The Australian Apple and Pear Industry believe that with the lack of experimental data on these particular chemicals should lead to the elimination of these chemicals as part of any protocol for the treatment of apples that might be exported to Australia.

- b) The RAP indicates that *“naturally-contaminated mature apples infested with an average of 10^3 cfu per mL (from bulked samples) when treated with 100 µg per mL of chlorine were not effectively sanitised”*.

The Australian Apple and Pear Industry supports the statement by the RAP that there are *“naturally-contaminated mature apples”*.

The Australian Apple and Pear Industry believe that if *“100 µg per mL of chlorine”* was not an effective sanitiser then the proposed risk management strategy of using chlorine is not appropriate.

- c) The RAP indicates that *“these reports indicate that chlorine at different concentrations is effective in reducing but not eliminating the bacterial population”*.

The Australian Apple and Pear Industry believe that if chlorine is not effective in eliminating bacterial populations then the proposed risk management strategy of using chlorine is not appropriate.

- d) The RAP indicates that *“although currently there is no direct evidence to support the formation of aggregates or biofilms on apple fruit by *E. amylovora*, the potential for aggregates to be attached to discontinuities in the waxy surface of fruit and other structures may exist, especially when a temperature differential occurs between fruit and the external environment”*

AND

*“it should be noted that the above comments are based on work done on species other than *E. amylovora* for which the information is lacking”*

AND

*“given the paucity of work on these aspects of *E. amylovora* it is difficult to assess the significance of this concept”*.

The Australian Apple and Pear Industry believes that given that information is lacking with regards biofilms and aggregates for *E. amylovora* the RAP must commission further studies on biofilm before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

17. Page 66, Waxing.

The RAP indicates that *“sealing of *E. coli* within wax cutin platelets because of contact between apples has been demonstrated (Beuchat, 2001). These bacteria may be released as a result of breakdown in tissue that is embedding bacteria (Kenney et al., 2001). However, whether *E. amylovora* undergoes similar processes on apples is unknown”*.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on *E. amylovora*, using the methodology developed in the *E. coli* studies before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

18. Page 66, Sorting and grading.

The RAP indicates that “*internal infection of immature fruit has been recoded (van der Zwet et al., 1990) but not in mature fruit*”.

The Australian Apple and Pear Industry believe that this statement is questionable given the circumstance upon which the research was refuted.

19. Page 68, Cold Storage.

The RAP indicates that “*while there is data on the efficacy of cold storage on survival of E. amylovora populations, there is no evidence concerning the effect of controlled atmosphere storage*”.

The Australian Apple and Pear Industry believe that the data relating to cold storage is conflicting and therefore is questionable.

The Australian Apple and Pear Industry believes that as there is no evidence with regards the “*effect of controlled atmosphere storage*” this aspect has no relevance to any protocols that might be proposed.

20. Page 68, Summary.

Does the RAP consider the use of high-pressure water blasters as a method of disinfection?

21. Page 69 and 70, Importation step 5.

- a) The RAP indicates that “*the dump tank water is generally replenished every 600 bins*”.

The Australian Apple and Pear Industry believe the following questions need to be answered:-

- (i) Is 600 bins an industry standard?
- (ii) Is 600 bins part of “*standard commercial agronomic practice*”?

In addition, the Industry believes there is no science to substantiate that 600 bins is the figure at which the water should be replenished. The importance of this figure is questionable.

- b) The RAP indicates that “*there is no information available concerning E. amylovora concentrations in dump tanks*”.

The Australian Apple and Pear Industry is concerned at the lack of evidence and/or information available and believes that the RAP must commission further studies on "*E. amylovora concentrations in dump tanks*" before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

- c) The RAP indicates that "*this comparison and the above conclusion are not valid as apple samples A1 and A2 were taken different distances from the inoculum sources*".

The Australian Apple and Pear Industry believe that this statement is a judgement made by the RAP and their conclusion is not substantiated by any science.

- d) The RAP indicates that "*Sholberg et al. (1998) found an average 10^3 - 3cfu/mL in washings of fruit from an orchard severely damaged by fire blight after a hail storm, with every tree heavily infected with blighted shoots and many oozing fruitlets. There is no doubt that washings of such fruits would have high bacterial numbers, but such situations in well-managed New Zealand export orchards would be extremely rare*".

The Australian Apple and Pear Industry believe that the high levels of bacterial numbers after a hail storm highlights the need for an additional inspection of orchards after a hail storm.

The Australian Apple and Pear Industry believe that the RAP has made a questionable judgement relating to statement that "*such situations in well-managed New Zealand export orchards would be extremely rare*".

Industry members that have previously visited New Zealand have experienced visiting orchards, from which fruit was exported overseas, that had a high number of cankers and infected shoots. In fact one grower was very open in his discussions with the Australian industry delegates about this situation.

The Australian Apple and Pear Industry believe that the above statement is an assumption not supported by science.

- e) The RAP indicates that "*this behaviour of E. coli is different to E. amylovora, which has been shown in several studies to be easily washed from contaminated surfaces. This clearly demonstrates the differing behaviours of the two bacteria and the dangers of extrapolating from one to the other. In contrast to observations of Sapers (1999) for E. coli, we have concluded that a very small level of cross contamination as infestation in the dump tank may be possible for E. amylovora*".

The Australian Apple and Pear Industry believe that the RAP has made judgements based on limited or no science. Having expressed "*the*

dangers of extrapolating” the RAP then makes some conclusions relating to the “*level of cross contamination*” of *E. amylovora* based on contrasting the observations of scientific work on *E. coli*.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on *E. amylovora*, using the methodology developed in the *E. coli* studies before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

22. Page 70, Summary.

The RAP indicates that “*this conclusion was based on the potential for the fruit dump tank to become contaminated by bacteria and the fact that disinfection of the dump tank water is not a routine practice in a significant number of New Zealand packing houses*”.

The Australian Apple and Pear Industry believe that the “*disinfection of dump tank water*” must be a routine practice for all New Zealand packing houses that might export fruit to Australia. Such practices must be an integral part of the risk management protocol and subsequent ‘work programme’.

23. Page 71, Summary.

The RAP indicates that “*this is based on the conclusion that a small reduction in the number of fruit infested would occur simply because of the passage of time from the packing house to arrival in Australia*”.

The Australian Apple and Pear Industry believe that this conclusion is not based on any scientific data and as a result the representation of Imp6 is underestimated and should be represented as 1.

24. Page 71, Importation step 7.

The RAP indicates that “*packed fruit is kept under secure conditions, not exposed to elements and therefore not exposed to bacterial inoculum*”.

The Australian Apple and Pear Industry believe that this statement is not supported with any scientific evidence and/or information. Australian exporters have had experiences whereby their product has been left within the marketing chain in unsecured conditions.

25. Page 72, Orchard wholesalers.

a) The RAP makes reference to “*non-urban areas*”.

The Australian Apple and Pear Industry believe this is a non-descript terminology and should be eliminated or a definition of “*non-urban areas*” is prepared and included within the document.

b) The RAP indicates that “*industry sources suggested that about seven facilities of this type could have some involvement with New Zealand apple fruit*”.

The Australian Apple and Pear Industry would dispute this information and believe that the RAP has failed to apply a properly conservative approach^[TJBrennan2] when utilising the information.

As indicated in earlier points above there are more than seven orchard wholesalers. Within the Adelaide Hills region (only 35 kilometres from the central business district of Adelaide) there are at least ten (10) orchard packinghouses/wholesalers. At least seven of them are suppliers to at least one of the two major supermarket retail chains as well as many independent retailers. Other regions within Australia would have similar or greater numbers.

There are in excess of 50 agents/wholesalers within the Adelaide Produce Markets that could become urban wholesalers of imported apples.

- c) The RAP indicates that *“one stakeholder also suggested that citrus packing houses may sometimes deal with apples. However, an industry source indicated that this was most unlikely, as the handling arrangements for citrus are quite different from those for apples. Even if this did occur, citrus packing houses are unlikely to be close to apple and pear orchards and therefore would not constitute a significant risk”*.

The Australian Apple and Pear Industry question the advice given in relation to this situation.

Within South Australia there are a number of orchardists within the Riverland area that grow, pack and export both apples and citrus. The apple orchards are spread throughout citrus orchards. The packing of both apples and citrus is conducted in the same packing shed. One particular packing facility packs citrus for the USA export market and is a major packer of Riverland apples during the season.

Again there would be nothing stopping this grower/packer importing apples from New Zealand, transporting them to the Riverland and packing them in their facility.

The Australian Apple and Pear Industry believe that the RAP has failed to accurately use the precautionary principle in relation this possible scenario.

26. Page 73, Consumers.

- a) The RAP indicates that *“this group includes all final consumers of apples. The majority of the population (and therefore the majority of apple consumption) is in the capital cities significant distances from most commercial apple and pear orchards”*.

The Australian Apple and Pear Industry believes that this is an over simplification of the real situation. For instance there are commercial

apple and pear orchards within the Adelaide Hills are part of the peri-urban zone less than 20 kilometres from the Central Business District (CBD) of Adelaide. In fact the major part of the South Australian Apple and Pear Industry is within 35 kilometres of the CBD.

Given that this is at least one scenario in which the majority of the population of a capital city are in extremely close proximity to commercial apple and pear orchards, it is essential that this 'worst case' scenario is the basis from which decisions are made. This would satisfy the precautionary principle.

- b) The RAP indicates that *"care must be exercised to avoid 'double counting' when estimating proximity values. For example, an apple eaten and discarded by a consumer in a park close to wild and amenity hosts cannot simultaneously be close to household and garden plants"*.

The Australian Apple and Pear industry believes that this situation highlights a fundamental flaw within the model being used.

The fact that an apple core can be discarded close to both *"wild and amenity hosts"* and *"household and garden plants"* and at the same time possibly *"commercial orchards"* must heighten the risk by increasing the population of host plants in the vicinity of the discarded apple. This would increase the possibility of the bacteria finding a host plant.

This is not an aspect of 'double counting' but the aspect of understanding the practical 'environment' in which the whole pathway works.

The Australian Apple and Pear Industry believe that the RAP has failed to truly understand the real and practical 'environment' in which the Australian apple and pear industry operates. The RAP has utilised broad national wide scenarios without giving due consideration of the 'worst case' scenarios that exist in specific parts of the country. As a result they have failed to adequately utilise the precautionary principle.

27. Page 74, Commercial fruit crops near utility points.

The RAP indicates that *"only a small proportion of the Australian population is estimated to be near commercial fruit crops, as the majority of the population is located in urban areas"*.

The Australian Apple and Pear Industry believe that this statement is an over simplification and does not take into account specific 'worst case' scenarios eg., Adelaide/Adelaide Hills, Perth/ Perth Hills, Melbourne/Yarra Valley. In addition the RAP has failed to adequately understand the increasing peri-urban nature of Australia, Australian capital cities and many of the larger regional cities.

28. Page 74 and 75, Nursery plants near utility points.

- a) The RAP indicates that *"up to 5% of major retail outlets may sell nursery plants that are hosts such as apple, pear and/or ornamentals"*.

The Australian Apple and Pear Industry believe that this figure of 5% is an underestimation. A large proportion of the supermarket shops have a garden section within the same shop as the fruit and vegetable section. During the season times they will stock potted apple and pear plants, bare rooted apple and pear as well as other ornamental plants. The Industry believes the RAP has underestimated this risk.

- b) The RAP indicates that *“major food services such as airline caterers are extremely unlikely to be near nursery plants”*.

The Australian Apple and Pear Industry does not believe that *“airline caterers”* are *“major food service”*.

The Industry believe that there has been an inadequate definition of *“major food services”* and that such definition/delineation must be undertaken so that stakeholders have a better appreciation of what the RAP is considering within this area.

The use of *“airline caterers”* as an example of a *“major food service”* highlights the lack of practical understanding of the market chain by the RAP.

29. Page 75, Household and garden plants near utility points.

- a) The RAP lists a range of plants they consider as *“common household and garden plants”* but they are mainly fruit trees.

The Australian Apple and Pear Industry believe that the RAP has failed to consider the following as household and garden plants:-

Mountain ash (*Sorbus* spp.)

Crab-apples (*Malus* spp.)

Photinia spp.

Cotoneaster (*Cotoneaster* spp.)

Even in many of the older urban and peri-urban gardens you can still find hawthorn (*Crataegus* spp.).

This lack of consideration of these additional plants again is considered by the Industry as an underestimation of the range of host plants and therefore an underestimation of the true risk.

- b) The RAP indicates that *“orchard wholesalers and their waste disposal sites are located in an isolated area within the orchard premises, but some household and garden plants may be near them”*.

The Australian Apple and Pear Industry believe that this statement lacks any true accuracy. Most often the waste disposal site(s) is very close to the packing facility and not in an *“isolated area”*. In fact the waste disposal site(s) could well be within an area of the orchard. In addition such sites are not only located near *“household and garden plants”* they are located near abandoned orchards, feral plants and *“wild and amenity plants”*.

This lack of understanding of the practical aspects of “*orchard wholesalers*” again is considered by the Industry as an underestimation of the range of host plants close to waste sites and therefore an underestimation of the true risk.

- c) The RAP indicates that “*local authorities encourage recycling of waste to make compost, and this is becoming a common practice in some rural areas*”.

The Australian Apple and Pear Industry believe that composting is a common practice of many consumers, home gardeners and commercial orchardists not only in rural areas but within urban areas and peri-urban areas. The concept of composting will continue to increase as authorities like the EPA and Local Government work towards ‘Zero Waste’.

This limited consideration of composting within the community by the RAP is considered by the Industry as an underestimation of the importance of composting and therefore an underestimation of the true risk.

30. Page 75 and 76, Wild and amenity plants near utility points.

- a) The RAP lists a range of plants they consider as “*wild and amenity plants*” but they are mainly ornamental plants.

The Australian Apple and Pear Industry believe that the RAP has failed to consider the following as wild and amenity plants:-

Pears (*Pyrus* spp.)

Apples (*Malus* spp.)

Quince (*Cydonia* spp.)

Many of these are wild and/or feral plants in most regions within Australia.

This lack of consideration of these additional plants again is considered by the Industry as an underestimation of the range of host plants and therefore an underestimation of the true risk.

- b) The RAP indicates that “*orchard wholesale waste sites are mostly located within orchard premises and are not near wild and amenity plants*”.

The Australian Apple and Pear Industry believe that this statement lacks any true accuracy. Most often the waste disposal site(s) is very close to the packing facility and are located near abandoned orchards, feral plants and “*wild and amenity plants*”.

This lack of understanding of the practical aspects of “*orchard wholesalers*” again is considered by the Industry as an underestimation of the range of host plants close to waste sites and therefore an underestimation of the true risk.

- c) The RAP indicates that *“orchard wholesalers will not allow feral plants and volunteer apple seedlings to grow near these waste disposal sites”*.

The Australian Apple and Pear Industry believe that this statement lacks any true accuracy. Most often the waste disposal site(s) is very close to the packing facility and are located near abandoned orchards, feral apple plants and *“wild and amenity plants”*.

This lack of understanding of the practical aspects of *“orchard wholesalers”* again is considered by the Industry as an underestimation of the range of host plants close to waste sites and therefore an underestimation of the true risk.

Also the lack of appreciation of the growing region environment within Australia is of concern. In the Industry submission made to the 2004 RDIRA the Industry presented work by Creeper and Nicholson (2003) conducted in South Australia with regards the concentration and spread of host plants as well as *“wild and amenity plants”*.

The following is material presented in the Industry submission to the 2004 RDIRA

“Recent work by Creeper & Nicholson (2003) within South Australia indicated that:

“Derelict orchards and feral trees present a significant biosecurity threat to the industry from a number of perspectives.”

“Primarily this paper seeks to identify the best methods of locating derelict pome orchards and feral trees and to identify current data availability and requirements.”

The initial focus outlined in this paper is the Lenswood Region, as it is the main commercial production area of the State. However, other areas such as the Riverland and the South East may be investigated in later stages. The principles and recommendations from this paper will generally also be applicable to these areas.

The paper defines the hazard in the following manner:

“For the purposes of this paper, derelict or abandoned orchards may be defined as those not currently actively managed, particularly in relation to pest and disease control. Feral apple trees refer to those not deliberately planted, and have germinated either on roadsides, other properties and /or among other vegetation”.

“Derelict orchards not only enable residual untreated codling moth populations to exist, but also act as a significant biosecurity threat to the Pome fruit industry in South Australia. These orchards pose a significant threat to any Fire Blight eradication effort should an outbreak occur in the future, which has the potential to devastate the industry”

Key issues from the report are:

1. *In addition to increasing Codling Moth control costs, derelict orchards and feral host trees also undermine efforts to control other pests and diseases. These orchards also represent significant biosecurity threat, particularly in relation to any potential Fire Blight outbreaks”.*
2. *“Derelict orchards and feral apple trees represent a major barrier for the reduction in insecticide use by the Pome industry.”*
3. *“The management or removal of derelict orchards and feral trees will contribute to the future access of the SA Pome fruit Industry into export markets currently unavailable”.*

From the initial report two case studies were conducted with the Lenswood growing region:

Case Study 1

Apple grower, packer domestic and interstate supplier and exporter within the Adelaide Hills. Approximately 20 km from the Central Business District of Adelaide.

The site includes a:

Commercial orchard area of 5.0ha

Mature packing facility

Major distribution facility for apples going to the domestic, interstate and international markets

The business is an approved supplier of apples to at least one of the major retail supermarket chains as well as many independent retailers within Adelaide and South Australia.

Case Study 2

Pear Grower, Packer, Domestic and Interstate Supplier and Exporter within the Adelaide Hills

Approximately 30km from the Central Business District of Adelaide

The site includes:

**Commercial Pear orchards of 31 ha
Major packing facility
Major distribution facility for pears going to the
domestic, interstate and international markets.**

This business is an approved supplier of pears to at least one of the major retail supermarket chains as well as may independent retailers within Adelaide and South Australia

CONCLUSIONS:

The attached maps and tables detail the level of derelict orchards feral plants and host plants in home gardens and on roadsides in the zones of 300m, 600m and 1km from the commercial orchard.

These case studies would be typical of all other major commercial orchards and/or packing houses within the Adelaide Hills Region and within other regions throughout Australia

A snapshot of the Adelaide Hills Region is as follows:

- a) A number of large retail supermarkets within 5kms of commercial orchards and packing facilities**
- b) Feral plants that are along roadsides, creeks and within National Parks that form ‘ribbons’ from Metropolitan Adelaide into and through the Commercial Growing Regions within the Adelaide Hills**
- c) Many urban dwellers and hobby farms scattered throughout the Commercial Growing Region and in close proximity to both commercial orchards.**
- d) An Apple / Pear Industry which is highly vertically integrated industry with many commercial growers having major infrastructure including cool storage and packing facilities. They supply fruit through the marketing chain**
 - (1) Through their own wholesale agency within the Adelaide Produce Market**
 - (2) Directly to the major retail supermarket chains**
 - (3) Directly to Independent fruit shops**

- e) **There are 10 growers / packers within the Adelaide Hills region who supply apples / pears to the three retail supermarket chains – Woolworths, Coles/BiLo and Foodland.**

As suppliers to the major retail supermarket chain it is a very likely scenario that they would import, store, re-pack and distribute imported fruit as part of their role as category manager for apples/pears.

Again this ‘snapshot’ would be typical of growing regions in cities like Perth, Melbourne, Sydney and Hobart.

This ‘snapshot’ offers a far different position than is outlined within the 2004 RDIRA and the 2005 DIRA.

REFERENCES:

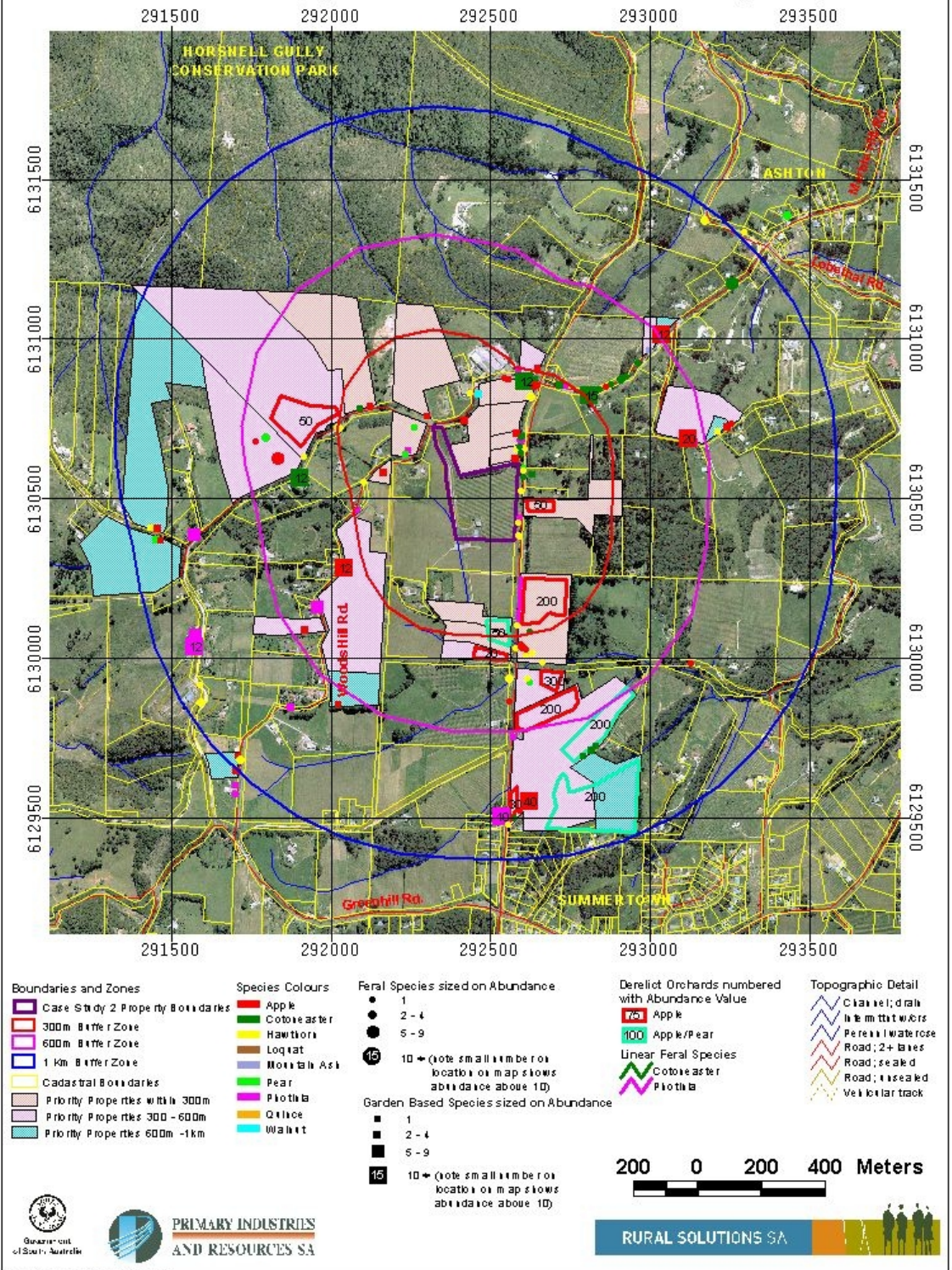
**Creeper, D and Nicholson, H (2003).
Examining Removal and Management Strategies: Derelict Pome Orchards in South Australia.”**

The Australian Apple and Pear Industry believe that the RAP has failed to truly understand the problems of host plants, feral plants, wild and amenity plants and abandoned orchards in commercial growing orchard regions, peri-urban areas of the major regional and capital cities and the urban areas within Australia.

If Fire Blight and/or European canker was to establish in these regions it will never be eradicated.

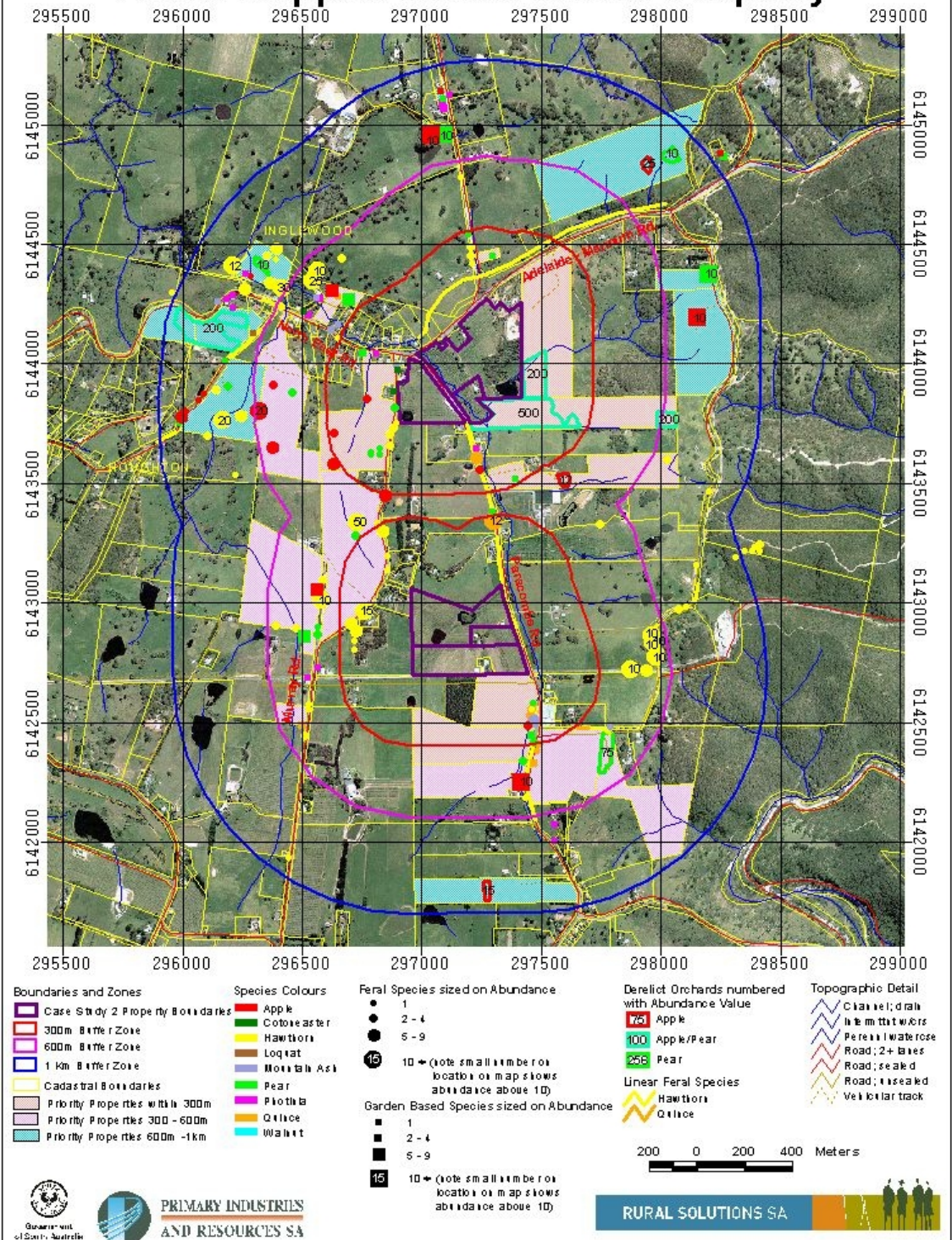
The Australian Apple and Pear Industry believe that the RAP has underestimated this risk throughout the 2005 DIRA.

CASE STUDY 1: APPLE & PEAR PEST SPECIES Hosts Mapped Within 1km of Property



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CASE STUDY 2: APPLE & PEAR PEST SPECIES Hosts Mapped Within 1km of Property



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CASE STUDY 1 - ASHTON										
# of orchards = 1										
# of orchardists = 1										
Commercial orchard area = 5.0 ha										
	AREA (ha)	# Surrounding DCDB	# of DCDB with hosts	# Derelict orchards	Species	GARDEN	FERAL	ROADSIDE	ORCHARD	SUM
BUFFER ZONE 1 v 300m	66.3	38	17	3	Apple	14		3	300	317
					Pear	2		1		3
					Quince					0
					Loquat					0
					Hawthorn	2	1	13		16
					Photinia	4		47		51
					Cotoneaster	26	1	5		32
					Walnut	3		1		4
					Mountain Ash					0
					SUM	51	2	70	300	423
BUFFER ZONE 2 300 - 600m	115.3	32	13	4	Apple	36	15	2	570	623
					Pear	1	3	2		6
					Quince					0
					Loquat			1		1
					Hawthorn		3	6		9
					Photinia	8				8
					Cotoneaster	27		8		35
					Walnut					0
					Mountain Ash	1				1
					SUM	73	21	19	570	683
BUFFER ZONE 3 600 - 1000m	245.7	105	13	3	Apple	63	1	2	430	496
					Pear	2				2
					Quince					0
					Loquat					0
					Hawthorn	2	1	10		13
					Photinia	37				37
					Cotoneaster	4	1	6		11
					Walnut					0
					Mountain Ash					0
					SUM	108	3	18	430	559
TOTAL	427.3	175	43	10	TOTAL	232	26	107	1300	1665

# of orchards = 2									
# of orchardists = 1									
Commercial orchard area = 31.0 ha									

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AREA STATS

CASE STUDY 1 - ASHTON

Commercial Orchard Area = 5.0 ha

	AREA (ha)	Derelict orchards (ha) : % of zone	# Trees	Roadside infestation (m)
ZONE 1	66.3 [15.5%]	0.3	50	840
		0.5	50	
		1.7	200	
		2.5 [3.7%]		
ZONE 2	115.3 [27%]	0.2	20	350
		1.7	50	
		1.2	200	
		0.3	300	
		3.4 [2.9%]		
ZONE 3	245.7 [57.5%]	0.2	30	110
		1.5	200	
		4.2	200	
		5.9 [2.4%]		
TOTAL	427.3 [100%]	11.8 [2.8% of total area]	1300	1300

CASE STUDY 2 - INGLEWOOD

Commercial Orchard Area = 31.0 ha

	AREA (ha)	Derelict orchards (ha) : % of zone	# Trees	Roadside infestation (m)
ZONE 1	191.5 [24.9%]	1.6	200	1390
		3.8	500	
		5.4 [2.8%]		
ZONE 2	215.1 [27.9%]	0.2	12	1260
		0.7	75	
		0.9 [0.4%]		
ZONE 3	363.8 [47.2%]	0.2	10	1250
		0.3	10	
		0.2	15	
		0.2	25	
		0.5	200	
		2.7	200	
		4.1 [1.1%]		
TOTAL	770.4 [100%]	10.4 [1.3% of total area]	1247	3900

- d) The RAP indicates that “*no information on the susceptibility of Australian native plants to E. amylovora is available*”.

The Australian Apple and Pear Industry support this statement and would highlight it as another area in which there is a lack of science.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on “*the susceptibility of Australian native plants to E. amylovora*” before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

Further, s11B of the Quarantine Act requires no less.

- e) The RAP indicates that “*local authorities encourage recycling of waste to make compost, and this is becoming a common practice in some rural areas*”.

The Australian Apple and Pear Industry believe that composting is a common practice of many consumers, home gardeners and commercial orchardists not only in rural areas but within urban areas and peri-urban areas. The concept of composting will continue to increase as authorities like the EPA and Local Government work towards ‘Zero Waste’.

This limited consideration of composting within the community by the RAP is considered by the Industry as an underestimation of the importance of composting and therefore an underestimation of the true risk.

31. Page 77, Viability.

- a) The RAP indicates that “*E. amylovora is known to survive in calyces of mature apple fruit at harvest*”.

The Australian Apple and Pear Industry supports this conclusion and believe that it is an integral issue in considering the risk of importing apples from countries that have Fire Blight.

- b) The RAP indicates that “*E. amylovora does not produce resting cells (Roberts et al. 1998)*”.

The Australian Apple and Pear Industry would seek clarification as to what the RAP mean by the term “*resting cells*”. If in fact the aspects of

VBNC and biofilms are accepted, then are these not “*resting cells*” of the bacteria?

The Australian Apple and Pear Industry would question the validity of the statement based on one piece of science.

32. Page 78, Transfer mechanisms.

The RAP indicates that “*although they are known to inhabit landfill sites and are capable of pecking fruit, no evidence is found in the literature to confirm their involvement*”.

The Australian Apple and Pear Industry believe that the fact that there is no evidence only highlights that there has not been any research done in this area and as a result the RAP cannot discount the role of birds in the possible spread of *E. amylovora*.

Given the high incidence of bird damage occurring to fruit on the tree by a wide variety of native and non-native birds across most of the apple growing regions within Australia, the Australian Apple and Pear Industry believes that this aspect requires some significant scientific research.

The Australian Apple and Pear Industry believe that the RAP must commission studies on role of birds in the possible spread of the *E. amylovora* relating to fruit on the tree, fruit in waste sites and fruit in landfill sites before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

33. Page 79, Inoculum dose.

The RAP indicates that “*there is no accepted threshold number of bacteria required to initiate an infection, and this may vary with environmental and host factors*”.

The Australian Apple and Pear Industry support this statement by the RAP and believe that this is one of the most significant statements when considering the importation of apples from countries that have *E. amylovora*.

The science that has been undertaken to build an “*accepted threshold number of bacteria required to initiate an infection*” is both variable and at time conflicting. In utilising the precautionary principle the RAP must then build all work relating to *E. amylovora* on the simple but powerful statement that “*there is no accepted threshold number of bacteria required to initiate an infection, and this may vary with environmental and host factors*”.

34. Page 80, Host receptivity.

The RAP indicates that “*in addition, epiphytic growth of E. amylovora has been detected in non-hosts of fire blight (Johnson, 2004)*”.

The Australian Apple and Pear Industry believe that this is highly significant new science that requires further scientific investigation particularly if there is the possibility that *E. amylovora* could survive on a range of Australian native non-host plants.

35. Page 81, Environmental factors.

The RAP indicates that *“the IRA team concluded that very little of the experimental work was directly relevant to this situation. It is just not possible to develop experimental work with a robust experimental design and sufficient replication to assess events where the probabilities are potentially so low. Most of the work has been done under highly artificial conditions with experimental designs that have very little chance of detecting low probability but significant events”*.

The Australian Apple and Pear Industry believe that the RAP has failed to adequately utilise the precautionary principle in relation to ‘environmental factors’ by making judgements based on limited experimental work.

This disregard of the ‘environmental factors’ by the RAP, is considered by the Industry as an underestimation of the importance of ‘environmental factors’ and therefore an underestimation of the true risk.

36. Page 81, Conclusion – exposure.

The RAP indicates that *“the IRA team concluded that the exposure value for an individual apple for all five utility points by four exposure group combinations should be in the range of Uniform (0, 10⁻⁶). This range is based on the IRA team’s view on both mechanical and insect mediated transmission and explicitly acknowledges that in some circumstances the chances of exposure would be zero”*.

The Australian Apple and Pear Industry believe that the RAP has made judgements that are not based on sound science.

Points 31 to 35 above question much of material by the RAP to reach the above conclusion.

The Industry would question the view of the “IRA team” that they can *“explicitly acknowledge that in some circumstances the chances of exposure would be zero”*. Given that the whole process of Import Risk Analysis is based on the fact that there can never be ‘zero risk’ how can the RAP *“explicitly acknowledge that in some circumstances the chances of exposure would be zero”*?

The ‘conclusion – exposure’ presented by the RAP, is considered by the Industry as an underestimation of the importance of all the ‘exposure’ issues and therefore an underestimation of the true risk.

37. Page 81, Availability of suitable hosts, alternative hosts and vectors in the PRA area.

The RAP indicates that “*the potential for E. amylovora to grow epiphytically on flowers of non-host species of fire blight such as Acer (maple), Amelanchier (serviceberry), Cytisus (Scotch broom), Populus (cottonwood), Prunus (stone fruit), Rubus (blackberry, raspberry), Salix (willows) and Symphoricarpos (snowberry) has been reported in USA (Johnson, 2004). Most of these hosts are present in Australia*”.

The Australian Apple and Pear Industry believe that this information is highly significant in the following number of areas:-

- (i) potential host plants within New Zealand apple growing regions,
- (ii) potential host plants within Australian apple growing regions,
- (iii) potential hosts in gardens and parks within Australia, and
- (iv) the commercial production of stone fruit and raspberries.

The Australian Apple and Pear Industry believe that the non-host species need to be excluded from any of the proposed areas that include export ‘blocks’. Industry would believe that this fit within the requirements of New Zealand Integrated Fruit Production programme for Fire Blight.

The Australian Apple and Pear Industry believe that the potential for non-host plants having epiphytic populations needs to be built into the 2005 DIRA particularly in four exposure groups including “*commercial fruit crops*”, “*nursery points*”, “*household and garden plants*” and “*wild and amenity plants*”.

The Australian Apple and Pear Industry believe that this is highly significant new science that requires further scientific investigation particularly if there is the possibility that *E. amylovora* could survive on a range of Australian native non-host plants.

38. Page 82, Suitability of the environment,

The RAP indicates that “*hailstorms are common in pome fruit growing areas in Australia (QFVG, 2000). These cause injuries on plant tissues, predisposing them to infection (Brooks, 1926; Keil et al, 1966)*”.

The Australian Apple and Pear Industry would report that during the flowering and growing period of 2005 hailstorms have hit nearly every apple growing region including Stanthorpe (QLD), Orange and Batlow (NSW), Goulburn Valley (VIC) and the Adelaide Hills (SA). This makes these growing areas highly susceptible to an outbreak of Fire Blight if the organism *E. amylovora* was to enter these regions.

39. Page 83, The potential for adaptation of the pest.
The RAP indicates that “*the streptomycin resistance in E. amylovora was because of the mutation of genes and not plasmid-borne (Thomson et al. 1993). On the basis of available information, the transfer of streptomycin resistance genes from one organism to another would not occur as suggested by some stakeholders*”.

The Australian Apple and Pear Industry believe that there is a lack of scientific evidence relating to streptomycin resistance from which the RAP can justify the statement that “*the transfer of streptomycin resistance genes from one organism to another would not occur*”.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on “*the transfer of streptomycin resistance genes from one organism to another*” before making any final decision on the importation of apples from New Zealand or any other country that has Fire Blight.

40. Page 83, Minimum population needed for establishment.
The RAP indicates that “*one bacterium placed directly in the hypanthium was sufficient to cause blossom infection under controlled inoculations in the laboratory (Hildebrand, 1937). In some seasons five bacteria, and in another 5000 were sufficient to cause blossom infection (van der Zwet et al., 1994)*”.

The Australian Apple and Pear Industry believe that “*one bacterium*” is sufficient to cause blossom infection and as a result all import risk analysis must be based on this simple but relevant piece of scientific data.

41. Page 83 and 84, The method of pest survival.
a) The RAP indicates that “*Erwinia amylovora can survive in the previous year’s cankers (Beer and Norelli, 1977) and as latent infections in internal stem tissues (Brooks, 1926; Miller, 1929)*”.

The Australian Apple and Pear Industry believe that this is a highly significant statement that makes the process on orchard inspection very important. The Industry believes that because of this “*method of pest survival*” the most rigorous orchard inspections must be implemented and that more than one orchard inspection is required.

- b) The RAP indicates that “*E. amylovora can remain viable on fruit spurs following blossom infection until bud burst the following spring (Dye, 1949)*”.

The Australian Apple and Pear Industry believe that this is a highly significant statement that makes the process on orchard inspection very important. The Industry believes that because of this “*method of pest survival*” the most rigorous orchard inspections must be implemented and that more than one orchard inspection is required.

- c) The RAP indicates that “*populations of E. amylovora can survive in soil over winter (Thomson, 1969) and could act as a source of primary inoculum. Ark (1932) demonstrated that the pathogen survived under natural conditions for about 3 months. However, a more recent study showed that E. amylovora declined rapidly in untreated soil collected from a field, and the pathogen was no longer detected 5 weeks after inoculation (Hildebrand et al., 2001)*”.

The Australian Apple and Pear Industry believe that the science shows that *E. amylovora* can survive in soil and again this is a highly significant point.

The Industry believes there is conflicting evidence in relation to the length of time the bacteria will survival in the soil.

Given the need to adhere to the precautionary principle the RAP must accept that the survival of *E. amylovora* in soil is relevant and must be taken into consideration when establishing risk mitigation protocols relating to ‘pest free areas’ and/or ‘areas of low pest prevalence’. The survival of *E. amylovora* in the soil has major ramifications for the movement of the bacteria around the orchard and into the storage and packing facilities via bins and machinery.

- d) The RAP indicates that “*several stakeholders have raised issues relevant to the effects of VBNC state, biofilm/aggregates and sigma factor on the survival of E. amylovora. These have been discussed under Imp2. Preliminary evidence suggests that the above factors may have a role to play in the survival of E. amylovora, but are not completely understood as yet*”.

The Australian Apple and Pear Industry believe that VBNC, biofilm/aggregates and the sigma factor are significant survival mechanisms of

E. amylovora and given that the science is relatively new and incomplete then the precautionary principle must be used by the RAP.

The Australian Apple and Pear Industry believe that given the RAP must commission further studies on VBNC, biofilms/aggregates and the sigma factor before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

42. Page 85, Presence of natural barriers.
- a) The RAP indicates that “*the major apple production regions are confined to six states in Australia*”.

The Australian Apple and Pear Industry would indicate that apples are grown in each of the six states within Australia as well as one of the two territories, the ACT. In most states there is more than one growing region eg. SA – South East, Adelaide Hills and the Riverland; NSW – Orange, Batlow, Bilpin; etc.

When analysing the apple and pear industry there is a general tendency to consider that all production takes place in those areas considered to be the main production areas and no production takes place elsewhere. This is not the case in all states and the concentration of production varies, as shown below.

Apples

The analysis below indicates that the most concentrated state for apple production is Queensland, where no production takes place outside the main production area of Stanthorpe. The second most concentrated state for apple production is Western Australia with only 5% of production and 10% of producers outside the three main production areas.

The least concentrated state for apple production is South Australia where 38% of production takes place outside the main growing area and 59% of producers are located outside the main production region.

Tasmania also has a significant proportion of its production outside the main production area with 33% of production and 31% of growers in areas other than the single main production region.

NSW and Victoria with 25% and 19% respectively of production outside the main production areas also display a lower concentration than would be expected by the usual perception of apple growing in those states.

NSW and Victoria have 48% and 21% respectively of growers outside the main production regions.

Pears

Unsurprisingly, Queensland also has the most concentrated pear industry with all pear production and pear producers located in the Stanthorpe area. Western Australia is the next most concentrated production of pears with all but 2% of production and 8% of producers being located in the main growing areas. Victoria has a very similar concentration of production with 2% of production and 12% of producers located outside the main growing regions.

The least concentrated state for pear production is NSW with 71% of production and 70% of producers located outside the main production areas. In Tasmania the industry is also dispersed with 47% of pears are grown outside the main production areas by 54% of the producers.

Finally in South Australia there are many smaller pear producers outside the main growing areas with 29% of production and 68% of producers located outside the main growing area.

- b) The RAP indicates that *“these areas have differing climatic conditions and are separated by long distances, including desert areas between some states. There is potential for rapid spread within growing areas but not between them, unless simultaneous infections occur in each area or infected plants are transported to new areas across these natural barriers”*.

The Australian Apple and Pear Industry believe that the RAP has made an oversimplification of the *“presence of natural barriers”*. There are strong environmental linkages between growing regions in New South Wales, through Victoria and across to South Australia meaning the natural barriers such as deserts are much less relevant.

The Australian Apple and Pear Industry believe that there are many pests and diseases that have entered Australia and under strong state quarantine protocols have moved from one growing region to another even with the natural barriers in place. Some of these pests and disease are considered in more detail within Part C of this submission.

The following tables from ABS Figures give an idea of the spread of apple and pear orchards throughout each of the States and Australia in general. By mapping the locations it would highlight that the *“natural barriers”* being suggested by the RAP are overstated.

ASGC	Region	Total Apples		
		Total trees	Total production	Number
	NEW SOUTH WALES & ACT			
	Outer South Western			
10530	Sydney	12,965	98,886	7
10545	Outer Western Sydney	45,030	605,466	20
10560	Central Northern Sydney	147	70	2
10570	Gosford-Wyong	4,200	50,000	1
11010	Hunter SD Bal	908	12,950	1
11505	Wollongong	11,659	478,902	3
11510	Illawarra SD Bal	857	33,375	2

13010	Northern Slopes (excl. Tamworth)	67	860	1
13015	Northern Tablelands	101,483	2,654,483	10
13505	Central Macquarie (excl. Dubbo)	2,609	3,261	4
14005	Bathurst-Orange	543,481	17,068,095	51
14010	Central Tablelands (excl. Bathurst - Orange)	93,085	4,035,936	11
14015	Lachlan	25,323	2,824,544	6
14505	Queanbeyan	2,034	6,245	1
14510	Southern Tablelands (excl. Queanbeyan)	9,466	134,481	9
14520	Snowy	2,797	10,867	1
15005	Wagga Wagga	55,079	1,413,895	3
15010	Central Murrumbidgee (excl. Wagga Wagga)	1,060,166	32,041,354	49
15015	Lower Murrumbidgee	544	14,000	1
15510	Upper Murray (excl. Albury)	62,793	2,554,800	5
15515	Central Murray	700	1,000	1
16010	Far West	14,300	80,000	1
80535	South Canberra	2,634	35,171	4
	Total	2,052,328	64,158,642	194

VICTORIA

20540	Northern Outer Melbourne	31,083	1,456,121	4
20550	Eastern Middle Melbourne	10,341	414,000	2
20555	Eastern Outer Melbourne	7,846	287,000	2
20560	Yarra Ranges Shire Part A	411,224	13,180,991	23
20580	South Eastern Outer Melbourne	198,259	6,608,855	15

20590	Mornington Peninsula Shire	173,670	5,631,876	25
21010	East Barwon	338	5,450	1
21510	Glenelg	11,246	358,288	3
22010	East Central Highlands	164,682	1,434,015	6
22015	West Central Highlands	771	20,333	1
22505	South Wimmera	918	3,030	3
23010	West Mallee	510	741	1
23015	East Mallee	10,474	290,391	3
23510	North Loddon	354,028	7,397,380	22
24005	Greater Shepparton City Part A	481,131	18,626,218	65
24010	North Goulburn	1,526,762	54,015,705	157
24020	South West Goulburn	2,688	74,400	1
24505	Wodonga	84,768	2,443,624	9
24510	West Ovens-Murray	805	12,923	1
24515	East Ovens-Murray	166,110	4,845,777	2
25005	East Gippsland Shire	8,369	449,575	3
25510	West Gippsland	137,589	4,788,864	10
	Total	3,783,612	122,345,557	359
QUEENSLAND				
32005	Darling Downs SD Bal	1,002,922	29,552,381	77
	Total	1,002,922	29,552,381	77
SOUTH AUSTRALIA				
40505	Northern Adelaide	97	833	1
40515	Eastern Adelaide	213,933	5,251,399	18

40520	Southern Adelaide	34,566	574,678	6
41005	Barossa	1,849	124,017	2
41015	Mt Lofty Ranges	879,021	18,042,361	53
41020	Fleurieu	6,526	73,285	5
42005	Riverland	72,860	1,839,269	30
42505	Upper South East	57,000	520,725	2
42510	Lower South East	217,143	2,713,912	11
43005	Lincoln	147	1,852	2
43520	Flinders Ranges	60	1,600	1
Total		1,483,203	29,143,931	131

**WESTERN
AUSTRALIA**

50510	East Metropolitan	87,837	2,569,241	47
50515	North Metropolitan	4	-	1
50525	South East Metropolitan	106,490	4,504,474	42
51001	Mandurah	24,537	1,671,441	10
51010	Preston	412,670	13,035,863	80
51015	Vasse	154	240	2
51020	Blackwood	328,095	13,958,173	50
51510	King	7,975	131,142	9
52005	Hotham	105	15	1
52515	Campion	6	-	1
53005	Lefroy	15	600	1
Total		967,888	35,871,189	244

TASMANIA

60505	Greater Hobart	1,461	9,078	4
61005	Southern	986,720	30,364,416	74
61505	Greater Launceston	243,703	4,161,400	10
61510	Central North	3,400	96,922	1
61515	North Eastern	229	5,327	1
62005	Burnie-Devonport	88,361	3,071,750	12
62010	North Western Rural	152,926	7,803,371	5
	Total	1,476,801	45,512,263	107

TOTAL PEARS EXCLUDING NASHI

ASGC	Region	Total trees	Total production	Number
	NEW SOUTH WALES			
	Outer South Western			
10530	Sydney	819	2,555	5
10545	Outer Western Sydney	766	1,295	6
10560	Central Northern Sydney	690	2,840	1
11010	Hunter SD Bal	90		
11505	Wollongong	326	8,795	1
11510	Illawarra SD Bal	200		
13010	Northern Slopes (excl. Tamworth)	30	895	1
13015	Northern Tablelands	1,204	29,023	7
13505	Central Macquarie (excl. Dubbo)	74	330	2
14005	Bathurst-Orange	8,467	134,194	19
14010	Central Tablelands (excl. Bathurst - Orange)	6,900	320,343	7
14015	Lachlan	3,055	3,300	2

14505	Queanbeyan	129	591	1
	Southern Tablelands (excl.			
14510	Queanbeyan)	1,599	16,495	4
	Central Murrumbidgee			
15010	(excl. Wagga Wagga)	150		
15015	Lower Murrumbidgee	4,420	95,000	1
	Upper Murray (excl.			
15510	Albury)	595	35,640	1
80535	South Canberra	82	1,445	4
	Total	29,596	652,741	62
VICTORIA				
20540	Northern Outer Melbourne	12,361	1,571,500	4
20550	Eastern Middle Melbourne	1,000	76,500	2
20555	Eastern Outer Melbourne	844	57,500	2
20560	Yarra Ranges Shire Part A	27,860	2,263,540	11
	South Eastern Outer			
20580	Melbourne	4,724	115,880	7
	Mornington Peninsula			
20590	Shire	2,769	174,559	8
21010	East Barwon	30	600	1
22010	East Central Highlands	1,617	36,803	3
22015	West Central Highlands	59	2,000	1
22505	South Wimmera	220	2,350	2
23005	Mildura Rural City Part A	45		
23510	North Loddon	7,719	445,847	14
	Greater Shepparton City			
24005	Part A	346,417	31,167,881	63
24010	North Goulburn	1,314,974	94,476,692	176
24505	Wodonga	1,865	47,240	4
24515	East Ovens-Murray			1

		60	6,787	
25005	East Gippsland Shire	52	430	2
25510	West Gippsland	10		
	Total	1,722,626	130,446,109	301
	QUEENSLAND			
30505	Brisbane City	120		
32005	Darling Downs SD Bal	28,467	753,343	38
	Total	28,587	753,343	38
	SOUTH AUSTRALIA			
40505	Northern Adelaide	39	222	1
40515	Eastern Adelaide	2,855	109,550	9
40520	Southern Adelaide	11,667	603,886	6
41005	Barossa	1,718	180,188	2
41015	Mt Lofty Ranges	74,313	4,341,996	35
41020	Fleurieu	10,727	78,951	6
42005	Riverland	14,399	840,524	49
	Total	115,718	6,155,317	108
	WESTERN AUSTRALIA			
50510	East Metropolitan	29,149	1,989,353	44
50515	North Metropolitan	1		
50525	South East Metropolitan	15,571	1,164,657	36
51001	Mandurah	3,190	147,700	6
51010	Preston	128,163	4,672,656	50
51015	Vasse	3	60	1
51020	Blackwood	27,153	905,901	18

51510	King	345	12,751	4
52005	Hotham	125	150	1
52515	Campion	6		
53005	Lefroy	8	60	1
Total		203,714	8,893,288	161

TASMANIA

60505	Greater Hobart	182	2,090	4
61005	Southern	17,527	417,082	15
61505	Greater Launceston	9,876	172,378	5
61515	North Eastern	40	1,621	1
62005	Burnie-Devonport	2,827	114,160	6
62010	North Western Rural	648	80,000	2
Total		31,100	787,331	33

- c) The RAP indicates that “*there is circumstantial evidence that E. amylovora can be spread long distance over land or sea by birds (Meijneke, 1974; Billing, 1974b) or aerosols transported by high altitude air currents (Meijneke, 1974)*”.

The Australian Apple and Pear Industry has considered the world wide spread of *E. amylovora* and has covered the issues in more detail in Part 2 of this submission.

43. Page 85, Potential movement of pest commodities or conveyances.

- a) The RAP indicates that *Erwinia amylovora has been isolated from the calyces of apple fruit at harvest (Hale et al., 1987; van der Zwet et al., 1990)*”.

The Australian Apple and Pear Industry believe that this is a highly significant fact that highlights that *E. amylovora* can survive on/in mature

apples and this needs to be reflected in the risk mitigation processes implemented after harvest.

- b) The RAP indicates that *“the pathogen could be spread via fruit, but its spread through this pathway has not been demonstrated (Taylor et al., 2003a)”*.

The Australian Apple and Pear Industry believe that this is a highly significant fact that recognises that

- (i) *“the pathogen could be spread via fruit”* and
- (ii) the *“spread through this pathway has not been demonstrated”*.

The Australian Apple and Pear Industry believe that the spread of *E. amylovora* through mature apples has not been researched particularly in countries that have the disease and cannot be researched in those countries that do not have the disease.

The Australian Apple and Pear Industry believe that given the RAP must commission further studies on the possible spread of *E. amylovora* through the movement of mature apples before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

44. Page 86, Potential vectors of the pest.

- a) The RAP indicates that *“of the 27 insect vectors listed for the USA (van der Zwet and Keil, 1979), Australia has either the same species or a closely related species (AQIS, 1998a)”*.

The Australian Apple and Pear Industry believe that this is a highly significant fact that highlights that insect vectors exist within Australia to transfer *E. amylovora* through the pathways.

- b) The RAP indicates that *“managed hives of honeybees are used in contract pollination o apple orchards. Feral honey bees can also act as pollinators. Bees generally fly up to two to four kilometres to forage, and are major vectors in the rapid spread of E. amylovora (Hoopingarner and Waller, 1992)”*.

The Australian Apple and Pear Industry believe that this is a highly significant fact that highlights that bee vectors exist within Australia to rapidly transfer *E. amylovora* through the pathways.

45. Page 86, Potential natural enemies of the pest.

The RAP indicates that *“P. fluorescens has not been reported on rosaceous hosts in Australia”*.

The Australian Apple and Pear Industry believe that there are no effective “*potential natural enemies*” within Australia. In addition there are no commercial formulations of the “*potential natural enemies*” registered within Australia for use on *E. amylovora*.

46. Page 87, Nursery Plants.
The RAP indicates that “*use of some copper formulations, which act as bactericides, may prevent the spread of the pathogen if it were to establish*”.

The Australian Apple and Pear Industry believe there is no scientific evidence to support this statement.

48. Page 87, Household and garden plants
a) The RAP indicates that “*it is unlikely that garden plantings would be contiguous, and therefore spread from household to household may be quite slow*”.
- The Australian Apple and Pear Industry believe there is no scientific evidence to support this statement.
- b) The RAP indicates that “*if abnormal symptoms are detected in household plants, there is a reasonable chance that a diagnosis would be undertaken, followed by an appropriate control measure*”.

The Australian Apple and Pear Industry believe there is no technical and/or scientific evidence to support this statement.

49. Page 87, Wild and amenity plants
The RAP indicates that “*the density of these plants is likely to be low and randomly distributed over a wide area*”.

The Australian Apple and Pear Industry believes that the RAP has failed to adequately investigate the spread and density of wild and amenity plants within apple growing regions around Australia. The two examples investigated by the South Australian apple industry, and detailed above, have not been adequately considered in the 2005 DIRA.

50. Page 89, Plant life or health – F
The RAP indicates that “*fire blight epidemics can develop rapidly in orchards with no history of the disease, killing many large limbs or even whole trees*”.

The Australian Apple and Pear Industry believe that this is a highly significant fact. This issue needs to be taken into account both within New Zealand and Australia.

As Australia has not had Fire Blight within any commercial orchards the likely effect of an outbreak in such orchards could be most dramatic. While this comment is not supported by technical evidence within Australia there is sufficient evidence of the costs of outbreaks in many other countries throughout the world. The impacts would be highly significant at the national level – and the ranking should be ‘G’.

51. Page 91, Human life or health – **A**

The RAP indicates that *“there are no known direct impacts of E. amylovora on human life or health, and the rating assigned to this criterion was therefore ‘A’.”*

The Australian Apple and Pear Industry questions the relevance of this particular section of the matrix as there is no direct relationship between the disease and *“human life or health”*.

52. Page 91, Control or eradication – **E**

The RAP indicates that *“in the event of a fire blight outbreak, the Australian Commonwealth and State Governments would incur substantial costs, associated with regulatory enforcement and implementation of the contingency plan (control/eradication and surveillance/monitoring)”*.

Under the new Plant Health Australia Deed signed by Apple and Pear Australia Limited on behalf of the industry means that the Australian Apple and Pear Industry will face the payment of 20% of the costs relating to an outbreak of Fire Blight within commercial orchards. These funds for such a programme are most likely to come through a compulsory industry levy.

53. Page 91, Domestic trade or industry – **E**

The RAP indicates that the *“indirect impact on domestic trade or industry would be minor at the national level, significant at a regional level and highly significant at the district level”*.

The Australian Apple and Pear Industry believe that this is an underestimation of the possible scenario. The alleged outbreaks of Fire Blight within South Australia and Victoria in 1997 had a major effect on the domestic trade of fruit from those two states.

The closure of the borders through the quarantine protocols not only affected the regional level (states) caught in the quarantine zones but also had a dramatic effect on the total Australian apple and pear domestic market.

The Industry believes that the rating should be an ‘F’.

54. Page 92, International trade – **D**

The RAP indicates that the *“indirect impacts on international trade are unlikely to be discernible at the national level, and would be of minor significance at a*

regional level, significant at the district level and highly significant at the local level”.

The Australian Apple and Pear Industry would question the judgement made by the RAP particularly at a national and regional level.

Again if an outbreak were to occur at the regional level (state) that state would be closed from both the domestic market and a range of international markets. If the initial outbreak was in Tasmania the ramifications to that state would be far greater than “*minor significance*”.

The industry believes that the rating should be ‘E’

55. Page 93, Environment – A

The RAP indicates that “*any indirect impacts of fire blight on the environment are unlikely to be discernible*”.

The Australian Apple and Pear Industry believe that the RAP has failed to consider the importance of the current ‘landscape’ within the context of the ‘environment’. In many regions the apple and pear orchards are a community asset within the ‘landscape’ and under the new and emerging Natural Resource Management programmes are considered an essential and integral part of the ‘environment’.

The industry believes that because of this fact the rating should be far greater than ‘A’.

56. Page 94, Conclusions – consequence.

The RAP indicates that “*based on the decision rule described in the method section – that is, where the consequences of a pest with respect to a single criterion is ‘F’ and the consequences of a pest with respect to the remaining criteria are not unanimously ‘E’ – the overall consequences are considered to be ‘high’.*”

The Australian Apple and Pear Industry believe that those decision rules do not provide a basis for rational assessment of consequence and do not accurately contribute to an assessment of Australia’s ALOP. Detailed reasons are given in Part C.

Given the points raised in points 50 to 55 above and the adjustment of a number of ratings upwards, the Australian Apple and Pear Industry believes that the rating of ‘**high**’ should in fact be ‘**extreme**’.

57. Page 94, Risk management for fire blight.

- a) The RAP has introduced the term “*standard commercial agronomic practice*” but offers real no explanation.

Is the “*standard commercial agronomic practice*” in New Zealand based on their Integrated Fruit Production programme?

- b) The RAP indicates that “*one of the features of standard commercial agronomic practice is that fruit be free from fire blight symptoms*”.

The Australian Apple and Pear Industry seek clarification on where “*standard commercial agronomic practice*” documents that “*fruit be free from fire blight symptoms*”.

In addition Industry would seek clarification on how the “*standard commercial agronomic practice*” determines that fruit is from fire blight symptoms.

58. Page 96, Areas free from disease symptoms.

- a) The RAP indicates that “*an area free from disease symptoms could be a place of production (an orchard managed as a single unit) or a production site (a designated block within an orchard) for which freedom from the fire blight symptom is established, maintained and verified by MAFNZ*”.

The Australian Apple and Pear Industry believe that it is essential that any area designated for export must be TOTALLY “*free from disease symptoms*”.

The 2005 DIRA does not adequately detail how MAFNZ is going to establish, maintain and verify an area free from “*the fire blight symptom*”. This makes it impossible for Industry to adequately review and comment on the ‘work plan’.

- b) The RAP indicates that “*the IRA team acknowledged that it would be extremely difficult to confirm absolute freedom from symptoms using visual inspection of orchards*”.

The Australian Apple and Pear Industry would agree with this statement and given the precautionary principle believe that apples from New Zealand or any other country with Fire Blight should not be allowed access to Australia.

- c) The RAP indicates that “*the IRA team concluded that a practical inspection regime should be specified as free from visual symptoms as an inspection intensity that would, at 95% confidence level, detect visual symptoms if shown by 1% of the trees*”.

The Australian Apple and Pear Industry have commented on this concept in more detail within Part 2 of this submission.

- d) The RAP indicates that *“the inspection should take place between 4 to 7 weeks after flowering when conditions for fire blight disease development are likely to be optimal”*.

The Australian Apple and Pear Industry believe that

- (i) one inspection is insufficient to adequately declare a *“place of production”* is *“free from disease symptoms”*, and
- (ii) there is inadequate science to indicate that the period *“between 4 to 7 weeks after flowering”* is the optimum time for inspection.

- e) The RAP indicates that *“Roberts et al. (1998) reported that the average number of apples carrying fire blight bacteria was 10 times greater among apples from orchards with fire blight symptoms than from orchards in general”*.

The Australian Apple and Pear Industry believe that this is a highly significant fact and agrees that any orchard showing any fire blight symptoms must be eliminated from any proposed export programme of apples to Australia.

59. Page 98, Disinfection treatment.

- a) The RAP indicates that *“even in these conditions, if chlorine concentrations and pH levels are maintained correctly, at least a 10 to 100 fold reduction in the bacterial numbers in solution can be expected”*.

The Australian Apple and Pear Industry believe that there is insufficient scientific evidence to substantiate this statement.

In addition the Industry sees nothing within the 2005 DIRA as to how the New Zealand industry will maintain the chlorine concentrations and pH levels correctly. Such information needs to be presented to Industry before there is any agreement to allow any proposed trade of apples between New Zealand and Australia.

- b) The RAP indicates that *“the system of application would need to ensure that fruit is fully exposed to this active concentration for the full period and prevent subsequent contamination after treatment”*.

The Australian Apple and Pear Industry believe that there is insufficient detail within the 2005 DIRA that indicates how the fruit will be *“fully exposed to this active concentration for the full period and prevent subsequent contamination after treatment”*. Such information needs to be presented to Industry before there is any agreement to allow any proposed trade of apples between New Zealand and Australia.

- c) The RAP indicates that *“if all packing houses were to use minimum of 100 ppm chlorine treatment, then the risk of E. amylovora being present in or on apples for export would be reduced”*.

The Australian Apple and Pear Industry believe that there is insufficient scientific research and/or technical data to substantiate this statement.

- d) The RAP indicates that *“based on a consideration of all the evidence, the IRA team concluded that chlorine applied at 100 ppm for one minute would lead to the following reduction compared to the unrestricted values:*
- *reduction of surface contamination present at Imp4 by a factor of 0.66*
 - *reduction in calyx infestation present at Imp4 by a factor of 0.15*
 - *reduction of contamination at Imp5 by a factor of 0.95”*.

The Australian Apple and Pear Industry believe that there is insufficient scientific research and/or technical data to substantiate this assessment and statement.

60. Page 99, Storage.

The RAP indicates that *“the IRA team has decided to take a conservative view of the effect of storage and has used a two-fold reduction factor for infested apples of a result of six weeks storage”*.

The Australian Apple and Pear Industry believe that there is insufficient scientific research and/or technical data to substantiate this assessment and statement.

Based on the lack of scientific research and/or technical data the RAP has made a flawed decision in using a *“two-fold reduction factor”*.

61. Page 103, Other potential risk management measures.

The RAP indicates that *“that the IRA team considered other possible risk management measures including irradiation, fumigation and treatment with different bacterial agents, vacuum infiltration of disinfectants and the use of pest free places of production”*.

The Australian Apple and Pear Industry believe that the RAP should have included the information relating to *“irradiation, fumigation and treatment with different bacterial agents, vacuum infiltration of disinfectants and the use of pest free places of production”* within the 2005 DIRA for review and consideration by the stakeholders.

As fumigation is used for other pests and diseases it may be a relevant treatment for

E. amylovora in and on mature apples. Similarly, the value of irradiation has not been able to be assessed by stakeholders.

EUROPEAN CANKER:

1. Page 105 and 106, Biology.

a) The RAP lists a large range of common host plants for European canker.

The Australian Apple and Pear Industry would believe that the 2005 DIRA does not adequately cover the impact of this disease on other industries/sectors including:-

- cherries
- nuts (walnut)
- nursery
- home gardens
- parks and gardens.

b) The RAP indicates that “*Rose (Rosa spp.) is cited as a host (CABI, 2005), however, there is a lack of information in the literature on this host and there may be confusion with black berry (Prunus serotina), a member of the Rosaceae family. If ornamental rose is a host, it is only infected rarely and is not considered a primary host*”.

The Australian Apple and Pear Industry believe that this aspect of whether the rose is a host requires much further investigation by the RAP. If in fact ornamental rose is a host then the potential economic consequence to the commercial nursery industry and the millions of roses in parks, gardens and household gardens would be catastrophic.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on whether or not the ornamental rose is a host of European canker before making any final decision of the importation of apples from New Zealand or any other country that has Fire Blight.

c) The RAP indicates that the science details where European Canker is known to infect apples and pears including:-

- *fruit is also infected and develops rots,*
- *infection of fruit occurs at the blossom end, through either the open calyx, lenticels, scab lesions or wounds caused by insects,*
- *sometimes the rot can develop on the stem-end,*
- *on the fruit's surface when the skin is damaged,*
- *the rot has been observed to spread to the seed cavity of fruit,*
- *the fungus has been isolated from the mycelium surrounding the seeds,*
- *in dessert varieties, infection of the fruit generally leads to the development of rot before harvest,*

- *infection can sometimes remain latent and develop only during storage, and*
- *no variety is immune”.*

The Australian Apple and Pear Industry believe that this is highly significant scientific data that enhances the industry’s position that European Canker is as an important disease to the industry as Fire Blight. The economic consequence for the commercial apple and pear industry would be ‘extreme’ if European Canker was to enter and establish in Australia.

- d) The RAP indicates that *“damage to host species used for timber, through reduction in the quality and quantity of marketable logs, particularly in North America has been reported (CABI, 2005) although there is no estimate of the magnitude of this loss”.*

The Australian Apple and Pear Industry believe that the RAP has a responsibility in considering economic consequence to calculate the *“magnitude of this loss”* and reported that within the 2005 DIRA.

- e) The RAP indicates that *“sanitation (that is, removal and burning of cankered limbs or trees and spraying with fungicides) is the only feasible control measure”.*

The Australian Apple and Pear Industry believe that this is a highly significant statement and that such action should be an integral part of any risk management/mitigation protocols established.

2. Page 106, Risk scenario.

- a) The RAP indicates that *“in dessert apple varieties, any infection of fruit generally develops in the orchard. Because New Zealand mostly exports dessert varieties, the risk of latent infection is reduced”.*

The Australian Apple and Pear Industry believe that there is insufficient scientific research and/or technical data to substantiate this assessment and statement.

- b) The RAP indicates that *“small twigs in trash are of concern because the disease occurs on branches, but the likelihood of this happening in export quality apples would be remote”.*

The Australian Apple and Pear Industry believe that there is insufficient scientific research and/or technical data to substantiate this assessment and statement particularly in relation to the statement that *“the likelihood of this happening in export quality apples would be remote”.*

In addition the Industry would ask whether the RAP has considered what role the stem of the apple may play in the possible spread of European canker and believe that the RAP must commission further studies on whether the apple stem can carry European canker before making any final decision of the importation of apples from New Zealand or any other country that has European canker.

3. Page 107, Pathogen/disease distribution.

- a) The RAP indicates that *“MAFNZ (2004) indicates the establishment and spread of the disease in these areas occurred largely because of extraordinary wet springs and autumns during 1998, 2000 and 2001”*.

The Australian Apple and Pear Industry believe that this is a highly significant statement and as a result recommend that inspection of orchards after high rainfall occurrences, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European canker.

- b) The RAP indicates that *“in spite of these measures, the disease is thought to have arrived in Nelson on trees imported from Waikato (Murdoch, 2002). Therefore, there is a continual threat of new pathogen inoculum being introduced into disease-free districts and remaining latent for up to 3 to 4 years”*.

The Australian Apple and Pear Industry believe that this is a highly significant statement in that it highlights the fact that European canker could be in many of the growing regions with in New Zealand and still be latent. This would make it impossible to detect in orchards where the latent infection has not expressed itself into a canker.

Part of “standard commercial agronomic practices” should be the supply of nursery trees that are free of disease. As a result the Industry recommends that MAFNZ ensure testing of nursery trees is undertaken and audited as part of the risk management/mitigation protocol for European canker.

4. Page 108, Environmental conditions.

- a) The RAP indicates that *“McCracken et al. (2003b) state that sporulation, dispersal and infection of N. galligena are strongly encouraged by mild, wet conditions”*.

The Australian Apple and Pear Industry believe that this is a highly significant statement and as a result recommend that inspection of orchards after “mild, wet conditions occur”, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European canker.

- b) The RAP indicates that *“two out of the three trial orchards developed high levels of canker and were planted close to old orchards known to have high incidence of canker”*.

The Australian Apple and Pear Industry believe that this is an important issue and as a result the aspect of the outbreak of the disease in close proximity to export blocks and/or orchards must be considered within the risk assessment.

The Industry believes it also highlights the need for host plants to be removed from areas in close proximity to the export blocks/orchards and recommends that this be part of the risk management/mitigation protocol for European canker.

5. Page 108, Summary.

The RAP indicates that *“this range takes into account the variations in climatic conditions across New Zealand, and the information indicating that about 95% of the apple export production in New Zealand comes from orchards in areas where the disease has either never been recorded or the disease occurs only sporadically in very wet seasons”*.

The Australian Apple and Pear Industry believe that this is an underestimation particularly based on the data presented.

For instance the average annual rainfall, for areas within New Zealand, is as follows:-

- Waikato 1190 mm
- Auckland 1240 mm
- Nelson 970 mm
- Gisborne 1051 mm
- Hawke’s Bay 803 mm

On page 107 of the 2005 DIRA, the RAP indicates the following percentage of apple export trade from each of the production regions in New Zealand:-

- Waikato and Auckland 3%
- Gisborne and Nelson 40%
- Hawke’s Bay, Otago and Marlborough 55%.

Using the precautionary principle and the basis that the distribution of European Canker correlates with the 1000 mm estimation , then at least 43% of the export trade in apples would come from those regions with 1000 mm and also known to have European Canker.

The Australian Apple and Pear Industry recommends that the summary statement above be amended to be at best 55%.

6. Page 109 and 110, Orchard Management.

- a) The RAP indicates that *“fruit rot caused by N. galligena has been reported in New Zealand (Brook and Bailey, 1965; Braithwaite, 1996), but limited data is available on the incidence of fruit infection in New Zealand”*.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on the incidence of European canker within New Zealand before making any final decision of the importation of apples from New Zealand or any other country that has European Canker.

- b) The RAP indicates that *“various disease management measures to control summer fruit rots in New Zealand orchards, including cultural practices (removal of diseased wood and rotting fruit from trees and orchard floors) and the use of fungicides from late November/early December until withholding periods”*.

The Australian Apple and Pear Industry believe that as these are *“standard commercial agronomic practices”* that these practices must be incorporated into any risk management/mitigation protocols. This is particularly so for the removal of *“rotting fruit from trees and orchard floors”*.

The Australian Apple and Pear Industry is unsure from the 2005 DIRA as to whether New Zealand exporters would be allowed to undertake the removal of diseased wood before the proposed winter inspection.

When will the latest time for the removal of diseased wood be allowed before the inspection?

- c) The RAP indicates that *“these diseases are reported to be a problem only in high rainfall areas of Auckland and the Waikato as well as periodically in Nelson and Hawke’s Bay during wet years (anonymous, 2004a)”*.

The Australian Apple and Pear Industry believe that this statement highlights that Nelson and Hawke’s Bay are more regularly subject to an outbreak of European canker than has been previously reported.

- d) The RAP indicates that *“Braithwaite (1996), in a report to MAFNZ, acknowledged the possibility that European canker could go unnoticed at harvest or during the early part of storage, and therefore could be transmitted in fruit as latent infections”*.

The Australian Apple and Pear Industry believe that this is a highly significant statement and highlights the fact that

- (i) even with orchard inspection fruit will be infected,

- (ii) there is a need for another orchard inspection after flowering in spring or just before harvest,
- (iii) latent infection of fruit is an important part of the pathway process that requires risk management/mitigation processes other than orchard inspection.

7. Page 111, Fungi from cankers.

The RAP indicates that *“clean fruit could be surface-contaminated by*

- *Trash with actively sporulating fungus and spores making contact with fruit in bins”.*

The RAP then indicates further down that *“foliage is not affected and trash presents an extremely small likelihood of contamination unless twigs with active cankers are picked along with fruit (Butler, 1949)”.*

The Australian Apple and Pear Industry believe that this is conflicting statements particularly relating to the importance of trash as a carrier of European canker. Given the fact that *“clean fruit could be surface-contaminated by trash with actively sporulating fungus and spores making contact with fruit in bins”* then trash must be considered as an important part of the pathway for European canker.

8. Page 111 and 112, Transfer of fungi from hosts to clean fruit.

- a) The RAP indicates that *“because N. galligena has a large host range, contamination could come from canker infections on susceptible hosts planted near export orchards”.*

The Australian Apple and Pear Industry believe that this is a highly significant statement.

The Industry believes it also highlights the need for host plants to be removed from areas in close proximity to the export blocks/orchards and recommends that this be part of the risk management/mitigation protocol for European canker.

- b) The RAP indicates that *“climatic conditions typically experienced during harvest periods in most New Zealand orchards are not conducive to spore release and infection, but in wetter districts of Auckland and the Waikato region, conditions favour these processes”.*

The Australian Apple and Pear Industry believe that this statement is an over simplification, an underestimation of the risk and fails to consider

- (i) that other areas like Nelson and Gisborne have very similar climatic conditions, and
- (ii) that all growing regions in New Zealand can be subject to *“mild and wet conditions”* during the late spring and summer.

9. Page 112, Washing.
The RAP indicates that *“although there is no specific data to indicate their effectiveness against N. galligena, it is likely these chemicals used at the correct dosage rates (concentration and times) would have varying degrees of effectiveness”*.
- The Australian Apple and Pear Industry believe that this statement is highly speculative and is not supported by any scientific and/or technical data. As a result the precautionary principle must be utilised and that the use of disinfectants has no risk reduction with regards European canker.
10. Page 113 and 114, Importation step 5.
- a) The RAP indicates that *“given the extremely small likelihood of fruit being infested/infected with N. galligena, the probability of surface spores being present on fruit and contaminating the dump water is similarly extremely small”*.
- The Australian Apple and Pear Industry believe that this statement is highly speculative and is not supported by any scientific and/or technical data. As a result the precautionary principle must be utilised and that the possibility of *“surface spores being present on fruit and contaminating the dump water”* exists and the risk values detailed within the 2005 DIRA are too low.
- b) The RAP indicates that *“foliage is not affected and leaf trash presents an insignificant contamination pathway”*.
- The Australian Apple and Pear Industry believe that this statement is in conflict with Point 7 above and that the risk of infected trash has been underestimated.
11. Page 116, Orchard wholesalers.
The RAP indicates that *“one stakeholder suggested that citrus packing houses may also sometimes deal with apples. However, an industry source indicated that this was most unlikely, as the handling arrangements for citrus are quite different from those for apples”*.
- The Australian Apple and Pear Industry question the advice given in relation to this situation.
- Within South Australia there are a number of orchardists within the Riverland area that grow, pack and export both apples and citrus. The apple orchards are spread throughout citrus orchards. The packing of both apples and citrus is conducted in the same packing shed.

One particular packing facility packs citrus for the USA export market and is a major packer of Riverland apples during the season.

Again there would be nothing stopping this grower/packer importing apples from New Zealand, transporting them to the Riverland and packing them in their facility.

The Australian Apple and Pear Industry believe that the RAP has failed to accurately use the precautionary principle in relation this possible scenario.

12. Page 116, Consumers.

- a) The RAP indicates that *“the majority of the population (and therefore the majority of apple consumption) is in the capital cities significant distances from most commercial apple and pear orchards”*

The Australian Apple and Pear Industry believes that this is an over simplification of the real situation. For instance there are commercial apple and pear orchards within the Adelaide Hills are part of the peri-urban zone less than 20 kilometres from the Central Business District (CBD) of Adelaide. In fact the major part of the South Australian Apple and Pear Industry is with 35 kilometres of the CBD.

Given that this is at least one scenario in which the majority of the population of a capital city are in extremely close proximity to commercial apple and pear orchards, it is essential that this ‘worst case’ scenario is the basis from which decisions are made. This would satisfy the precautionary principle.

- b) The RAP indicates that *“the opportunities for hosts to be exposed to apples are significantly fewer for consumers living in flats or apartments compared to those living in houses with gardens. ABS figures indicate that about 30% of dwellings in major cities are flats, apartments or townhouses where there are unlikely to be any hosts of European canker”*.

The Australian Apple and Pear Industry would question this statement. While we would accept the ABS figures the reality is that the flats, apartments and townhouses are not all clustered together. Instead they are spread throughout the city and suburban areas in the same areas as homes. As a result flats, apartments and townhouses can be next to household gardens and local parks and gardens that have host plants of European canker.

The Industry believes that the RAP has underestimated the risk of host plants being close to consumers.

- c) The RAP indicates that *“an apple eaten and discarded by a consumer in a public park close to wild and amenity hosts cannot simultaneously be close to household and garden plants”*.

The Australian Apple and Pear industry believes that this situation highlights a fundamental flaw within the model being used.

The fact that an apple core can be discarded close to both *“wild and amenity hosts”* and *“household and garden plants”* and at the same time possibly *“commercial orchards”* must heighten the risk by increasing the population of host plants in the vicinity of the discarded apple. This would increase the possibility of the fungus spores finding a host plant.

13. Page 117, Commercial fruit crops near utility points.

The RAP indicates that *“urban wholesalers are predominantly located in metropolitan areas, with waste typically going to landfill. Both the utility point and the waste are located well away from commercial fruit crops”*.

The Australian Apple and Pear Industry believe that this is an oversimplification of the situation and as a result an underestimation of the risk relating to *“commercial fruit crops near utility points”*.

14. Page 119, wild and amenity plants near utility points.

The RAP indicates that *“orchard wholesale waste sites are mostly located within the orchard premises and are not located near wild and amenity plants”*.

The Australian Apple and Pear Industry believe that this statement lacks any true accuracy. Most often the waste disposal site(s) is very close to the packing facility and not in an *“isolated area”*. In fact the waste disposal site(s) could well be within an area of the orchard.

In addition such sites are not only located near *“wild and amenity plants”* they are located near abandoned orchards, feral plants and *“household and garden plants”*.

This lack of understanding of the practical aspects of *“orchard wholesalers”* again is considered by the Industry as an underestimation of the range of host plants close to waste sites and therefore an underestimation of the true risk.

15. Page 121, Survival and viability of the fungus in (or on) the fruit.

The RAP indicates that *“apple waste disposed of in landfills and compost may be subjected to high temperatures (60°C) which would kill the fungus”*.

The Australian Apple and Pear Industry believe this statement is not supported by any scientific research and/or technical data and as a result has little relevance to the assessment of risk from European canker.

16. Page 121 and 122, Transfer mechanism.

- a) The RAP indicates that *“no studies exist in the literature to demonstrate long-distance disease spread from fruit infections”*.

The Australian Apple and Pear Industry believe that the RAP must commission further studies on the *“long-distance disease spread from fruit infections”* of European canker before making any final decision of the importation of apples from New Zealand or any other country that has European Canker.

- b) The RAP indicates that the *“involvement of birds and insects as vectors is suspected, although transfer has not been demonstrated and N. galligena does not have any specific insect vectors or mechanisms to allow transmission from apples to a suitable host”*.

The Australian Apple and Pear Industry believe due to the lack of sound scientific information that the RAP must commission further studies on the *“involvement of birds and insects as vectors”* of European canker before making any final decision of the importation of apples from New Zealand or any other country that has European Canker.

- c) The RAP indicates that *“the possible role of woolly aphid as a vector has been mentioned (Brook and Bailey, 1965; Marsh, 1940; Munson, 1939) although infection through this route has not been demonstrated and its involvement is doubted by some (McKay, 1947)”*.

The Australian Apple and Pear Industry believe due to the conflicting nature of the scientific information that the RAP must commission further studies on the *“possible role of woolly aphid as a vector”* of European canker before making any final decision of the importation of apples from New Zealand or any other country that has European Canker.

- d) The RAP indicates that *“woolly aphid is a common apple pest in Australia; however, it is unlikely that aphids would colonise a discarded fruit and transfer N. galligena to a healthy tree”*.

The Australian Apple and Pear Industry while agreeing that woolly aphid is a common apple pest in Australia believe that the rest of the statement is highly speculative and is not supported by any scientific and/or technical data.

As a result the precautionary principle must be utilised and woolly aphid must be considered as a possible vector of European canker.

17. Page 122, Availability of entry points.

The RAP indicates that *“entry points for infection by N. galligena are available throughout most of the year (Swinburne, 1975) with wound sites caused by leaf*

fall in autumn and leaf cracks from onset of spring bud burst presenting natural infection sites (Wiltshire, 1921; Wilson, 1966)”,

AND

“infection can also be initiated in the absence of wounds through natural openings for example, the calyx end of fruit or via lenticels (Swinburne, 1975; Bondoux and Bulit, 1959)”.

The Australian Apple and Pear Industry believe that these are highly significant statements and highlight the need for more than one orchard inspection per year.

The Australian Apple and Pear Industry recommend that inspection of orchards after spring flowering and before harvest, over and above the inspection in autumn, be part of the risk management/mitigation protocol for European canker.

18. Page 122, Inoculum dose.

The RAP indicates that *“the number of conidia required to initiate an infection varies depending on environmental and host factors”*.

What does the RAP consider as the minimum number of conidia required to initiate an infection?

The Australian Apple and Pear Industry believe that given the scientific data presented by the RAP the minimum *“the number of conidia required to initiate an infection”* would be 10.

19. Page 124, Wild and amenity plants.

The RAP indicates that *“orchard wholesaler waste is disposed of onto isolated areas within the orchard itself or in landfills close to the orchard. These disposal sites are surrounded mostly by pome fruit grown as a monoculture and wild and amenity plants are less abundant”*

The Australian Apple and Pear Industry believe that this statement lacks any true accuracy. Most often the waste disposal site(s) is very close to the packing facility and are located near abandoned orchards, feral plants and *“wild and amenity plants”*.

This lack of understanding of the practical aspects of *“orchard wholesalers”* and the closeness of *“wild and amenity plants”* again is considered by the Industry as an underestimation of the range of host plants close to waste sites and therefore an underestimation of the true risk.

20. Page 126, The potential for adaptation of the pest.

The RAP indicates that *“currently there is no information on strains of the fungus exhibiting fungicide tolerance or the ability to overcome some resistance observed in certain apple cultivars”*.

The Australian Apple and Pear Industry believe that the issue of resistant strains of European Canker is inconclusive but given there is “*some resistance observed in certain apple cultivars*” the precautionary principle must be applied and accept that there is an existence of “*strains of the fungus exhibiting fungicide tolerance*”.

21. Page 127, Minimum population needed to establish.

The RAP has presented some data but presented no conclusions.

As a result the Australian Apple and Pear Industry believe that given the scientific data presented by the RAP the minimum “*the number of conidia required to initiate an infection*” would be 10.

22. Page 127, The method of pest survival.

The RAP indicates that “*apple fruit remaining on the tree or on the orchard floor could become mummified and produce perithecia and ascospores, although Swinburne (1064) reported that perithecia rarely develop on infected fruit left in a waste dump*”.

The Australian Apple and Pear Industry believe that the scientific information presented is incomplete. While the existence of perithecia may be rare the issue is that it does “*develop on infected fruit left in a waste dump*”. As a result the precautionary principle must be applied and the RAP accept that perithecia can “*develop on infected fruit left in a waste dump*”.

23. Page 127, Cultural practices and control measures.

The RAP indicates that “*integrated pest management programs used in Australia, including fungicide applications to control apple scab (except for Western Australia) and other fungal pests, will assist in reducing the opportunities for the establishment of the pest*”.

The Australian Apple and Pear Industry believe that while Integrated Pest Management assists with the control of apple scab there are season in which if the environmental conditions are right IPM has limited effect and apple scab can be a major orchard and apple disease. The recent 2005 growing season within South Australia highlighted that no matter what programme was in place if the environmental conditions were conducive to apple scab then it would occur. The Industry believes that Integrated Pest Management is a management tool and will not specifically reduce “*the opportunities for the establishment of the pest*”.

24. Page 128, Potential for movement with the commodities or conveyances

The RAP indicates that “*foliage is not affected (Butler, 1949) and leaf trash is unlikely to present a pathway unless twigs with active canker are present*”.

The Australian Apple and Pear Industry believe that this statement is in conflict with Point 7 above and that the risk of infected trash has been underestimated.

25. Pages 130, Household and garden plants.
The RAP indicates that *“the scattered distribution of host plants would restrict spread”*.

The Australian Apple and Pear Industry believe that this statement is an oversimplification and not supported by scientific and/or technical data. Within the Adelaide Hills (SA) there are significant host plants given the large number of gardens planted with European species of host plants. This region is a major residential region as well as the major commercial apple and pear region within South Australia. The mix of host plants, consumers and commercial orchards with a high rainfall make the region highly susceptible to the establishment of European canker.

26. Page 131, Assessment of consequences.
The RAP, in table 36 includes *“human life or health”* as a Direct Impact.

The Australian Apple and Pear Industry questions the relevance of this particular section of the matrix as there is no direct relationship between the disease and *“human life or health”*.

27. Page 133, Any other aspects of environmental effects - **D**
a) The RAP indicates that *“the Australian community places a high value on its forest and garden environments”*.

The Australian Apple and Pear Industry would support this statement. While giving support to the statement the Industry believes that the RAP has failed to consider the importance of the current ‘landscape’ within the context of the ‘environment’. In many regions the apple and pear orchards and well established European style gardens are community assets within the ‘landscape’ and under the new and emerging Natural Resource Management programmes are considered an essential and integral part of the ‘environment’.

- b) The RAP indicates that *“such hosts are sparsely distributed however, and any impact would be restricted to the district level”*

The Australian Apple and Pear Industry would question this statement and believe the RAP has oversimplified the risk.

Again the Adelaide Hills is a prime example where the host plants are both widely distributed and well established. This makes them highly vulnerable and the resulted damage would have a catastrophic effect on the landscape.

The Industry believes the risk has been underestimated and should be an **‘E’**.

28. Page 133, Control or eradication – **D**
 The RAP indicates that *‘the cost of control and eradication of an outbreak of European canker is unlikely to be discernible at a national level and would be of minor significance at the regional level, but would be significant at the district level and highly significant locally. A rating of ‘D’ was assigned to this criteria’*.
- The Australian Apple and Pear Industry believe that this is an underestimation of the costs of control and eradication. Given the information detailed above and the ‘worst case scenarios’ presented for areas like the Adelaide Hills the rating should be **‘E’**.
29. Page 134, Domestic trade or industry - **D**
 The RAP indicates that *“restrictions were placed on the movement of nursery stock from disease affected areas in Tasmania (Ransom, 1977). This could have a highly significant impact locally and significant consequence across a district, particularly for nurseries involved in propagation of planting stock”*.
- The Australian Apple and Pear Industry believe that if trade of nursery stock from Tasmania to mainland Australia, which would have been the case with host plant material, was also restricted then this would be a significant impact at regional level.
- If European canker was to occur in Tasmania or any other region (State) in Australia then trade restrictions would occur. As a result the Industry believes that the rating should be increased to **‘E’**.
30. Page 135, Environment – **C**.
 The RAP indicates that *“the indirect consequence on the environment are unlikely to be discernable at the regional level, of minor significance at the district level and significant at the local level. A rating of ‘C’ was assigned to this criterion”*.
- The Australian Apple and Pear Industry believe that the RAP has failed to consider the importance of the current ‘landscape’ within the context of the ‘environment’. In many regions the apple and pear orchards and well established European style gardens are community assets within the ‘landscape’ and under the new and emerging Natural Resource Management programmes are considered an essential and integral part of the ‘environment’.
- The Adelaide Hills is a prime example where the host plants are both widely distributed and well established within the ‘environment’. This makes them highly vulnerable and the resulted damage would have a catastrophic effect on the landscape at both a district and region level.
- The Industry believes the risk has been underestimated and should be an at least a **‘D’**.

31. Page 137, Pest free area.

- a) The RAP indicates that *“extensive detection and delineating surveys, including inspection of alternative host plants would be required to confirm pest free area. Similarly, the establishment and maintenance of pest free areas would need to be relevant to the biology of N. galligena including its means of spread. Infected nursery stock presents a pathway for establishment and spread of European canker in New Zealand. Recent detections in Nelson (Murdoch, 2002) and previous reports in Hawke’s Bay (Wilton, 2002b; MAFNZ, 2003a) are considered to have occurred as a result of this pathway”*.

The Australian Apple and Pear Industry recommend that any risk management/mitigation protocol for European canker must include

- (v) extensive detection and delineating surveys of export ‘blocks’,**
- (vi) the removal of host plants around export ‘blocks’, and**
- (vii) the control of nursery material into areas in which export ‘blocks’ are established, and**
- (viii) as part of “standard commercial agronomic practices” nursery trees should be the supplied ‘free of disease’. As a result, MAFNZ must ensure testing of nursery trees is undertaken and audited.**

- b) The RAP indicates that *“as there are no restrictions on the movement of planting stock within New Zealand, maintenance of pest free areas may not be a technically feasible option except with continuous inspection and verification of freedom”*.

The Australian Apple and Pear Industry believe that *“continuous inspection and verification”* must be a major component of the risk management/mitigation protocol for European Canker.

32. Page 138, Orchard Inspection.

- a) The RAP indicates that *“all trees in the export orchard would be visually inspected annually in winter, after leaf fall and before winter pruning”*.

The Australian Apple and Pear Industry believe that this aspect of the proposed protocol requires greater explanation.

For instance,

- (i) What is defined as winter? Is it the 1st June and any particular year?
- (ii) What happens if leaf fall in certain varieties occurs in autumn and the grower wants to prune in that period of time?
- (iii) What if a grower wants to do autumn pruning before leaf fall?
- (iv) How will the visual inspection be carried out? Will all trees be inspected?
- (v) Will inspection be from the ground or will the inspectors get up into the tops of large trees?

(vi) Will summer pruning be allowed?

- b) The RAP indicates that *“in areas where climatic conditions are less favourable for disease establishment and spread (for example, Hawke’s Bay and Otago), orchard freedom from European canker would be assessed by walking down every row and visually examining all trees on both sides of each row for symptoms”*.

The Australian Apple and Pear Industry would question whether this inspection process for “less favourable” production areas is any different to the inspection process in the other ‘more favourable areas’?

This is not clear within the document.

Will inspection be from the ground or will the inspectors get up into the tops of large trees?

Will summer pruning be allowed?

- c) The RAP indicates that *“all new planting stock must be intensively examined, and appropriate cultural practices and fungicide sprays used to minimise the likelihood of canker infections”*.

Part of “standard commercial agronomic practices” should be the supply of nursery trees that are free of disease. As a result the Australian Apple and Pear Industry recommends that MAFNZ ensure testing of nursery trees is undertaken and audited as part of the risk management/mitigation protocol for European canker.

APPLE LEAFCURLING MIDGE:

1. Page 142, Biology.

The RAP indicates that *“the authors clearly state that apple leafcurling midge infestations only cause leaf damage necessary for fire blight infections to occur and ‘there is currently no evidence to implicate the adult midge as a vector for dissemination of E. amylovora’ (Gouk and Boyd. 1999)”*.

The Australian Apple and Pear Industry believe that there is a lack of scientific evidence relating to the possibility of *“the adult midge as a vector for dissemination of E. amylovora”*.

Given the need to take the precautionary principle the Industry believes that the RAP must commission further studies on Apple leafcurling midge and its possibility to act as a vector for the dissemination of Fire Blight before making any final decision on the importation of apples from New Zealand.

2. Page 143, Summary.

The RAP indicates that *“this was based on the evidence that contamination rates for pupae or larvae of apple leafcurling midge range from 1-2% to 11.5% of apples in the Bay of Plenty and the Waikato region respectively, and taking into*

account that these rates are not indicative of apple leafcurling midge abundance which is affected by rainfall leading to higher levels in wet districts or lower levels in dry districts”.

The Australian Apple and Pear Industry believe that the RAP has failed to adequately cover the issues of environmental conditions relating to population levels. In the summary the RAP highlights that the figures used are “*not indicative of apple leafcurling midge abundance*” and that “*higher levels*” can occur in “*wet districts*” but offers no real scientific and/or technical data.

Given the need to take the precautionary principle the Industry believes that the RAP must commission further studies on Apple leafcurling midge and better define the

- a) occurrence of the pest in the regions within New Zealand,
- b) role high rainfall has on the population, and
- c) role spring and summer rainfall events might have on the population levels.

3. Page 143, Importation step 3.

- a) The RAP indicates that “*a leafroll contains 20 -30 larvae, but numbers of up to 500 have been observed (Tomkins, 1998)*”.

The Australian Apple and Pear Industry believe that based on this data it is possible to expect between 20 and 500 larvae in any single leafroll.

The reality is that it would only require one leafroll to enter Australia with a population of between 20 and 500 larvae to establish a population and to create an outbreak of the pest

- b) The RAP indicates that “*the number of leaves picked is relatively small; a typical figure of up to 200 leaves per bin has been estimated by informed industry sources*”.

The Australian Apple and Pear Industry would seek clarification as to whether this number of 200 leaves per bin has been checked by the RAP by visiting and physically checking bins of harvested fruit?

The Industry would believe that this is the role of the RAP to check such data particularly given that one previous stakeholder had indicated that this was an underestimation.

Based on the above figures any single bin might have between 4,000 and 10,000 larvae.

4. Page 146, Sorting and grading.

The RAP indicates that “*this stakeholder states that there is limited unpublished data available demonstrating that routine packing house procedures have a significant effect on the number of apple leafcurling midge cocoons attached to*

mature apple fruit. It is claimed that up to 20% of cocoons are washed off and a high percentage of the remainder are sufficiently damaged to render them non-viable”.

The Australian Apple and Pear Industry believe that because of the lack of scientific and/or technical data the claim that *“that up to 20% of cocoons are washed off and a high percentage of the remainder are sufficiently damaged to render them non-viable”* is a personal judgement that has no formal validity.

Also given that *“there is limited unpublished data available demonstrating that routine packing house procedures have a significant effect on the number of apple leafcurling midge cocoons attached to mature apple fruit”* the RAP must take the precautionary principle and accept that *“routine packing house procedures”* will not lower the risk for Apple leafcurling midge.

5. Page 146, Cold storage.

The RAP indicates that *“there is no evidence to suggest that cold storage would significantly reduce the viability of apple leafcurling midge pupae”*.

The Australian Apple and Pear Industry believe that given *“there is no evidence to suggest that cold storage would significantly reduce the viability of apple leafcurling midge pupae”* the RAP must take the precautionary principle and accept that *“cold storage”* will not lower the risk for Apple leafcurling midge.

6. Page 146, Summary.

The RAP indicates that *“based on the lack of evidence that packing house procedures and cold storage are detrimental to the survival of apple leafcurling midge and the USDA-APHIS interception data that indicates that some apple leafcurling midges have survived the packing house process, the IRA team decided to represent Imp4 as a triangular distribution with a minimum value of 0.5, a maximum value of 0.8, and a most likely value of 0.67”*.

The Australian Apple and Pear Industry questions the values given to this by the RAP. Given the lack of evidence on the value of both *“packing house procedures and cold storage”* and the fact that there has been interception of the pest the RAP must use the precautionary principle and utilise a far greater rating. Industry would believe that the only value acceptable would be **‘certain’** or a maximum value of **‘1’**.

7. Page 147, Importation step 6.

The RAP indicates that *“the IRA team considered that not all apple leafcurling midges would survive this step, since some natural mortality is expected to occur during the time it remains in cold storage during transportation”*.

The Australian Apple and Pear Industry believe that this a judgement made by the RAP that is not justified by either scientific or technical data and/or information.

Again using the precautionary principle the RAP must disregard any consideration that “cold storage during transportation” will reduce any numbers of apple leafcurling midge.

8. Page 151, Proximity.

The RAP indicates that “*it should be noted that the risk assessment is based on a national perspective, therefore the ranges shown in Table 41 reflect the ‘average’ ranges for all of Australia. However it is acknowledged that there are some districts (for example, apple growing areas) where a higher number of apple trees are in close proximity to a particular utility point*”.

The Australian Apple and Pear Industry believe that this is where the Risk Model and the RAP interpretation of the model fails in that it utilises and ‘average’ range for all of Australia and fails to utilise the ‘worst case’ scenario to base the work and assessment on.

Given that the RAP acknowledges “*that there are some districts (for example, apple growing areas) where a higher number of apple trees are in close proximity to a particular utility point*”, Industry would believe that using the precautionary principle the RAP must use the ‘worst case’ scenario within the model.

If for instance the Adelaide Hills or the Goulburn Valley were considered as the ‘worst case’ scenario and the Australian ‘average’ is used then the process is underestimating the risk in the ‘worst case’ areas.

9. Page 151, Commercial fruit crops near utility points.

The scenario of a “*citrus orchard wholesaler repacking New Zealand apples*” is a real possibility and examples within the Riverland of South Australia have been covered within the specific areas within the Fire Blight and European canker sections above.

The Australian Apple and Pear Industry believe that the RAP cannot disregard this as a possible option.

10. Page 152, Nursery plants near utility points.

a) The RAP indicates that “*up to 5% of consumers may come in proximity to nursery plants susceptible to apple leafcurling midge*”.

The Australian Apple and Pear Industry would question the figure of “5%”. The figure is utilised throughout the document but is not justified with any scientific and/or technical data and/or information.

b) The RAP indicates that “*this is likely to be only for brief periods but is more likely to occur when apples have actively growing leaves*”.

The Australian Apple and Pear would question the validity of the statement and believes that the personal judgement is not supported by any scientific and/or technical data and/or information and therefore has no value to the DIRA.

11. Page 152, Household and garden plants near utility points.
The RAP indicates that *“a small proportion of metropolitan and suburban consumers may have apple trees as household and garden plants”*.

This statement is utilised throughout the 2005 DIRA and the Australian Apple and Pear would question the validity of the statement (in all sections of the document) and believes that the personal judgement is not supported by any scientific and/or technical data and/or information and therefore has no value to the DIRA.

13. Page 152, Wild and amenity plants near utility points.
The RAP indicates that *“well managed orchard wholesalers in most cases will not allow feral plants and volunteer apple seedlings to grow in close proximity to these premises”*.

This statement is utilised throughout the 2005 DIRA and the Australian Apple and Pear would question the validity of the statement (in all sections of the document) and believes that the personal judgement is not supported by any scientific and/or technical data and/or information and therefore has no value to the DIRA.

In fact the work presented by Creeper et al, 2005 highlights that the statement is not factual but instead the survey work highlights that there are *“feral plants and volunteer apple seedlings”* growing *“in close proximity to”* orchard wholesalers. Also it is obvious from the survey that the orchardist has very little control in the management of such plants.

14. Pages 153 and 154, Transfer of hosts.
a) The RAP indicates that recent research *“has shown that significant numbers of (male) midges were caught at all distances up to 50m and greater distances were not investigated”* and *“no experiments on the distances females can fly have been attempted (Cross, 2005)”*.

The Australian Apple and Pear Industry believe that there is a lack of scientific evidence relating to the possible *“flight activity”* of Apple leafcurling midge.

Given the need to take the precautionary principle the Industry believes that the RAP must commission further studies on Apple leafcurling midge and its *“flight activity”* before making any final decision on the importation of apples from New Zealand.

- b) The RAP indicates that *“most apple imports will arrive over a six-month period from March to August”*.

The Australian Apple and Pear Industry again question the accuracy of this statement and validity of this statement.

- c) The RAP indicates that *“the number of orchard wholesalers that might process imported fruit is seven”*.

This statement is utilised throughout the 2005 DIRA and the Australian Apple and Pear would question the validity of the statement (in all sections of the document) and believes that sufficient information available from regions like the Adelaide Hills has been presented to show this is an oversimplification and therefore an underestimation of the risk.

15. Page 157, Availability of suitable hosts, alternate hosts and vectors in the PRA area.

The RAP indicates that *“the surge of new leaf growth in early summer is particularly suitable for rapid population increase in the second and third generations, while the cessation of leaf growth in mid- to late-summer often helps to reduce the late season populations”*.

The Australian Apple and Pear Industry believe that there are stages of new leaf growth throughout the growing season due to irrigation of the trees as well as environmental conditions like summer rain. As a result there is no guarantee that there will be reductions in *“late season populations”*.

In addition the Industry would question what scientific and/or technical data and/or information has been used by the RAP to make the assumption that *“the cessation of leaf growth in mid- to late-summer often helps to reduce the late season populations”*.

16. Page 158, The reproductive strategy of the pest.

The RAP indicates that *“apple leafcurling midge has up to seven generations over summer under wet summer conditions typical of the Waikato region (MAFNZ, 2004). In the primary fruit producing districts of Hawke’s Bay and Nelson respectively there are 3 – 4 and 4 – 5 generations of apple leafcurling midge depending on summer rainfall (MAFNZ, 2004)”*.

The Australian Apple and Pear Industry would ask whether the RAP has considered the situation with regards wet summer conditions in Hawke’s Bay and Nelson and the possibility that such weather conditions would see the generations increase up to seven as in the Waikato region.

The Industry believes that the environmental conditions, with particular emphasis on wet summer conditions, and this effect on the populations of apple leafcurling midge has not been considered in much detail within the 2005 DIRA. Any possible increased populations due to changing environmental conditions must be considered as an increase in the risk and therefore any risk mitigation/management protocols must take this into consideration.

17. Page 158, Minimum population needed for establishment.
The RAP indicates that “*the mated female lays several eggs on each leaf, with each female laying up to 200 eggs over about three days (CABI, 2002). A population can be started from a small group of viable eggs*”.

The Australian Apple and Pear Industry believe that is a highly significant statement and highlights the low population level required to start a population.

As a result Industry believes that a zero population of eggs as well as adult, larva and pupa stages of the life cycle is required on any imported fruit. The only way to achieve this would be through mandatory fumigation of all imported apples from New Zealand.

18. Page 158, Cultural practices and control measures.
a) The RAP indicates that “*apple leafcurling midge is partially controlled in New Zealand by a parasitic wasp, **Platygaster demades** (Walker), an introduced biological control agent (Todd, 1959; Tomkins et al., 2000)*”.

The Australian Apple and Pear Industry is concerned that there is no scientific and/or technical data and/or information on the success or not of the parasitic wasp in controlling apple leafcurling midge within New Zealand.

Such information is necessary to give any consideration and acceptance of biological control as an effective part of “*standard commercial agronomic practices*” within New Zealand orchards.

- b) The RAP indicates that “*this parasitoid is not present in Australia (Evenhuis, 1989)*”.

The Australian Apple and Pear Industry believe that the introduction of any biological control would take a significant period of time and there is no guarantee that the introduction would occur. In addition the introduction would not commence until after an outbreak of apple leafcurling midge occurred within Australia.

As a result the availability of a biological control in New Zealand has very little or no benefit to the Australian Apple and Pear Industry.

19. Page 158, Presence of natural barriers.
The RAP indicates that “*it would be difficult for the adults to disperse from one area to another unaided*”.

The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.

20. Page 159, Potential for the movement with commodities or conveyances.
- a) The RAP indicates that *“existing interstate quarantine control on the movement of nursery stock would reduce the scope for spread of apple leafcurling midge”*.
- The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.
- In fact there is a range of evidence that highlights that interstate quarantine has failed to stop the spread of a range of introduced pests and diseases eg., Western Flower Thrip.
- b) The RAP indicates that *“it should be noted that no experiments on the distance females can fly have been attempted”*.
- The Australian Apple and Pear Industry believe that there is a lack of scientific evidence relating to the possible *“flight activity”* of Apple leafcurling midge.
- Given the need to take the precautionary principle the Industry believes that the RAP must commission further studies on Apple leafcurling midge and its *“flight activity”* before making any final decision on the importation of apples from New Zealand.
21. Page 159, Potential natural enemies.
- The RAP indicates that *“other natural enemies in the PRA area, especially generalist predators, may be able to attack apple leafcurling midge but there is no evidence that these would be effective”*.
- The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.
22. Pages 160,161 and 162, Partial probability of entry, establishment and spread.
- a) The RAP indicates that *“these estimates are based on expert opinion taking into account the sequence of events”*.
- The Australian Apple and Pear Industry expresses concern that the information presented is an estimation *“based on expert opinion”*. Given the many general issues raised above and the specific issues raised in Part 2 the Australian Apple and Pear Industry believe that the *“estimates”* are understated and therefore the overall risk is underestimated.
- b) The RAP indicates that *“the period of availability of actively growing apple shoots is mainly limited to spring and early summer. Actively grown apple shoots are not available in Australia during the New Zealand export season of late summer to winter”*.

The Australian Apple and Pear Industry believe that there are stages of new leaf growth throughout the growing and harvesting season due to irrigation of the trees as well as environmental conditions like summer and autumn rain. As a result there is *“actively grown apple shoots”* in Australian orchards *“during the New Zealand export season of late summer to winter”*.

In addition the Industry would question what scientific and/or technical data and/or information has been used by the RAP to make the assumption that

“actively grown apple shoots are not available in Australia during the New Zealand export season of late summer to winter”.

- c) The RAP indicates that *“the fact that apple leafcurling midge has multiple generations would imply that the midge may also be able to lay its eggs on leaves other than actively growing apple leaf shoots”*.

The Australian Apple and Pear Industry believe that this is a highly significant point that requires further investigation.

While there appears to be limited scientific and/or technical data and/or information to strongly support the statement there is enough to indicate the need for the RAP to commission additional scientific work to clarify if *“the midge may also be able to lay its eggs on leaves other than actively growing apple leaf shoots”*.

- d) The RAP indicates that *“this parasitoid is not present in Australia (Evenhuis, 1989)”*.

The Industry would refer the RAP to point 18 a) and b) above.

23. Page 162, Probability of entry, establishment and spread – urban wholesalers. The RAP indicates that *“Table 42 and Table 43 show the indicative number of infested apples sent to urban wholesalers per week was significantly large. However, the tables also show that apple trees would not be available around urban wholesalers as commercial fruit crops, household and garden plants, nursery plants or wild and amenity plants in sufficient numbers for the entry, establishment and spread event to occur”*

The Australian Apple and Pear Industry believe this statement is a judgement that is lacking supportive technical information and/or data. The statement is a generalisation that highlights that the RAP does not have a good understanding of where *“urban wholesalers”* are located within capital cities and/or region cities. Within Adelaide for instance, urban wholesalers are in suburban areas of the city close to sufficient numbers of *“household and garden plants, nursery plants or wild and amenity plants”*.

24. Page 163, Probability of entry, establishment and spread – Retailers.
The RAP indicates that *“most retailers are located in urban areas. Apple trees are generally not available as commercial fruit crops around retailers (although some retailers, for example, the ones in the Goulburn Valley or Batlow could be near commercial fruit crops), and as nursery plants (although apple seedlings can be sold in some major retail outlets during the spring period), and may not be available as household and garden plants or wild and amenity plants”*.

The Australian Apple and Pear Industry believe this statement is a judgement that is lacking supportive technical information and/or data. The statement is a generalisation that highlights that the RAP does not have a good understanding of where *“retailers”* are located within capital cities and/or region cities. Within Adelaide for instance, retailers are in suburban areas of the city close to sufficient numbers of *“household and garden plants, nursery plants or wild and amenity plants”*.

In addition the Industry knows that retail nurseries can and do hold apple and pear trees in containers and other host plants throughout the year and not just in the spring period.

25. Page 163, Probability of entry, establishment and spread – Food services.
The RAP indicates that *“most food services are in urban areas. Apple trees are generally not available around food services as commercial fruit crops, nursery plants, household and garden plants or wild and amenity plants”*.

The Australian Apple and Pear Industry would question this statement because the RAP has made some sweeping generalisations that do not consider the ‘worst case’ scenario in any particular area within Australia.

Food services are spread around many parts of the cities and suburbs of all major capital cities and regional towns. The peri-urban spread occurring throughout Australia means that there is greater mix of commercial food services, nurseries and commercial orchards with the general private house, rural living blocks and hobby farms.

Within the Adelaide and the Adelaide Hills there would be food services close to *“commercial fruit crops, nursery plants, household and garden plants or wild and amenity plants”*.

26. Page 165 and 166, Assessment of consequence.
The RAP, in Table 48 and in the text on page 166, includes a section on *“Human life or health”*.

The Australian Apple and Pear Industry would again indicate that they believe this direct impact is irrelevant and should be removed from the Risk matrix and process.

27. Page 166, Any other aspects of environmental effects - **A**
 The RAP indicates that *“there are no known direct impacts of apple leafcurling midge on any other aspects of the environment, and the rating assigned to this criterion was therefore ‘A’”*.
- The Australian Apple and Pear Industry believe that the RAP has again failed to recognise commercial orchards as integral parts of the current ‘landscape’ and therefore an integral part of the current ‘environment’. Any damage or destruction of commercial orchards as part of an eradication programme will create damage to the ‘landscape’ and therefore the ‘environment’.
28. Page 167, Environment - **B**
 The RAP indicates that *“the indirect consequence on the environment would not be discernible at a national level and would be of minor significance at the local level, and a rating of ‘B’ was assigned to this criterion”*.
- The Australian Apple and Pear Industry believes that the RAP has again failed to recognise commercial orchards as integral parts of the current ‘landscape’ and therefore an integral part of the current ‘environment’. Any affect to the ‘landscape’ at a local level will have a major significance to the ‘environment’.
- In addition the Industry is concerned that in the *“Direct Impact”*, *“any other aspects of the environment”* has an impact score of ‘A’, yet in the *“Indirect Impact”*, *“environment”* has an impact score of ‘B’. This appears to be somewhat inconsistent.
29. Page 169, Inspection.
 The RAP indicates that *“fumigation was assumed to be 100% effective in killing the apple leafcurling midge”*.
- The Australian Apple and Pear Industry believe that the mandatory fumigation of all lots of imported apples is necessary to eliminate the risk of Apple leafcurling midge of entering Australia.
30. Page 173, Mandatory treatment.
 The RAP indicates that *“an alternative to the inspection/treatment approach may be the routine use of a mandatory treatment such as fumigation to all export lots. This may be a less trade restrictive approach if the prevalence of apple leafcurling midge is such that most or all lots are likely to fail at inspection”*.
- The Australian Apple and Pear Industry believe that “mandatory treatment such as fumigation to all export lots” should be the minimum risk mitigation protocol for the control of Apple leafcurling midge.**

GARDEN FEATHERFOOT:

1. Page 175, Biology.

The RAP indicates that *“very little has been published on the life history of this species”*.

The Australian Apple and Pear Industry believe this lack of scientific and/or technical information on the *“life history”* of this pest is of major concern and as a result believes that the RAP must collect additional information before allowing the importation of apples from New Zealand.

2. Page 178, Summary.

The RAP indicates that there is a *“lack of evidence that packing house procedures and cold storage are detrimental to the survival of garden featherfoot”*.

The Australian Apple and Pear Industry believe that *“packing house procedures and cold storage”* must be disregarded as methods of controlling Garden featherfoot and as a result the representation of Imp4 must be higher than detailed in the 2005 DIRA.

3. Page 179, Importation step 6.

The RAP indicates that *“it is likely that limited mortality will occur during this stage because of mechanical damage to the larvae and pupae, cold storage or controlled atmosphere storage”*.

The Australian Apple and Pear Industry would question the judgement that some *“mortality”* would occur given there is no scientific and/or technical information to support any *“mortality”* particularly from *“cold storage or controlled atmosphere storage”*.

4. Page 179, Summary.

- a) The RAP indicates that *“the fact that garden featherfoot larvae diapause over winter in New Zealand suggests they would be able to survive cold conditions during transportation and thus survive palletisation, quality inspection, containerisation and transportation to Australia”*.

The Australian Apple and Pear Industry believe that there is lack of scientific and/or technical information and/or data relating to the ability of Garden featherfoot to survive cold conditions and that the RAP must commission further studies on this aspect before making any final decision on the importation of apples from New Zealand.

- b) The RAP indicates that *“the IRA team decided to represent Imp6 as a uniform distribution, with a minimum value of 0.7 and a maximum value of 1”*.

The Australian Apple and Pear Industry believes that because of the lack of scientific information relating to the ability of Garden featherfoot to survive cold conditions that the RAP has underestimated the risk relating to Imp6.

5. Page 182, Nursery plants near utility points.
The RAP indicates that *“major food services such as restaurants and airline caterers are unlikely to be near nursery plants”*.

The Australian Apple and Pear Industry again questions the relevance of *“airline caterers”* to this particular section.

The Industry would indicate that there are many retail nurseries within Australia that also have restaurants or tea rooms as part of their businesses and as a result there is a direct linkage between *“food services such as restaurants”* and *“nursery plants”*.

6. Page 183, Wild and amenity Plants near utility points.
The RAP indicates that *“orchard wholesalers in most cases will not allow feral plants and volunteer apple or peach seedlings to grow near their sites”*.

The Australian Apple and Pear Industry again believe that this statement lacks accuracy. The point has been covered within earlier sections of this submission.

7. Page 184, Estimation of the number of infested fruit arriving at each utility point by exposure group combination.
a) The RAP indicates that *“the number of orchard wholesalers that might process imported fruit is seven”*.

The Australian Apple and Pear Industry believe that this is in incorrect assumption and that there could be far more *“orchard wholesalers”* than seven involved in the process of importing apples from New Zealand.

- b) The RAP indicates that *“the number of urban wholesalers that might process imported fruit is six”*.

The Australian Apple and Pear Industry believe that this is in incorrect assumption and that there could be far more *“urban wholesalers”* than six involved in the process of importing apples from New Zealand.

- c) The RAP indicates that *“the analysis assumed that imported apples will be evenly distributed among the six urban wholesalers”*.

The Australian Apple and Pear Industry believe that Import Risk Analysis must be based on sound scientific information and/or data and not on unsubstantiated assumptions.

The issue of the potential number of “*urban wholesalers*” has been discussed in other sections of this submission.

- d) The RAP indicates that “*this possibility and other scenarios were analysed but in the interests of simplicity only the data based on the assumption shown above are presented*”.

The Australian Apple and Pear Industry believe that the RAP has a responsibility to consider and report on **all** possibilities and/or scenarios for the consideration of any and all stakeholders.

Industry believes that the RAP has made a poor judgement “*in the interests of simplicity*” and must present all possibilities and scenarios.

8. Page 186, Reproductive strategy of the pest.
The RAP indicates that “*there is limited information on the biology of garden featherfoot*”.

The Australian Apple and Pear Industry believe this lack of scientific and/or technical information on the “*biology of garden featherfoot*” is of major concern and as a result believes that the RAP must implement the precautionary principle and collect additional information on the “*biology*” of this pest before allowing the importation of apples from New Zealand.

9. Page 186, Cultural practices.
The RAP indicates that “*integrated pest management (IPM) programs are utilised in the production of apples in Australia*”.

The Australian Apple and Pear Industry would question the relevance of this statement.

Given the fact that there is a lack of “*information on the biology of garden featherfoot*” where is the information that would indicate that Integrated Pest Management can control this pest? What biological control methods are available?

10. Page 187, Presence of natural barriers.
a) The RAP indicates that “*the main Australian commercial apple, kiwifruit and peach orchards are located in six states of Australia with natural barriers including the areas, climatic differentials and long distances existing between these areas*”.

The Australian Apple and Pear Industry believe that the spread of apple orchards throughout Australia are not as isolated from each other as suggested by the RAP. Earlier documentation indicates the spread of apple and pear orchards within Australia.

By also including kiwifruit and peach orchards into the spread the distances and “*natural barriers*” diminish even further.

- b) The RAP indicates that *“it would be difficult for adults to disperse from one area to another unaided”*.

The Australian Apple and Pear Industry believe that this is an assumption of the RAP that is not supported by any scientific and/or technical information and/or data.

11. Page 187, Potential natural enemies.

The RAP indicates that *“the relevance of potential natural enemies in Australia is not known”*.

The Australian Apple and Pear Industry believe that this lack of *“potential natural enemies in Australia”* within Australia means that any outbreak will be potentially more difficult to control.

The Industry believes that as there is lack of scientific and/or technical information and/or data relating to the *“potential natural enemies in Australia”* of Garden featherfoot the RAP must commission further studies on this aspect before making any final decision on the importation of apples from New Zealand.

12. Page 187 and 188, Partial probability of entry, establishment and spread.

- a) The RAP indicates that *“these estimates are based on expert opinion taking into account the sequence of events”*.

The Australian Apple and Pear Industry would seek clarification on who gave the expert opinion and what are their qualifications to give such opinion?

- b) The RAP indicates that *“it has been suggested that most apple imports would be late summer to winter (March to August). The assessments provided in the above table were mainly based on the assumption that most imported apples will arrive in Australia over a half year period as suggested above”*.

The Australian Apple and Pear Industry believe that this assumption by the RAP cannot be substantiated.

The Industry would believe that under the precautionary principle the RAP must consider that imports will occur for a far longer period from March to August. In fact the potential to export fruit will be as long as the New Zealand industry has fruit available within storage. This data could be gained from the New Zealand industry based on the period they have available fruit and the period in which they export to other countries.

- c) The RAP indicates that *“the recorded hosts of garden featherfoot include apple (*Malus x domestica*), kiwifruit (*Actinidia deliciosa*) and peach*

(Prunus persica) although it is considered to be probably polyphagous on fruits of a wide range of trees”.

The Australian Apple and Pear Industry seeks clarification as to whether Garden featherfoot is “*polyphagous on fruits of a wide range of trees*” or not. The statement appears to indicate a lack of scientific and/or technical information and/or data.

The Industry would seek clarification from the RAP as to the significance of the possible situation of Garden featherfoot as “*polyphagous on fruits of a wide range of trees*”. Does this mean that Garden featherfoot is potentially more devastating than currently considered by the RAP?

13. Page 188, Probability of entry, establishment and spread – Orchard wholesalers
The RAP indicates that “*the host plants of garden featherfoot such as apple and peach are available around orchard wholesalers as commercial fruit crops, may be available as household and garden plants and wild amenity plants, but may not be available as nursery plants*”.

The Australian Apple and Pear Industry believe that this statement, particularly related to host plants not being “*available as nursery plants*” is incorrect. There are many wholesale and retail nurseries that produce and/or sell apple and peach trees that are based near “*orchard wholesalers*”. In fact within the Adelaide Hills there is one company that is a major apple grower and a potential orchard wholesaler who could import and pack/repack New Zealand that also owns and operates an apple and peach wholesale production nursery within the same region. There are no doubt other such examples within Victoria, Western Australia and Tasmania.

14. Page 189, Probability of entry, establishment and spread – Urban wholesalers.
a) The RAP indicates that “*Table 58 shows that small numbers of garden featherfoot could be distributed to urban wholesalers on a weekly basis and therefore there is a small chance of at least a male and female emerging together and successfully mating, but this may not be sufficient to initiate a sustainable population*”.

The Australian Apple and Pear Industry believe that there is no scientific and/or technical information and/or data to substantiate the statement at “*least a male and female emerging together and successfully mating*” “*may not be sufficient to initiate a sustainable population*”.

The Industry believes that as there is lack of scientific and/or technical information and/or data relating to the ability of “*successfully mating*” garden featherfoot to “*initiate a sustainable population*” of the RAP must commission further studies on this aspect before making any final decision on the importation of apples from New Zealand.

- b) The RAP indicates that *“the table also shows that the host plants of garden featherfoot would not be available around urban wholesalers as commercial fruit crops, household and garden plants, nursery plants or wild and amenity plants”*.

The Australian Apple and Pear Industry believe that the RAP has made an error in this assessment.

As indicated previously there are many *“household and garden plants, nursery plants or wild and amenity plants”* near urban wholesalers.

15. Page 191, Human life and health – A.
The Australian Apple and Pear Industry would again question the relevance of this component of the Risk Matrix Model.

GREY-BROWN CUTWORM:

1. Page 193, Introduction.
The RAP indicates that *“it is a native of New Zealand and is found in apple orchards throughout New Zealand”*.

The Australian Apple and Pear Industry believe that this is a highly significant statement and highlights the potential this pest has to enter Australia on imported apples from New Zealand.

2. Page 193, Biology.
- a) The RAP indicates that *“egg batches are also sometimes laid on the fruit close to harvest (HortResearch, 1996b)”*.
The Australian Apple and Pear Industry believe that this is a highly significant statement and highlights the potential this pest has to enter Australia on imported apples from New Zealand.
- b) The RAP indicates that *“HortResearch (1996b) states that most of the young caterpillars of **G. mutans** descend from the trees to the ground cover of the orchard after a short time, where they feed on a variety of pasture plants”*.

The Australian Apple and Pear Industry would seek clarification from the RAP as to what the term *“most”* means in relation of numbers of young caterpillars descending and the numbers that don’t descend. This appears to be a significant aspect that is not clearly defined through scientific and/or technical information and/or data.

- c) The RAP indicates that *“G. mutans caterpillars, which were artificially prevented from their normal behaviour of descending to the orchard*

understorey, cause considerable damage to the surface of apple fruit (HortResearch, 1996b)”.

The Australian Apple and Pear Industry believe that this is a highly significant statement given that the caterpillars can “*cause considerable damage to the surface of apple fruit*”. This means that if the pest were to enter Australia and establish in commercial apple orchards it has the ability to cause “*considerable damage*”.

The Industry recognises that the research undertaken utilised artificial barriers to stop the caterpillars from descending. Notwithstanding this the Industry believes there is a need to investigation what natural events might result in the caterpillars not descending to the orchard understorey.

3. Page 193, Risk scenario.

- a) The RAP indicates that “*adult females of the grey-brown cutworm sometimes lay eggs under the calyces of apple fruit close to harvest, and larvae are known to damage the surface of apple fruit (HortResearch, 1996b)”.*

The Australian Apple and Pear Industry believe that this is a highly significant statement and highlights the potential this pest has to enter Australia on imported apples from New Zealand.

- b) The RAP indicates that “*the potential for viable grey-brown cutworm eggs, larvae or pupae to be associated with trash after harvesting, packing house processing and transport would be minimal. Eggs, if laid on apples and then dislodged onto trash, would probably be damaged, as would larvae*”.

The Australian Apple and Pear Industry believe that this statement relating to the association with “*trash*” and being damaged when “*dislodged onto trash*” is not supported with any scientific and/or technical information and/or data.

The Industry believes that the RAP must commission research in this area before allowing the importation of apples from New Zealand.

4. Page 194, Harvesting fruit for export.

The RAP indicates that “*fruit are picked into picking bags and then transferred into bins which are kept on the ground in the orchard before transportation to the packing house*”.

Given that the young caterpillars descend from the trees to the ground and given that the bins are sitting on the same ground within the orchard is it not possible that the caterpillars may shelter in or on the bins? The caterpillars may enter the bins and shelter within the harvested and then stored apples.

The Australian Apple and Pear Industry would question the RAP as to whether they have considered this scenario and the possible risk of the caterpillars infecting the fruit.

5. Page 195, Processing of fruit in the packing house.

- a) The RAP indicates that *“some eggs would be washed off but some eggs may survive the washing process if they are in the calyx”*.

The Australian Apple and Pear Industry believe this is a significant issue and highlights that the washing process should not be considered as an important process in risk mitigation for Grey-brown cutworm.

- b) The RAP indicates that *“there is no data available on the impact of cold storage on the viability of the eggs on apple fruit”*.

The Australian Apple and Pear Industry believe that given the lack of scientific data relating to the *“impact of cold storage on the viability of the eggs on apple fruit”*, cold storage must not be considered as an important process in risk reduction and/or mitigation for Grey-brown cutworm.

- c) The RAP indicates that *“post-harvest grading, washing and packing procedures are likely to remove the majority of this pest from the fruit”*.

Given the points above and given the lack of scientific and/or technical information and/or data the Australian Apple and Pear Industry would question the assumption made by the RAP. There is no evidence that shows that *“post-harvest grading, washing and packing procedures are likely to remove the majority of this pest from the fruit”*.

6. Page 195, Pre-export and transport to Australia.

- a) The RAP indicates that *“there is no data available on the impact of cold storage during transportation on the viability of grey-brown cutworm eggs on apple fruit”*.

The Australian Apple and Pear Industry believe that given the lack of scientific data relating to the *“impact of cold storage during transportation on the viability of grey-brown cutworm eggs”*, cold storage must not be considered as an important process in risk reduction and/or mitigation for Grey-brown cutworm.

- b) The RAP indicates that *“remaining eggs are not likely to hatch at transportation temperatures”*.

Given the lack of scientific and/or technical information and/or data the Australian Apple and Pear Industry would question the assumption made by the RAP.

7. Page 196, Distribution.
The RAP indicates that *“grey-brown cutworm has been intercepted on New Zealand produce, indicating that the larvae can survive cold storage during distribution”*.
- The Australian Apple and Pear Industry believe this is a highly significant statement in *“that the larvae can survive cold storage during distribution”*. More importantly it highlights that the risk mitigation process put in place in the orchard, during harvest, transportation, storage and packing have not controlled the larvae of the Grey-brown cutworm. The Australian Apple and Pear Industry would therefore recommend that if the trading of apples from New Zealand is allowed, there be mandatory fumigation of all imported apples from New Zealand as the only acceptable risk mitigation protocol.**
8. Page 197, Probability of entry.
The RAP indicates that *“likelihood that grey-brown cutworm enter Australia as a result of trade in apple fruit from New Zealand and be distributed in a viable state to the endangered area: **LOW**”*.
- The Australian Apple and Pear Industry would question this statement and the rating of **“LOW”** allocated by the RAP.
Given the information detailed in point 7 above it is already a given that Grey-brown cutworm are already in produce leaving New Zealand and we assume entering Australia and or other countries to which the produce is being exported. As a result the pest can potentially reach Australia in apples from New Zealand. Once the fruit leaves quarantine and enters the marketing chain in Australia it has effectively entered the *“endangered area”*.
The Australian Apple and Pear Industry believe that the rating of *“probability of entry”* must be at least **‘HIGH’**.
9. Page 197, Potential for adaptation.
The RAP indicates that *“the potential for adaptation of the pest is not known”*.
- The Australian Apple and Pear Industry believe that given the lack of scientific and/or technical information and/or data relating to the *“potential for adaptation of the pest”* the RAP must commission research in this area before allowing the importation of apples from New Zealand.
10. Page 198, Cultural practices and control measures
The RAP indicates that *“IPM programs are utilised for the control of other pests in the production of Australian apples, including apples grown in Western Australia. This may reduce the likelihood of establishment of grey-brown cutworm”*.

The Australian Apple and Pear Industry question the value of this statement and the reasoning behind the statement.

While the Industry agrees that they utilise IPM programs, such programs are for specific pests and diseases within the orchard eg., codling moth, mites, etc.

There is no evidence that indicates that what Industry is doing to manage these pests through the IPM programs will have any value and/or affect on Grey-brown cutworm.

It is well established that while industry has utilised IPM programs to assist in the control of certain pest and/or diseases there has been an increase in problems from secondary pests like weevils.

The Australian Apple and Pear Industry believe that the current industry IPM programs will have no bearing on reducing the *'potential of establishment'* of Grey-brown cutworm.

11. Page 198, Potential for movement with commodities or conveyances.

The RAP indicates that *"existing interstate quarantine control on the movement of nursery stock would reduce the rate of spread"*.

The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.

In fact there is a range of evidence that highlights that interstate quarantine has failed to stop the spread of a range of introduced pests and diseases eg., Western Flower Thrip.

12. Page 198, Potential use of the commodity.

The RAP indicates that *"consumption of fruit and limitations on nursery stock movement between states would limit spread"*.

The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.

In fact there is a range of evidence that highlights that interstate quarantine has failed to stop the spread of a range of introduced pests and diseases eg., Western Flower Thrip.

13. Page 199, Potential natural enemies.

The RAP indicates that *"the relevance of potential natural enemies in Australia is not known"*.

The Australian Apple and Pear Industry believe that this is a highly significant statement and as a result the RAP must implement the precautionary principle and

- a) commission additional research, and
- b) ensure mandatory fumigation of apple apples imported from New Zealand.

14. Page 199, Conclusion – potential of entry, establishment and spread.
The RAP concludes that *“the overall likelihood that grey-brown cutworm will enter Australia as a result of trade in apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in the area and subsequently spread within Australia: **Low**”*.

Given the issues raised by Industry in points 4 to 13 above the Australian Apple and Pear Industry believe that the rating is an underestimation and at least should be represented as **‘HIGH’**.

15. Page 199, Table 63 and Page 200, Human life or health – **A**
The RAP indicates that *“there are no known direct impacts of grey-brown cutworm on human life or health and the rating assigned to the criterion was therefore ‘A’”*.

The Australian Apple and Pear Industry would again question the relevance of this component of the Risk Matrix Model.

16. Page 200, Domestic trade or industry – **D**
The RAP indicates that *“the indirect consequences on domestic trade are unlikely to be discernible at a national level and would be of a minor significance at a regional level. A rating of ‘D’ was assigned to this criterion. The presence of grey-brown cutworm could result in trade restrictions in the sale or movement of infested commodities within that district and region and between states and different districts”*.

The Australian Apple and Pear industry believe that with Grey-brown cutworm as with any of the pests and diseases covered by the 2005 DIRA, once an outbreak occurs within a specific area then State Quarantine will be instigated. This means that industry will be affected at a State level. Industry understands that State is considered as ‘regional’ within the context of the 2005 DIRA. Given this, Industry would believe that the rating for ‘regional level’ would be greater than *“of minor significance”*. In fact it should be considered as *“highly significant”*. The Australian Apple and Pear Industry would believe that the rating should be greater than **‘D’**.

17. Page 201, Unrestricted risk.
The RAP indicates that *“as indicated in Table 64, the unrestricted annual risk for grey-brown cutworm is **‘very low’**, which meets Australia’s ALOP. Therefore, risk management would not be required for this pest”*.

The Australian Apple and Pear Industry believe that given the information detailed above the rating of **‘very low’** is an underestimation.

LEAFROLLERS:

1. Page 203, Introduction

The RAP indicates that *“these five species of tortricid moths were assessed together because they are classified in the same family and are predicted to have similar biology”*.

The Australian Apple and Pear Industry is concerned that the RAP has assessed the *“five species of tortricid moths”* together given that there appears to be some doubt that all five have the same biology.

The Industry believes that the RAP must utilise the precautionary principle and conduct a full assessment of the five species before proceeding any further.

2. Page 203, Biology

- a) The RAP indicates that *“brownheaded and greenheaded leafrollers lay eggs in flat oval rafts or batches of between 2 and 216, usually on the upper surface of host plant leaves”*.

The Australian Apple and Pear Industry believe this a significant fact and highlights the potential number of egg larvae that a moth might lay if they reach Australian.

- b) The RAP indicates that *“larvae of different leafroller species are very similar in appearance and it can be very difficult to distinguish between them”*.

The Australian Apple and Pear Industry believe this is significant and further highlights the need to treat the five species as separate and distinct species.

3. Page 204, Risk scenario.

- a) The RAP indicates that *“the risk scenario of concern for leafrollers in this draft IRA is the presence of larvae on or inside the apple fruit”*.

The Australian Apple and Pear Industry believe that this is a highly significant fact and highlights the fact that any one of the five species of Leafroller could enter Australia inside fruit.

While fumigation may control the Leafrollers on the apples there appears to be no mechanism that will control Leafrollers inside the fruit.

Any fruit that might enter Australia must be cut and inspected to ensure no larvae are entering with such fruit.

- b) The RAP indicates that *“the potential for viable leafroller eggs or larvae to be associated with trash after harvesting, packing house processes and transport would be minimal”*.

The Australian Apple and Pear Industry believe that this is a judgement that is not supported by scientific and/or technical information and/or data.

4. Page 205, Source orchards.

- a) The RAP highlights the spread of the five different Leafrollers. Effectively the majority of the Leafrollers are in the major apple growing regions and are major pest species of apples.

The Australian Apple and Pear Industry would believe that based on the information no growing region is free of Leafrollers.

- b) The RAP indicates that *“in the Auckland area there are four to six overlapping generations annually and every stage of the lifecycle is present throughout the year (Green, 1998)”*.

The Australian Apple and Pear Industry is not clear on whether this situation is the same for the other growing regions within New Zealand. Industry believes that the RAP needs to clarify this point.

- c) The RAP indicates that *“re-invasion of apple trees by the overwintering generation take place during October – December (HortResearch, 1999b)”*.

The Australian Apple and Pear Industry would seek clarification as to whether re-invasion only occurs in October to December or can it occur in other times of the year. Also, is this specific for one particular region eg., Auckland, or for all growing regions.

5. Page 205, Harvesting fruit for export.

- a) The RAP indicates that *“occasionally young larvae enter through the calyx and feed on the internal tissue of the apple. When this occurs, the apple fruit may show no sign of external damage (HortResearch, 1999b; Thomas, 1998)”*.

The Australian Apple and Pear Industry believe that this is a highly significant point and would highlight the visual inspection as part of any risk mitigation protocol will not show the presence of internal larvae unless there is a process of cutting and inspecting apples. The Industry believes that cutting and inspection of cut fruit must be an integral part of any risk mitigation protocol.

- b) The RAP indicates that *“internal damage to apple fruits caused by Greenheaded leafrollers is much less common than surface damage (HortResearch, 1999b)”*.

The Australian Apple and Pear Industry would indicate that while this may be the case the important issue is that internal damage of apple fruits does occur.

- c) The RAP indicates that *“larvae that have been dislodged from trees could contaminate harvest bins or containers used to transport apples to the packing house”*.

The Australian Apple and Pear Industry believe that given this packing house protocols must be implemented to minimise the contamination of harvest bins or containers and ultimately apples during the harvesting, transport and storage periods.

6. Page 206, Processing of fruit in the packing house.

- a) The RAP indicates that *“larvae feeding within the apple would not be removed by washing, although internal feeding is not common”*.

The Australian Apple and Pear Industry believe that the statement that *“internal feeding is not common”* is in conflict with earlier statements. Notwithstanding this, the statement highlights that visual inspection will not show the presence of larvae within the fruit.

- b) The RAP indicates that *“larvae of greenheaded leafrollers overwinter as late instars in the cold Canterbury region of the South Island of New Zealand (Thomas, 1998), suggesting that they are able to survive cold conditions”*.

The Australian Apple and Pear Industry believe that this is evidence to indicate that cold storage will have no affect on Greenheaded leafrollers that might be living within fruit and/or packaging.

7. Page 206, Pre-export and transport to Australia.

- a) The RAP indicates that *“larvae inside the apple fruit may initially be provided with some protection from the cold and they may be able to survive by feeding internally on the fruit”*.

The Australian Apple and Pear Industry believe that this further highlights that Greenheaded leafroller will not be affected by cold storage.

- b) The RAP indicates that *“Planotortrix excessana has been intercepted on fresh avocados exported from New Zealand to Australia (DAFF-PDI, 2002), indicating that larvae can survive cold storage during transportation”*.

AND

“Brownheaded leafroller larvae have been detected several times on imported fresh apricots, peaches, nectarines, cherries and avocados (DAFF-PDI, 2002), indicating that larvae can survive cold storage (DAFF-PDI, 2002)”.

The Australian Apple and Pear Industry believe that is a highly significant statement and highlights that the relevant risk mitigation protocols implemented in New Zealand for the importation of avocados, apricots, peaches, nectarines and cherries from New Zealand are not working. This offers no confidence to the Australian Apple and Pear Industry particularly if similar risk management protocols are being recommended for apples.

8. Page 207, On-arrival procedures.
The RAP indicates that *“the minimum on-arrival border procedures as described in the method section would not be effective in detecting the larvae”*.

The Australian Apple and Pear Industry would believe that given this statement the RAP has, using the precautionary principle, no option but to reject the importation of apples from New Zealand.

9. Page 207 and 208, Distribution.
a) The RAP indicates that *“leafrollers are able to move to a host plant in either the larvae or the adult stage”*.

AND

“Winged adult leafrollers can escape from many points in the apple supply and waste”.

The Australian Apple and Pear Industry believe that these are highly significant statements as they highlight the ability of the Leafrollers to move from one host to another. This makes it highly possible for the Leafroller on arrival in Australia to move around the endangered areas of Australia.

- b) The RAP indicates that *“larvae of greenheaded and brownheaded leafroller species are highly polyphagous and have a wide host plant range”*.

AND

“Many of the leafroller host plants are common and widely available throughout Australia”.

The Australian Apple and Pear Industry believe that these statements highlight the high probability that Leafrollers, on arrival in Australia will have both the mechanism and the host range to establish in Australia.

- c) The RAP indicates that *“consumption or discarding of the apple fruit and the search by the larvae for a suitable pupation site may increase mortality”*.
The Australian Apple and Pear Industry believe that this assumption by the RAP is not substantiated by any scientific and/or technical information and/or data.

10. Page 209, Availability of suitable hosts, alternate hosts and vectors in the PRA area.
The RAP indicates that *“caterpillars of greenheaded and brownheaded leafrollers have been recoded on more than 200 plant species in 71 families”*.

AND

“Many of these host plants are widely available in Australia.

The Australian Apple and Pear Industry believe that these statements highlight the high probability that Leafrollers, on arrival in Australia will have the host range to establish in Australia.

11. Page 209, Suitability of the environment.
The RAP indicates that *“brownheaded and greenheaded leafrollers are found throughout New Zealand and some offshore islands where climatic conditions are similar to those of Australia”*.

The Australian Apple and Pear Industry believe that these statements highlight the high probability that Leafrollers, on arrival in Australia will have the appropriate climatic conditions to establish in Australia.

12. Page 209, The potential for adaptation of the pest.
The RAP indicates that *“the genetic adaptability of brownheaded and greenheaded leafroller populations has not been studied, but high host range and the potential for several generations per season may indicate potential for genetic adaptation”*.

The Australian Apple and Pear Industry believe this is a highly significant issue and is concerned at the possibility of “*genetic adaptation*”.

The Industry believes that the RAP must commission research in the area of “*genetic adaptation*” for Brownheaded and Greenheaded leafrollers before any further consideration of the importation of apples from New Zealand.

13. Page 209 and 210, The reproductive strategy of the pest.

- a) The RAP indicates that “*leafrollers only reproduce sexually and produce from two to six overlapping generations a year depending on latitude and climate*”.

The Australian Apple and Pear Industry believe that there is a lack of information relating to the number of generations a year based on the latitude and climate of each of the New Zealand growing regions. This makes it difficult to consider whether there is a need to look at different risk management protocols for different growing regions. Using the precautionary principle industry would believe that RAP must use six generations per year across all growing regions to develop any risk mitigation and/or management protocols.

- b) The RAP indicates that “*fecundity is highly variable between individual females and in one study ranged from 52 -282 eggs/female for greenheaded leafroller and from 58 – 429 eggs/female for brownheaded leafroller when larvae were fed on apple foliage*”.

The Australian Apple and Pear Industry would believe that the minimum number of eggs likely to be laid by any one individual Leafroller female is 52 eggs.

- c) The RAP indicates that “*eggs infertility in New Zealand under natural conditions is rare at less than 1%, as is egg mortality, which averages only 2% (HortResearch, 1999b)*”

The Australian Apple and Pear Industry believe that these figures highlight the strong fertility Leafrollers have and further increase the possibility of populations establishing in Australia on the arrival of eggs and/or fertile female Leafrollers.

14. Page 210, Minimum population needed for establishment.

The RAP indicates that “*populations can start from a single mated female that is able to lay up to 216 eggs) HortResearch, 1999b)*”.

The Australian Apple and Pear Industry believe that this statement highlights the strong fertility Leafrollers have and further increases the possibility of populations establishing in Australia on the arrival of a single fertile female Leafroller.

15. Page 210, Cultural practices and control measures.
The RAP refers to Integrated Pest Management programmes and parasitoids as possible methods of *“adversely affecting the ability of leafrollers to establish”*.
- The Australian Apple and Pear Industry believe that neither of these cultural practices/control measures will be effective within Australia. In addition the RAP has not offered any scientific and/or technical information/data to support the assumptions.
16. Page 211, Presence of natural barriers.
- a) The RAP indicates that *“there is little information on the ability of these leafrollers to spread beyond natural barriers”*.
- The Australian Apple and Pear Industry believe that given the lack of scientific information the RAP must commission additional research before any further consideration of the importation of apples from New Zealand.
- b) The RAP indicates that *“the long distances existing between some of the main Australian commercial orchards may make it difficult for these leafrollers to disperse directly from one area to another unaided”*.
- The Australian Apple and Pear Industry believe that this statement is not supported by any scientific and/or technical information and/or data. In addition the linkages between Australian commercial orchards has been dealt with in detail in the sections on Fire Blight, European canker, Apple leafcurling midge and other pests within Part B of the Industry submission.
17. Page 211, Potential for movement with commodities or conveyances.
The RAP indicates that *“existing interstate quarantine control on the movement of nursery stock would reduce the scope for the spread”*.
- The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.
- In fact there is a range of evidence that highlights that interstate quarantine has failed to stop the spread of a range of introduced pests and diseases eg., Western Flower Thrip.
18. Page 211, Intended use of the commodity.
The RAP indicates that *“leafrollers have multiple hosts with multiple end uses. Limitations upon the movement of nursery stock and host fruit (if implemented) would slow the spread of leafrollers”*.

The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.

In fact there is a range of evidence that highlights that interstate quarantine has failed to stop the spread of a range of introduced pests and diseases eg., Western Flower Thrip.

19. Page 211, Potential vectors of the pest.
The RAP indicates that *“leafrollers do not require a vector for their spread because they are capable of independent flight”*.

The Australian Apple and Pear Industry believe that this statement highlights the strong capability of Leafrollers to spread and further increases the possibility of populations establishing in Australia on the arrival of a single fertile female Leafroller.

20. Page 211, Potential natural enemies.
The RAP indicates that *“some parasitoids present in Australia would be able to attack these leafrollers”*.

The Australian Apple and Pear Industry would question this statement given there is no scientific and/or technical data and/or information to substantiate the statement.

21. Page 211, Conclusion – probability of entry, establishment and spread.
The RAP indicates that *“the overall likelihood that leafrollers will enter Australia as a result of trade in apple fruit from New Zealand, be distributed in a viable state to suitable hosts, establish in that area and subsequent spread within Australia: **LOW**”*.

The Australian Apple and Pear Industry believe that given the information and issues raised in points 1 to 20 does not support the RAP estimation *“probability of entry, establishment and spread”* of **‘LOW’**.

In fact based on the information the Australian Apple and Pear Industry would place the rating at least **‘Moderate’** but more likely **‘High’**.

22. Page 212, Plant life or health – **D**.
a) The RAP indicates that *“Wearing et al. (1991) rated brownheaded and greenheaded leafrollers as primary economic pests in New Zealand where they damage leaves, buds and fruit of their hosts”*.

The Australian Apple and Pear Industry believe that this will be the case on the establishment of Leafrollers within Australia.

- b) The RAP indicates that *“buds of deciduous host plants are especially vulnerable to attack in the winter and early spring, when the interior of the buds may be eaten”*.

The Australian Apple and Pear Industry believe that this bud damage also highlights that Leafrollers will not only damage mature fruit but also have an affect on production levels by destroying the growing buds.

23. Page 213, Any other aspects of environmental effects – **A**.

The RAP indicates that *“there are no known direct impacts of the leafrollers on any other aspects of the environment and a rating of ‘A’ was assigned to this criterion”*.

The Australian Apple and Pear Industry believe that the natural environment and the ‘landscape’ of many regions will be affected through an outbreak of Leafrollers. This will be particularly so in those ‘landscapes’ with high quantities of host plants.

24. Page 213, Control or eradication – **E**.

The RAP indicates that there

- a) leafrollers are controlled in New Zealand through the use of insecticides and insect growth regulators,
- b) is a possibility that *“resistant leafrollers”* could be introduced to Australia,
- c) natural enemies offer inadequate control for *“commercial leafroller”*, and
- d) *“increased costs for crop monitoring and consultant’s advice to the producer may be incurred”*.

The Australian Apple and Pear Industry believe that these facts highlight the major impact that Leafrollers will have on the Australian apple industry as well as other commercial horticultural crops and the environment if any of the five species were to enter and establish in Australia.

25. Page 214, Domestic trade or industry – **D**.

The RAP has throughout the 2005 DIRA, particularly for the arthropods, indicated that an outbreak of one of these pests is *“unlikely to be discernable at a national level and a minor significance at the regional level”*.

The Australian Apple and Pear Industry knows, based on the alleged outbreak of Fire Blight in 1997, that when there is an outbreak of a new pest and/or disease State Quarantine requirements will be introduced and domestic trade will stop. This is a significant issue at regional (or State) level as well as a national level. Industry would believe that the rating should be ‘E’.

26. Page 214, Environment – B.
The RAP indicates that *“a wide range of beneficial predators and parasitoids attack greenheaded and brownheaded leafrollers, but these have never been the primary method of control in commercial orchards”*.

AND

“Biological control agents, such as Bacillus thuringiensis or viruses, may offer an alternative method of control (HortResearch, 1999b)”.

The Australian Apple and Pear Industry would question these statements given there is no scientific and/or technical data and/or information to substantiate the statements.

27. Pages 215 and 216, Risk management for leafrollers.
a) The RAP is proposing that the risk mitigation/management protocol be *“inspection and remedial action based on 600-fruit sample from each lot”*.

AND

“Information from New Zealand states that ‘the calyx of various fruits, especially pip fruits, may be invaded by young larvae [of brownheaded leafrollers] but show no external damage’ (HortResearch, 1998) and therefore visual inspection may not be appropriate for detecting the internal larvae in apple fruit”.

The Australian Apple and Pear Industry believe that given the above statements, the proposed risk mitigation/management protocol of *“inspection and remedial action based on 600-fruit sample from each lot”* is totally inadequate.

The Australian Apple and Pear Industry believe the minimum risk mitigation/management protocol for Leafrollers is mandatory fumigation of all lots entering Australia.

- b) The RAP indicates that *“because of the uncertainty about the level of internal infestation of apple fruit by brownheaded and greenheaded leafrollers. New Zealand is requested to provide additional information that addresses those issues”*.

The Australian Apple and Pear Industry believe that any additional information

- (iii) **must be presented before the RAP gives any further consideration to the application for the importation of apples from New Zealand, and**

- (iv) any additional information be supervised by Biosecurity Australia.

RISK MANAGEMENT AND DRAFT OPERATIONAL FRAMEWORK:

1. Page 291, Recognition of the competent authority.
The RAP indicates that *“as part of the responsibilities MAFNZ must ensure that administrative processes are established that provide assurances that the requirements of the program are being met”*.

The Australian Apple and Pear Industry believe that there is insufficient detail relating to what is involved in the *“administrative processes”*. Such information needs to be determined and made available for consideration.
2. Page 291 and 292, Operating manual and work plan.
 - a) The RAP indicates that *“it is a requirement that MAFNZ or the registered agency prepare a documented standard operating procedure (SOP) or manual that describes the phytosanitary procedures for each of the pests of quarantine concern for Australia”*.

The Australian Apple and Pear Industry seek clarification as to who might be a *“registered agency”*.
Given that MAFNZ is the recognised competent authority then the Industry would believe that is the sole responsibility of MAFNZ to prepare the SOP and/or manual.
 - b) The RAP indicates that *“the operating procedures must be approved by AQIS before exports commence and will be subject to audit by AQIS”*.

While the aspects of audits are covered in another section, there appears to be no reference as to how non-compliance will be dealt both by the performance of MAFNZ, the export packing facilities and/or the export orchards.
The Australian Apple and Pear Industry believe that is important for risk management and draft operational framework to detail the relevant penalties relating to non-compliance.
 - c) The RAP indicates that *“a draft work plan will be developed between DAFF and MAFNZ following the finalisation of the revised draft IRA”*.

The Australian Apple and Pear Industry seek clarification as to which part of DAFF will be responsible for the development of the draft work plan. Will it be AQIS or Biosecurity Australia or both?

The Australian Apple and Pear Industry recommend that Biosecurity Australia is involved from the beginning in the processes of developing a draft work plan.

The Australian Apple and Pear Industry would seek clarification as to what role either or both the New Zealand and Australian Industries would have in the development of the draft work plan.

The Australian Apple and Pear Industry recommend that Apple and Pear Australia Limited be consulted and involved from the beginning in the development of the appropriate draft work plan.

3. Page 292, Requirements for pre-clearance.

The RAP indicates that *“it is proposed that at least for the initial trade the quarantine measures will be undertaken through a standard pre-clearance arrangement with AQIS officers being directly involved. The need for pre-clearance would be reassessed after experience had been gained following significant trade”*.

The Australian Apple and Pear Industry would seek clarification as to what *“significant trade”* might be.

The Australian Apple and Pear Industry recommend that pre-clearance arrangements be in place for the longevity of any trade of apples between New Zealand and Australia.

Notwithstanding this the Industry recommends that pre-clearance arrangements be put in place for a minimum mandatory five year period and that a comprehensive review be undertaken in the fifth year to consider how the issue of pre-clearance will progress at the end of the 5 year period.

4. Page 292 and 293, Registration of export orchards or blocks.

a) The RAP indicates that *“all export orchards or orchard blocks supplying apples for export to Australia must be registered with MAFNZ”*.

The Australian Apple and Pear Industry seek clarification as to what form orchard and/or block registration will take.

The Australian Apple and Pear Industry recommend that

- (i) any registration must be listed on an approved computer data base and made available for access to the Australian Industry,**
- (ii) identification of orchards and/or blocks must be through aerial photographs and GIS and such information must be placed on the data base.**

- b) The RAP indicate that *“export orchards or orchard blocks must be registered before the start of each apple season to allow inspection for fire blight and European canker to take place”*.

The Australian Apple and Pear Industry seek clarification as to what defines the *“start of each apple season”* and will this be based on a calendar date and/or a specific part of the growing cycle.

Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the *“start of each apple season”* be defined as at the commencement of autumn leaf fall.

- c) The RAP indicates that *“growers must notify MAFNZ of their intention to register an orchard or orchard block”*.

The Australian Apple and Pear Industry seek clarification as to when the growers would be required to *“notify MAFNZ of their intention to register an orchard or orchard block”*.

Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the growers must *“notify MAFNZ of their intention to register an orchard or orchard block”* at the commencement of autumn leaf fall.

- d) The RAP indicates that *“each export orchard or orchard block must be allocated a unique identification number by MAFNZ. This unique identification number will be used to enable traceback”*.

The Australian Apple and Pear Industry would support this requirement but in doing so recommends that

- (i) the information must be include on the computer based registration database, and**
- (ii) the number(s) must be on each carton of fruit before it can be considered for export to Australia.**

5. Page 293, Standard commercial practice.

The RAP indicate that *“information provided by New Zealand on orchard and packing house practices and procedures and levels of pest infestation/infection in orchards and on apples is largely based on data derived from commercial apple production systems used in New Zealand”*.

The Australian Apple and Pear Industry recommend that ALL information relating to *“standard commercial practice”* must be included within the *“standard operating procedure (SOP) or manual”* developed and implemented by MAFNZ/AQIS.

For instance the “*Disease Management*” document (NZ Pipfruit IFP/0408/B.i) as supplied by the RAP at the consultation meeting on the 5th January 2006 contains relevant information on Black Spot, Fire Blight and European Canker.

One important component of the Fire Blight disease management program is the identification and removal “*alternative hosts from within 100 meters of the orchard block*”.

Such requirements must be built into the “*standing operating procedure (SOP) or manual*”.

6. Page 293, Fire Blight symptoms.

The RAP indicates that “*the inspection should take place between 4 to 7 weeks after flowering when conditions for fire blight development are likely to be optimal*”.

The Australian Apple and Pear Industry believe that the proposed one inspection of export orchards and/or orchard blocks at 4 to 7 weeks after flowering is inadequate.

The Industry recommendations regarding inspection for Fire Blight symptoms are detailed in other parts of the Industry submission.

7. Page 294, European canker.

The RAP indicates that “*risk management for European canker is based on establishing that export orchards or blocks are pest-free places of production*”.

The Australian Apple and Pear Industry believe that the proposed risk management based on establishing that export orchards or blocks are pest-free places of production is inadequate.

The Industry recommendations regarding inspection for European canker are detailed in other parts of the Industry submission.

8. Page 294, General requirements.

The RAP indicates that “*records must be kept of all confirmed fire blight and European canker detections*”.

The Australian Apple and Pear Industry recommend that any records of confirmed Fire Blight and European canker detections must be recorded and registered on an approved computer data base and made available for access to the Australian Industry.

9. Page 294 and 295, Registration.

- a) The RAP indicates that “*MAFNZ will register all exporters and export packing houses before the start of harvest each season to maintain quarantine integrity of the commodity, and provide for traceability of consignments should non-compliance with import conditions occur*”.

The Australian Apple and Pear Industry seek clarification as to what defines the “*start of harvest each season*” and will this be based on a calendar date and/or a specific part of the growing cycle.

Given that the proposed inspection for European canker is after leaf fall then the Australian Apple and Pear Industry would recommend that the “*start of each apple season*” be defined as at the commencement of autumn leaf fall. This is the time when exporters and export packing houses should be registered. This is essential to “*maintain quarantine integrity of the commodity, and provide for traceability of consignments should non-compliance with import conditions occur*”.

The Australian Apple and Pear Industry recommend that any registration of exporters and export packing houses must be listed on an approved computer data base and made available for access to the Australian Industry.

- b) The RAP indicates that “*each export packing house must be allocated a unique registration number by MAFNZ*”.

The Australian Apple and Pear Industry would support this requirement but in doing so recommends that

- (i) the information must be include on the computer based registration database, and**
- (ii) the number(s) must be on each carton of fruit before it can be considered for export to Australia.**

- c) The RAP indicates that “*the manager of the packing house will ensure that equipment and storage areas used for handling export apples are clean and are free from quarantine pests or other regulated articles*”.

The Australian Apple and Pear Industry seek clarification and description of “*other regulated articles*”.

- d) The RAP indicates that “*MAFNZ will conduct audit checks on approved packing houses to monitor the measures taken*”.

The Australian Apple and Pear Industry seek clarification as to whether the “*audit checks*” will be planned and announced or unannounced spot checks.

- e) The RAP indicates that *“MAFNZ must immediately suspend exports from packing houses found to be non-compliant”*.

The Australian Apple and Pear Industry seek clarification as to what aspects of packing house procedures will result in non-compliance.

10. Page 295, Disinfection treatment in the packing house.

- a) The RAP indicates that *“disinfection treatment of apples in the packing house is a mandatory requirement”*.

The Australian Apple and Pear Industry would support this risk management protocol.

- b) The RAP indicates that *“other agents may be used as effective as chlorine. New Zealand would need to submit supporting documentation for other agents for approval by AQIS”*.

The Australian Apple and Pear Industry recommends that any new disinfection agents submitted for consideration must be presented to the Australian Apple and Pear Industry and Biosecurity Australia for review before approved by AQIS.

- c) The RAP indicates that *“monitoring of the available chlorine and pH must occur at the start of packing each day and least every 2 hours throughout the packing process and be adjusted as required”*.

The Australian Apple and Pear Industry seek clarification and evidence that monitoring every 2 hours is scientifically sound and will ensure that the minimum requirements are maintained.

The Australian Apple and Pear Industry recommend that a continuous form of monitoring chlorine and chlorine levels be required for each and ever export packing house.

11. Page 296, Freedom from trash.

The RAP indicates that *“freedom from trash will be confirmed by the inspection procedures”*.

The Australian Apple and Pear Industry believe that while the RAP has supported the possible importation of mature apples from New Zealand trash free, the RAP has failed to offer a risk mitigation/management protocol for ensuring no trash enters with New Zealand apples.

The Australian Apple and Pear Industry recommends that based on the principle of 600 fruit per lot being inspected for specific pests and/or diseases the equivalent of 600 boxes per lot must be inspected for the presence of trash.

If trash is found then the appropriate remedial action must be taken.

12. Page 296, Prevention of contamination in storage, transport and handling.
The RAP indicates that *“apple fruit inspected and certified by MAFNZ for export to Australia must be securely stored and segregated from fruit from other destinations, to prevent mixing”*.

The Australian Apple and Pear Industry seek clarification as to what is secure and segregated storage.

The Australian Apple and Pear Industry recommend that “apple fruit inspected and certified by MAFNZ for export” must be stored in separate clean storage facilities that contain no other apples.

13. Page 296, Management of apple leafcurling midge.
The RAP indicates that *“the IRA team acknowledges that it may be possible to develop other risk management measures (for example, perhaps based on low pest prevalence in orchards or pest free places of production) but this would require more detailed information on apple leafcurling midge that is currently available”*.

The Australian Apple and Pear Industry DOES NOT support any consideration of “low pest prevalence” and/or “pest free places of production” as acceptable risk management measures.

14. Page 297, Option 1: Inspection with treatment
a) The RAP indicates that *“where a lot comprises apples from more than one supplying orchard or block then the inspection sample should be selected proportionally across all orchards/blocks”*.

The Australian Apple and Pear Industry recommend that 3000 samples must be taken from each individual supplying orchard and/or orchard block with a lot comprising apples from a number of different orchards and/or orchard blocks.

- b) The RAP indicates that *“any apples suspected of harbouring pests are cut and examined”*.

The Australian Apple and Pear Industry recommend that all 3,000 fruit must be cut no matter what their status.

- c) The RAP indicates that *“lots that pass the MAFNZ/Agency phytosanitary inspection must be kept segregated from non-inspected product and product destined for other markets”*

The Australian Apple and Pear Industry recommend that “lots that pass MAFNZ/Agency phytosanitary inspection” must be stored in separate clean storage facilities that contain no other apples.

- d) The RAP indicates that “*where apples are multiple orchards/blocks are present in one lot and only one orchard block is found to be non-compliant then the lot can be reconfigured to remove fruit from the non-compliant orchard block*”.

The Australian Apple and Pear Industry does not support this aspect of the Risk Management protocol.

The Australian Apple and Pear Industry recommend that once “one orchard block is found to be non-compliant” the lot cannot be reconfigured and the whole lot must be rejected.

- e) The RAP indicates that “*the detection of any significant pests of quarantine concern not already identified in the analysis may, depending on the circumstances, result in the suspension of trade*”.

The Australian Apple and Pear recommend that on the “detection of any significant pests or quarantine concern” all trade must be suspended until new measures are developed and implemented to provide the appropriate level of phytosanitary protection for Australia.

15. Page 298, Option 2: Mandatory treatment.

- a) The RAP indicates that “*where the lot comprises apples from more than one supplying orchard or block then the inspection sample should be selected proportionally across the orchards/blocks*”.

The Australian Apple and Pear Industry recommend that 600 samples must be taken from each individual supplying orchard and/or orchard block with a lot comprising apples from a number of different orchards and/or orchard blocks.

- b) The RAP indicates that “*where apples from multiple orchards/blocks are present in one lot and only one orchard/block is found to be non-compliant then the lot can be reconfigured to remove fruit from the non-compliant orchard/block*”.

The Australian Apple and Pear Industry does not support this aspect of the Risk Management protocol.

The Australian Apple and Pear Industry recommend that once “one orchard block is found to be non-compliant” the lot cannot be reconfigured and the whole lot must be rejected.

- c) The RAP indicates that “*the detection of any significant pests of quarantine concern not already identified in this IRA may, depending on the circumstances, result in the suspension of trade*”.

The Australian Apple and Pear recommend that on the “detection of any significant pests or quarantine concern” all trade must be suspended until new measures are developed and implemented to provide the appropriate level of phytosanitary protection for Australia.

16. Page 299, Management of leafrollers and quarantine pests including contaminant pests.

The Australian Apple and Pear Industry do not support the risk Management protocol recommended by the RAP.

The Australian Apple and Pear Industry recommend mandatory fumigation as the only acceptable risk management protocol for “Leafrollers and quarantine pests including contaminant pests” to provide the appropriate level of phytosanitary protection for Australia.

17. Page 300, Use of accredited personnel.
The RAP indicates that “*operational components and the development of risk management procedures may be delegated by MAFNZ to an accredited agent under an agency arrangement as appropriate (for example, through an accredited independent verification agency – IVA)*”.

The Australian Apple and Pear Industry recommend that all accredited agents and agency agreements are registered on a computer based data-base to which the Australian Industry has access.

18. Page 301, Verification of documents and inspection on arrival where pre-clearance is not used.

- a) The RAP indicates that “*the detection in Australia of live quarantinable arthropods including contaminant pests will require the consignment to be treated or to be re-exported or to be destroyed*”.

The Australian Apple and Pear Industry recommend that upon the “detection in Australia of live quarantinable arthropods including contaminant pests” the produce must only be re-exported or destroyed.

Industry does not support the treatment of the consignment.

- b) The RAP indicates that *“if any pests are detected that have not previously been assessed or categorised in respect to their quarantine status for Australia, the lot will be held. AQIS in consultation with Biosecurity Australia will determine the quarantine status of the pest and appropriate action taken”*.

The Australian Apple and Pear recommend that on the detection of any pests that have not previously been assessed all trade must be suspended until new measures are developed and implemented to provide the appropriate level of phytosanitary protection for Australia.

The Industry also recommends that the produce be re-exported or destroyed.

19. Page 301, Review of import conditions.
The RAP indicates that *“it is proposed that Biosecurity Australia, in consultation with MAFNZ, will review the import requirements after the first year of trade. Further reviews will occur if circumstances or information warrant such action”*.

The Australian Apple and Pear Industry recommend that import requirements be in place for the longevity of any trade of apples between New Zealand and Australia.

Notwithstanding this the Industry recommends that import requirements be put in place for a minimum mandatory five year period and that a comprehensive review be undertaken in the fifth year to consider how the issue of pre-clearance will progress at the end of the 5 year period.

PART C:

- SECTION 1:** AUSTRALIA'S APPROPRIATE LEVEL OF PROTECTION (ALOP)
- SECTION 2:** ECONOMIC CONSEQUENCES
- SECTION 3:** THE MODEL IN CONTEXT
- SECTION 4:** THE IRA STANDARD FOR INSPECITON OF AREAS OF FIRE BLIGHT SYMPTOM FREEDOM
- SECTION 5:** FIRE BLIGHT
- SECTION 6:** EUROPEAN CANKER
- SECTION 7:** ARTHROPODS

SECTION 1:

AUSTRALIA'S APPROPRIATE LEVEL OF PROTECTION (ALOP)

1.1 TECHNICAL CONSIDERATION OF THE ALOP:

The Australian Apple and Pear Industry endorse the statement at page 3 of the 2005 DIRA:

“The SPS Agreement defines the concept of an "appropriate level of sanitary or a sanitary 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.”

These statements are consistent with long standing statements of Australian government policy:

Australia has the sovereign right to determine its ALOP which reflects Government policy and community expectations. This element of quarantine policy precedes and is separate from the establishment of quarantine measures by AQIS. The ALOP determines the quarantine measures required; it is not the quarantine measure that determines the ALOP.¹

There may be difficulties in describing the ALOP in practical terms. While the ALOP is the objective and the measure is the means of achieving that objective, to imply the ALOP from an existing SPS measure would be to assume that every measure accurately reflects the ALOP set by the Member. While our ALOP is illustrated by the body of quarantine decisions made, among those decisions will be "outliers", made for reasons perhaps significant at the time the measure was adopted, but which do not fit well into the ALOP 'zone'. Review of such decisions is carried out on a continuing basis, within the boundaries of the ALOP. This review may lead to minor changes in import policies or procedures - significant changes are considered in consultation with stakeholders. Older decisions in particular may need such review, and also matters in which new information has emerged or new technologies oblige AQIS to re-examine the outcomes. A guide to the ALOP may be found in community and industry acceptance of quarantine policy and practice over the years. It

¹ AQIS Policy Memorandum 1999/26

reflects value judgments of the Australian community that take into account the benefits of trade and community access to imported goods and the consequences of pest or disease introductions on industry, the environment and society in general. Australian Governments have consistently adopted a highly conservative approach with respect to the ALOP. However, since the 1980's, successive Australian Governments have rejected the proposition that it is possible or desirable for Australia to adopt a 'no-risk' approach to quarantine.²

A number of points should be stressed from this fuller statement of longstanding Australian government policy.

First, the rejection of a "no risk" approach to quarantine does not mean the acceptance of any particular quantity or quality of risk.

Second, the statement that Australian governments have consistently adopted a highly conservative approach tells us that Australia's ALOP is "highly" risk averse. However it does not tell us, with any precision, where a risk acceptance line is to be drawn.

Third, it can be accepted from very long established quarantine policies Australia places a high value on its pome fruit industries and the communities which are dependent upon them, and has not been prepared to accept any significant level of risk that pome fruit pests which could not be contained would establish and spread in Australia.

Fourth, there is nothing in the 2005 DIRA which suggests that changes in technology or new information require any changes to Australia's established level of risk acceptance with respect to pome fruit pests.

Fifth, there has never been a suggestion by Biosecurity Australia, any of its predecessors or any officer of Biosecurity Australia or its predecessors that the existing policies with respect to pome fruit pests are "outliers" or otherwise outside the "ALOP zone".

Sixth, nor has there ever been a suggestion that Australia's existing policies with respect to pome fruit pests evidence a level of risk acceptance which is inconsistent with the level of risk accepted in a comparable area by Australia.

It follows that while the Australian Apple and Pear Industry does not oppose the conduct of the IRA, the Industry does not accept that the IRA is an occasion for shifting the level or nature of Australia's risk acceptance with respect to pome fruit pests and/or diseases. If there is to be any shift in

² AQIS Policy Memorandum 1999/26

Australia's ALOP that is a matter for the government at ministerial level and not for Biosecurity Australia or the RAP.

This position of the Australian Apple and Pear Industry is also directly in line with long established Australian government policy and practice:

...the appropriate level of protection is the same in each case unless and until the government tells us that it wants a wholesale shift in the policy or it wants to tell us that we are not conforming with the policy which it requires us to implement.³

As the Senate Rural Regional Affairs and Transport Committee reported in 2000⁴:

In their supplementary submission, AQIS argued that there existed a misunderstanding about the central difference between the determination of

Australia's ALOP by the government as a matter of policy and the application of that determination by the Director of Quarantine and AQIS in relation to specific quarantine decisions. AQIS stated:

*The government determines ALOP at the broad policy level taking into account community expectations regarding the management of risk and the amount of damage which might be done (especially to vulnerable agricultural industries and the environment) by incursions of exotic pests and diseases. It also takes into account the impact which quarantine policy may have on trade; the more restrictive is quarantine policy (ie the higher ALOP is set), the greater are the benefits of trade which are foregone.*²³

The proposed shift in ALOP

The Australian Apple and Pear Industry has no difficulty with the generic description at the top of page 4 of the 2005 DIRA of the manner in which any country's ALOP might be illustrated:

“ALOP can be illustrated using a ‘risk estimation matrix’ (see Table 1). The cells of this matrix describe the product of likelihood and consequences – termed ‘risk’. When interpreting the risk estimation matrix, it should be remembered that, although the descriptors for each axis are similar (‘low’, ‘moderate’, ‘high’, etc.), the vertical axis refers to likelihood and the horizontal axis refers to consequences.”

³ AQIS Evidence to the Senate Rural, Regional Affairs and Transport Committee 11 November 1999, page 323

⁴ “An Appropriate Level of Protection – the Importation of Salmon Products” at paragraph 4.17.

Table 1 Risk estimation matrix

Likelihood of 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 entry, establishment and spread

The Australian Apple and Pear Industry understands that this Table 1 may well be a product of work which has been undertaken over the last several years. In 2000 officers of AQIS stated:

The Quarantine Development Unit is actively pursuing a better understanding of the concept of ALOP, with a view to describing Australia's ALOP in a manner which will provide better guidance to the Australian Quarantine and Inspection Service risk analysts and a clearer view for stakeholders and trading partners of the basis for our quarantine measures.⁵

The Australian Apple and Pear Industry recommends that great caution is needed to ensure that in providing "better guidance" and a "clearer view" as to Australia's ALOP, officials do not abrogate to themselves a role properly preserved to Government at ministerial level -- by changing Australia's ALOP.

The Industry notes that Table 1 on its own does not and cannot describe a level of risk tolerance. In order for Table 1 to have any content it is necessary to define what is meant by each of the descriptors of "consequences of entry, establishment and spread" and what is meant by each of the descriptors of "the likelihood of entry, establishment and spread".

⁵ Gascoine D, Wilson D and McRae C, *Quarantine policy in the World Trade Organisation environment*, Outlook 2000, p 171, at p 176

Unless the meaning of each of those descriptors is clearly and consistently defined Table 1 cannot provide either a transparent or a consistent (or indeed, any) definition of ALOP.

The following statement which appears immediately below Table 1 on page 4 is not consistent with the authoritative statements of Australia's ALOP set out on page 3 of the 2005 DIRA and analysed more fully above:

"The band of cells in Table 1 marked "very low risk" represents Australia's ALOP or tolerance of loss."

There is no statement of Australian government policy which refers to Table 1 or anything like it. There is no statement of Australian government policy which endorses Table 1 or anything like it as a representation, description or definition of Australia's ALOP.

Once the content of the descriptors used in Table 1 is considered it becomes clear that Table 1 does not describe Australia's ALOP. Rather it defines an ALOP which is inconsistent with Australia's long established approach to quarantine risk tolerance.

The Australian Apple and Pear Industry recommends that it is inappropriate for Biosecurity Australia to proceed on the basis that Table 1 is a representation of Australia's ALOP. Table 1 cannot be a representation of Australia's ALOP unless and until a responsible government official indicates that it reflects Australian government policy. The Industry suggests that the proper official to make that decision is the Minister for Agriculture Fisheries and Forestry.

Further, once the content to the descriptors used in Table 1, and found elsewhere in the 2005 DIRA is considered, it is clear that Table 1 does not reflect Australia's ALOP as it is understood by Australian policymakers, with whom the Industry through APAL has had detailed discussions.

The descriptors of consequences of entry, establishment and spread

The 2005 DIRA reports, at page 90, that if Fire Blight had occurred in Australia, the value of lost production between 1997 and 2002 would have totalled \$827 million over a five-year period; and that the annual potential loss in Pome fruit production would be \$125 million if Fire Blight were to establish in all regions of Australia.

The Australian Apple and Pear Industry considers it inconceivable that any Australian policymaker would classify those consequences as anything less than "extreme" which is the most severe descriptor of consequence

contemplated in Table 1. However, the 2005 DIRA allocates the descriptor of "high" to the consequences of Fire Blight.

Similarly, in the case of European canker the 2005 DIRA reports that the disease *"is one of the most economically damaging diseases of Apple in Europe, North America and South America"*. The 2005 DIRA further reports that *"climatic conditions in approximately 40% of Australian commercial fruit growing areas are conducive to infection"*.

In these circumstances the Australian Apple and Pear Industry considers that Australian policymakers would generally classify the consequences of European canker as at least "high" if not "extreme". However the 2005 DIRA classifies the consequences of European canker as "moderate".

This dissonance between what would be expected of Australian policymakers and the conclusions in the 2005 DIRA is explained by the nature of the arbitrary decision rules for classifying consequences and their application in this case.

Those rules are set out pages 37 to 38 of the 2005 DIRA.

The arbitrary nature of these rules is highlighted by continuing to consider the examples of Fire Blight and European canker.

It is fundamental to the logic of the 2005 DIRA that if there is an outbreak of Fire Blight it will establish and spread throughout Australia. It follows that its direct consequences will be felt in every State in Australia and the ACT.

The 2005 DIRA reports an assessment that the direct impact on plant life and health will be "highly significant" at the level of an Australian State but only "significant" at the national level. The Australian Apple and Pear Industry cannot understand how an impact which is "highly significant" in each of the States and one of the two internal Territories of Australia could be anything other than "highly significant" at the national level.

Nor can the Industry understand how an impact with a cost of \$125 million per year which, it is accepted, will persist for production cycles for the foreseeable future, could be described as anything other than *"highly significant"* at the national level.

Nevertheless, it is the arbitrary description of Fire Blight's direct impact on plant life and health at national level as merely *"significant"* which appears to drive the conclusion that the consequence of Fire Blight's entry establishment and spread is *"high"* rather than *"extreme"*. The first of the "decision rules" at page 37 would have the effect that if that impact was described as *"highly significant"* the assessed consequences of Fire Blight would be *"extreme"*.

No considerations of this kind have ever been articulated by a relevant Australian official as forming part of Australian government policy. This is a further reason why Table 1 cannot be treated as a representation or description of Australia's ALOP.

In the case of European canker the 2005 DIRA sets out the extreme risks to plant life and health in the Adelaide Hills, Perth and Manjimup, Orange and Batlow districts of Australia.

There is then a finding that this impact would be "*highly significant*" at the district level but only "*significant*" at the regional [that is State] level.

The Australian Apple and Pear Industry does not understand how an impact could be "*highly significant*" for the apple trees of Orange and Batlow but not for the apple trees of New South Wales. After all of the 2.05 million apple trees in NSW, 1.6 million are in Orange and Batlow.

Further, there are more apple trees in Batlow and Orange on the one hand than in any one of Queensland, South Australia, Western Australia or Tasmania. The Industry does not understand how the impact on the life and health of the 1.6 million apple trees of Batlow and Orange could be rated as less significant than the same impact would be rated if it were to affect the 1.5 million apple trees of Tasmania or South Australia or the 1 million apple trees of Queensland or Western Australia.

The arbitrary description of risk categories by reference to geopolitical units determines the level of assessed consequence. Again continuing the example, if it were accepted that the assessed direct impact on the life and health of the apple trees of Batlow and Orange should be equivalent to the assessed direct impact on the life and health of the apple trees of New South Wales (because they constitute 80% of those trees) the decision rule set out at the first dot point page 38 would mean that the assessed consequence of European canker would be "*high*" rather than the 2005 DIRA assessment of "*moderate*". Similarly if the climatic conditions across South Australia were conducive to the establishment of European canker the decision rule set out at the first dot point page 38 would mean that the assessed consequence of European canker would be "*high*". That would follow because the direct impact on tree life or health would be "*highly significant*" at the regional level. The 2005 DIRA attributes a consequence of "*moderate*" even though the direct impact on tree life or health in Batlow and Orange would necessarily be greater than across the whole of South Australia.

The Australian Apple and Pear Industry does not accept the proposition implicit in these decision rules: that in assessing the direct impact on plant life and health the value of 1.6 million apple trees in Orange and Batlow is less than the value of 1.5 million apple trees in South Australia or Tasmania. The rule is irrational and leads to arbitrary results.

Again there is no articulation of Australian Government policy which relevantly touches on the form of categorisation of consequence used in the 2005 DIRA.

Arbitrary bands of likelihood of entry establishment and spread

The Industry will now demonstrate that the categorisation of consequence as described above drives the outcome of the 2005 DIRA through the application of Table 1.

The meaning of the descriptors of "*likelihood of entry, establishment and spread*" in Table 1 is provided in Table 12 on page 41 of the 2005 DIRA.

The approach to risk acceptance in the 2005 DIRA is as follows:

1. Assess and categorise the consequence
2. Use the matrix in Table 1 to identify the descriptor of likelihood which produces the result "very low risk" for the relevant assessed consequence
3. Accept an annual likelihood of entry establishment and spread which is below the upper point of the statistical range (set out in Table 12 on page 41) which equates with the relevant descriptor of likelihood. When considering restricted risks calculations are conducted to bring the annual likelihoods below that figure.

In the case of Fire Blight the consequence is described as "*high*".

Applying step 2 above, Table 1 gives the answer that Australia's ALOP will be met when the annual likelihood of entry, establishment and spread is "*extremely low*".

Page 41 Table 12 then tells us that Australia will accept an "*extremely low*" annual likelihood of entry establishment and spread of one chance in a thousand.

Applying these same three steps, if the consequence of Fire Blight was described as "*extreme*" Australia would not accept an annual likelihood of entry establishment and spread greater than negligible - ie one in a million.

That is, the impact of the difference in one verbal descriptor of the consequence of Fire Blight would be that Table 1 would require a level of risk tolerance 1000 times lower than proposed in the 2005 DIRA. To put this another way, the 2005 DIRA proposes to accept a level of risk of entry establishment and spread of Fire Blight 1000 times greater than Australia would accept if there was one small change to one verbal descriptor of impact of one aspect of overall risk.

This arbitrary outcome is exacerbated by the modelling difficulties highlighted later in this Part 2 – where the output distribution for the likelihood of entry establishment and spread of Fire Blight is so strongly right skewed as to raise the real chance that the likelihood of entry establishment and spread is substantially higher than reported in the 2005 DIRA.

In the case of European canker the consequence is described as "*moderate*".

Applying step two above, Table 1 gives the answer that Australia's ALOP will be met when the annual likelihood of entry, establishment and spread is "*very low*".

Page 41 Table 12 then tells us that Australia will accept an annual likelihood of entry establishment and spread of 5%.

Again, applying the same three steps, if the consequence of European canker was described as "*high*" (because a highly significant impact on the life or health of 80% of the apple trees of NSW – being a greater number of trees than the total in four Australian states - would be highly significant at the state level) Australia would not accept an annual likelihood of entry establishment and spread greater than one in a thousand. The 2005 DIRA proposes to accept a level of risk of entry establishment and spread of European canker 50 times greater than Australia would accept if the 1.6 million trees in Batlow and Orange were valued as equivalent to the 1.5 million trees of Tasmania or South Australia or the 1 million trees of Western Australia or Queensland.

It involves no misunderstanding on the Industry's part ⁶ to note that, assuming the volume of trade and other variables remained constant, Table 1 would require that Australia accept a 41% likelihood of entry establishment and spread of European canker within 10 years.

Nor does it involve any misunderstanding to note that if the consequence of European canker was assessed as "*high*" Australia would not permit imports unless the likelihood of entry establishment and spread of European canker within 10 years was not higher than 1%.

These results flow not from any misunderstanding, or misapplication, of the method used in the 2005 DIRA. Rather, they highlight that once the content of the descriptors used in Table 1 is considered in detail that Table involves a very substantial change in Australia's ALOP.

The Australian Apple and Pear Industry notes that it is 10 years since Australia commenced review of its quarantine policies for apples from New Zealand. In that context it is reasonable to assume that policies adopted as a result of this review will be in place for a period of 10 years.

⁶ Cf DIRA page17

A policy which contemplates over a 40% likelihood that European canker will enter, establish and spread in Australia is inconsistent with Australia's ALOP. If that is the outcome of the accurate application of Table 1, that Table is demonstrated to not reflect or describe Australia's ALOP.

For the reasons set out above The Australian Apple and Pear Industry opposes any change to Australia's ALOP. Further, the Industry submits that if any change is to occur that should only be through a decision of the Australian Government at ministerial level. As Biosecurity Australia's predecessor properly informed the Senate committee, the making of such changes to policy is for Ministers, not officials.

1.2 A PRACTICAL CONSIDERATION OF THE ALOP:

Australia has a very conservative ALOP put into place to protect its citizens, its unique flora and fauna, and its primary industries. Superficially it appears that Australia is successful in protecting itself from exotic diseases and pests and maintaining its ALOP. **If the ALOP is set correctly and maintained through appropriate measures then incursions would also be 'very low', but how do we know that the measures put into place to maintain the ALOP and keep out pests and diseases are successful?**

The success of the protection measures is not necessarily a reflection of our ability to keep a pest or disease out, it may be that the pest or disease has entered but not been successful in establishing itself or spreading in Australia.

The lack of success in maintaining the ALOP is easier to judge. If a disease or pest that Australia wished to exclude has entered and become established and spread in Australia then clearly the measures in place to keep it out were not successful. The problem here is that once we discover the measures designed to achieve and maintain the ALOP have been unsuccessful it is usually too late to do anything about the issue or, at the very least, there is a need to spend considerable sums in either eradication or control activities.

So, the situation is that it is only after an outbreak has occurred that Australia discovers that the protocols were either not sufficient to achieve the ALOP or not sufficiently enforced to achieve the ALOP.

Does this happen often?

In the 25 years to 1995, the Nairn Review of Quarantine found:

- Animal pests and diseases – 11 incursions that resulted in the recent establishment of viable populations. Control costs of at least \$500,000 were incurred for control of each population. For example blue-tongue control costs were more than \$9 million for the years 1989 to 1991;

- Pathogens of plants – 652 incursions that resulted in establishment of pathogens (fungi, viruses, viroids, bacteria, nematodes, etc) previously unknown in Australia. In addition there were a further nine incursions specifically related to forest pathogens. A single nematode outbreak in WA, 1982 to 92 cost \$300,000 to control;
- Pests of plants – 40 insect pests of economic significance established viable populations in the period 1971 to 1995. Warehouse beetle control, NSW 1978-82 cost \$991,500.
- Weeds – 290 new species established populations in Australia between 1971 and 1995. Combellack (1989, in Nairn 1996) estimated that the total annual cost of weeds was more than \$3 billion, without including so-called environmental weeds.

In the years since the Nairn Review the Australian Apple and Pear Industry has found 16 instances of high risk imports and systems failures that have exposed Australia to major pest and disease risk. In summary form they are;

Table 1.1: Summary of High Risk Imports and Systems Failures

ID	Industry	Date & Source	Event	Potential Risk or Actual Impact	Potential Economic Loss to Australia	Comments
1	Beef	February 2005, ABC rural	Dumping of 450kg of Brazilian beef in a public landfill, Wagga Wagga NSW without on-ground assessment of disease risks	Potential introduction of Foot and Mouth Disease . Brazil had a positive FMD test Dec 2004	\$3.8 billion pa in beef exports	Inappropriate disposal resulting in a high risk event discovered by chance
3	Aquaculture	February 2001, AFFA Animal Biosecurity Policy Memorandum	Accidental feeding of uncooked imported prawns to aquaculture brood stock, Darwin NT	Prawn imports found to be infected with White Spot Syndrome Virus – absent from Australia	Aquaculture prawn industry valued at \$65 million in 2003/04	Inadvertent feeding of infested uncooked imports resulted in fear of introduction of WSSV

4	Citrus	June 2005, Landline, News Weekly July 2004, ABC rural Sept 2005	Introduction of citrus canker through suspected illegal import of plant material	Decimation of the Qld citrus industry with risk of spread to other citrus growing states	Cost to June 2005 of \$100 million, plus cost to government of \$13 million	Major regional economic loss realised in Queensland
5	Citrus	ABC rural Nov 2005	Queensland Citrus in Riverland after citrus canker outbreak	Potential spread of canker to other states	Potential Cost to South Aust Industry of \$100 million	Possible breach of internal quarantine
6	Vegetables	ABC rural Sept 2005	Outbreak of lettuce leaf blight in Western Australia, exotic disease previously unknown in Aust. But common Europe and USA	Potential reduction in lettuce production of between 1% and 50%	Industry valued at \$120 million pa	Outbreak currently only in WA
7	Tropical Fruit	AQIS website, Outbreak occurred 1995	Outbreak of Papaya Fruit Fly around Cairns	Outbreak cost \$33.5 million to eradicate and most likely source was larvae infested fruit imported into Aust.	Tropical fruit industry is valued at more than \$500 million pa. Future outbreak would stop all interstate sales	Outbreak associated with quarantine failure
8	Vegetables	ABC rural Nov 2005	Imported vegetables found to contain E coli and pesticide . Ten from 14 infected samples were leafy vegetables	Consumer health	Not quantified	Testing completed as part of a one off exercise rather than an ongoing AQIS program
9	Honey	ABC rural Nov 2002, RIRDC Online Nov/Dec 05	Identification of South African small hive beetle in NSW, Victoria and South Aust	Attacks and destroys European honey bee colonies	Major threat to Australia's \$100 million honey industry	Has already resulted in a major diversion of industry R&D funds
10	Wheat	ABC rural Oct 2005,	Wheat streak mosaic virus , first detected in Australia in 2003	Results in a minimum 60% yield loss	Major threat to Australia's \$4.8 billion wheat industry	

11	Marine	AQIS website, Outbreak occurred 1999	Invasive black-striped mussels invaded Darwin Harbour in 1998-99	Potential to colonise northern coast from Perth to Sydney – foul anchors, buoys, pipes, vessels and compete with native species.	Threatened \$350 million a year pearling industry and the northern prawn fishery worth close to \$120 million pa	Population likely to have established through undetected quarantine breach i.e. ballast water discharge
12	Wheat	ABC rural Sept 2005	Stem rust invades and establishes in WA. Infestation thought to have been carried by airline passengers from Europe	Stem rust can reduce yields by between 50 and 90%	Major threat to Australia's \$4.8 billion wheat industry	
13	Papaya	QDPI&F website, Outbreak occurred 1991	Papaya ring spot virus. Disease first found in Australia in Feb 91, endemic Hawaii, Taiwan, Brazil, Thailand, Caribbean and Philippines	Disease of economic importance in papaya, similar strain affects cucurbits	Australian papaya production valued at \$20 million pa	Disease now endemic in suburban Brisbane
14	Fire ant	ABC rural June 2001	Establishment of fire ant populations in SE Qld	Fire ant populations could establish themselves over northern Australia	ABARE estimate that untreated fire ants could cost the nation \$6.9 billion over the next 30 years.	Major economic impact
15	Banana	ABC rural Nov 2002	Outbreak of the disease black sigatoka in 2002, disease originally introduced to Australia in the late 1970s	\$100,000 joint Commonwealth state control program in the 1980s failed to eradicate the disease. Qld bananas banned from WA were the disease is not present	Industry has a Gross Value of Production of approx. \$250 million	

16	Pilchards	1995 and 1998, Parliament of South Australia. Sited in NSW Farmers Discussion Paper QAHTF 25/11/05	Mass pilchard kills – suspicion that imported frozen pilchards for feed to aquaculture ventures (without an IRA) or ballast water brought herpes virus. AQIS investigation – cause not confirmed.	Significant loss of wild stock.	Wild-catch pilchard industry valued at \$40.7 million in 2003/04	Event had major impact on both wild-catch and aquaculture sectors
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New plant diseases and pests recorded by the Australian Government Department of Agriculture Fisheries and Forestry between 2000 and October 2004 are:

- Ryegrass bacterial wilt
- Alternaria apple blotch
- Honeysuckle blight
- Banana leaf speckle
- Buckwheat downy mildew
- Grapevine rust
- Asparagus stem blight
- Asparagus rust
- Daylily rust
- Blueberry rust
- Grapevine virus B
- Potato nematode
- Potato tuber viroid
- Soybean aphid
- Fig wax scale
- Mango leafhopper
- Olive bud mite
- Bayberry whitefly
- Various thrips
- Fire ants

Five of these new diseases or pests were discovered in Victoria, five in NSW, seven in Qld, four in the NT, one in WA and one in SA. How these new plant pests and diseases came to be established in Australia in the last four years is unclear.

An Interesting Risk Analogy

When assessing the risk that apples from New Zealand will bring with them Fire Blight (or any other pest or disease) the IRA considers all apples that are likely to come from New Zealand as a single commodity and calculates the risk, concluding that, with suitable protocols, the risk is low enough. Considering all the apples as having equal risk no matter where they come from is a bit like assessing the risk of a tourist being bitten by crocodile while visiting Australia. If all the possible destinations are taken into account the risks are really very low. If however the tourist is swimming in a billabong in the Northern Territory, the risks become very much higher. Likewise, if all apples from New Zealand are taken as a whole, the risk of them bringing in Fire Blight can be made acceptable. When it is considered that some of the apples may be deemed acceptable for export to Australia even if they are of a Fire Blight susceptible variety, if they have come from an orchard with a recent history of disease outbreak, if they are sourced from an orchard that has had a disease outbreak very nearby or if they come from an orchard that has experienced a weather episode conducive to a fire blight outbreak after inspection then the situation has changed from a visit anywhere in Australia to swimming in that billabong!

In order to maintain its ALOP, Australia maintains strict quarantine regulations on all movements of fruit into Australia. Where no commercial trade exists, this protection takes the form of monitoring movements of people and packages. Although no one really knows the extent to which this quarantine fails, it becomes clear that a failure has taken place when there is a pest or disease outbreak.

In 1997 there was an outbreak of Fire Blight in the Melbourne Royal Botanical Gardens. As Fire Blight was unknown in Australia before that time it would seem to be important to seek a source for the disease. The disease was either deliberately or accidentally introduced into the gardens.

At the time there was extensive investigation but no case of deliberate introduction was ever suggested. That means that the introduction must have been accidental and must have come from outside Australia. It can also be assumed that the source of the infection was not a commercial shipment as Fire Blight host plants were not, at that time, imported into Australia on a commercial basis.

So where did the Fire Blight come from? Someone, probably a tourist, must have slipped through the airport security carrying some source of infection – most likely an apple. The whole apple or the discarded core was then disposed of in the gardens where the source of infection met a means of transfer and a susceptible host causing the establishment of the disease and its spread in the gardens.

This event is one that indicates two things. The first is that Australia's ALOP had been breached through some breakdown of the quarantine system. The second is that an event that is so unlikely to happen, that Biosecurity Australia feels it possible to commence commercial shipments (with protocols involved) actually did happen when the number of apples entering Australia must have been negligible.

The outbreak of Fire Blight in the Royal Melbourne Botanical Gardens shows just how easy it is for Fire Blight to enter Australia and just how cautious the approach must be to commercial apple shipments if Fire Blight is to be kept out of Australia.

Very few people appreciate just how lucky Australia was in the Fire Blight incident of 1997. Australia is the only country that has been acknowledged as having an outbreak of Fire Blight and then having eradicated it from the country. This was only possible because the disease did not break out in commercial orchards or in an area where it was not recognised for what it was. The combination of early identification and radical actions saved Australian orchards for the devastation of Fire Blight. The incident unmistakably underlines just how vulnerable Australia is to the disease and just how lucky we were in 1997. The chances of being so lucky again are virtually nil.

The situation as it now stands with Fire Blight is that Australia has and wants to maintain an ALOP set at very low and at the same time there are no commercial importations of apples from Fire Blight host countries. Under this current regime, Australia has suffered the consequences of an outbreak of Fire Blight in the Royal Melbourne Botanic Gardens. This indicates that the current situation is not sufficient to protect Australia from Fire Blight. Under current arrangements, Australia does not adopt a “zero risk” approach. If we did, the Melbourne outbreak would not have occurred.

Australia's ALOP is highly conservative. Importing fruit, under any set of risk-lowering protocols cannot possible meet Australia's ALOP of 'very low' because as the analysis in the 2005 DIRA demonstrates that importation will lift the likelihood of entry establishment and spread of fireblight above the current highly conservative level of risk acceptance.

Fire Blight itself has an interesting history of spread throughout the world. Not being sure where an outbreak originated or how it was transferred from one county to another is not an unusual circumstance and the doubt has led to some interesting – and alarming – conjecture. The table below shows the spread of the disease and the conjecture regarding its method of spread.

Table 1.2: Worldwide Distribution of Fire Blight and Projected Means of Dissemination

Year (1)	Country	Means of Dissemination (2)
1780	United States	Centre of origin
1840	Canada	Air currents?
1903	Japan	Nursery stock?
1919	New Zealand	Nursery stock?
1938	Bermuda	Nursery stock?
1943	Mexico	Nursery stock?
1957	United Kingdom	Contaminated fruit boxes?
1964	Egypt	LeConte pears from Florida
1966	The Netherlands	Migratory starlings form UK?
1966	Poland	Migratory starlings?
1968	Denmark	Migratory starlings?
1968	Guatemala	Nursery stock from USA?
1971	Germany	Migratory starlings?
1972	France	Migratory birds?
1973	Belgium	Migratory birds?
1982	Luxemburg	Air currents from Belgium?
1984	Cyprus	Air currents from Egypt?
1984	Greece	Air currents from Cyprus?
1985	Israel	Air currents from Egypt?
1985	Turkey	Air currents from Cyprus?
1986	Sweden	Air currents from Denmark?
1986	Norway	Air currents from Denmark?
1986	Macedonia	Air currents from Greece?
1986	Ireland	Nursery stock?
1986	Austria	Air currents from Germany?
1987	Czech Republic	Nursery stock from Germany?
1988	Lebanon	Air currents from Israel?
1988	Bulgaria	Air currents from Greece?
1989	Switzerland	Air currents from Germany?
1990	Jordan	Air currents from Israel?
1990	Syria	Air currents from Lebanon?
1990	Armenia	Air currents from Turkey?
1990	Italy (Apulia & Sicily)	Air currents from Albania / Greece?
1991	Iran	Air currents from Turkey?

1991	Serbia – Montenegro	Air currents from Macedonia?
1992	Bosnia-Herzegovina	Air currents from Serbia?
1992	Romania	Air currents from Bulgaria?
1992	Moldavia	Air currents from Romania?
1993	Croatia	Air currents from Serbia / Romania?
1994	Italy (Po Valley)	Nursery stock from West Europe?
1995	Ukraine	Air currents from Hungary?
1996	Hungary	Air currents from Serbia?
1996	Albania	Air currents from Greece / Macedonia?
1996	Spain	Nursery stock from France?
2001	Slovenia	Air currents from Italy / Croatia?
2003	Slovakia	Air currents from Czech Republic?
2004	Liechtenstein	Air currents from Switzerland?

Notes: (1) Dates are first literature recording and not necessarily earliest presence.
(2) Means of dissemination are without any proof and thus highly questionable.
Source: Van der Zwet 2005

A quick look at the table indicates that there has been no predictability about the spread and it can take from one year to many years to spread from one country to its neighbour. **If a bacterial infection can be spread by air currents then the coincidence of source of infection, susceptible host and means of transfer would appear not be a situation of ‘low’ or ‘very low’ risk.**

So, for Australia to maintain its ALOP would seem to need a far higher level of vigilance than is presently the case and the circumstances surrounding outbreaks of Fire Blight indicate that it is a high-risk disease that can spread easily, if erratically, but barely understood means. If Australia is serious about maintaining its ALOP the situation surrounding the importation of apples from Fire Blight host countries must be looked at long and hard and the technical considerations raised elsewhere in the response taken into account before any decision can be made. If there are areas of doubt then we must maintain the prohibition.

SECTION 2: ECONOMIC CONSEQUENCES

Economic Consequences as they relate to Fire Blight

2.1 Direct Consequences

a) Plant Life or Health

The Australian Apple and Pear Industry suggests that this area of consideration should be rated at the maximum possible level – ‘G’ – and would point out that many of the research bases of this finding are now quite old and revision would actually increase the estimate of the consequences in this category.

The first area of consideration is the estimation that production losses for apples would 20% in the event of a Fire Blight outbreak. This estimate was made by Roberts in 1991 and all other estimates of economic consequence since have used this figure.

Since 1991 the variety mix in Australia has changed dramatically. Of most importance here is the introduction of Cripps Pink (Pink Lady™) to the Australian industry. In 1991 there were virtually no Cripps Pink trees in Australian orchards. By 1995 there were just over 800,000 and in 2004 there were more than 2.3 million Cripps Pink trees in Australian orchards.

In 1991 Cripps Pink production was virtually nil by 1995 it was just over 7,600 tonnes (2.7% of the national apple crop) and by 2004 production was over 47,000 tonnes (more than 18% of the national apple crop)⁷.

Even the figure for Victorian losses of apples is underestimated using the outdated Roberts model. The IRA (p 90) quotes the losses of apple trees at 1% as a “worst case scenario”. Victoria currently has nearly 25% of its production in Cripps Pink (Pink Lady™). **As Cripps Pink is highly susceptible to Fire Blight the losses in that state will be far worse than predicted in the 2005 DIRA.**

The Cripps Pink information is important because the fruit from the trees is sold as the premium apple Pink Lady™ and it is highly susceptible to Fire Blight. This means that the probable losses from any outbreak of Fire Blight are now greater than they were at the time that Roberts carried out the research upon which the calculations of apple losses are based.

The impact of Fire Blight on the environment is described as “unknown” and the consequences on native flora dismissed with the assurance that very few native plants are closely related to known hosts of Fire Blight. The Australian Apple and Pear Industry would suggest that “unknown” leaves much room for error and the possible

⁷ All statistics from Australian Bureau of Statistics

impact of Fire Blight on native flora is another reason not to lower the consequence rating from ‘F’.

Finally, this section of the consequences discussion makes no reference to the possible impact on amenity plants. The costs of removing host amenity plants and replacing them in areas where there is a Fire Blight outbreak only add to the consequences.

All of the above means that the rating of ‘F’ in this category is entirely appropriate and cannot be downgraded in any way.

b) Human Life or Health

There are no known direct impacts on human health from Fire Blight outbreaks and as a result Industry would question the need to include this section within the Model.

If retention of the section is continued then the assignment of ‘A’ is seen as appropriate.

c) Any Other Aspects

Here again the assignment of ‘A’ is seen as appropriate.

2.2 Indirect Impact

a) Control or Eradication

The Australian Apple and Pear Industry believe that the economic consequences of control or eradication of Fire Blight in Australia would be significant. The costs of control or eradication are significantly underestimated in this section for the following reasons;

The figures used for the USA control are those used in varieties that are predominately of low Fire Blight susceptibility where as in Australia varieties are generally much more susceptible to the disease meaning that the costs of control measures would be significantly higher.

Fire Blight has been categorised under the Emergency Plant Pest Response Deed such that the government share of costs will be 80% so the costs incurred by the Governments will certainly be significant. This includes the costs of compensating growers, so the Government contribution would be very large indeed if the outbreak occurred in a major apple and pear growing region.

The \$2.8 million cost quoted for the outbreak in Melbourne was spent when Fire Blight was suspected to have occurred in amenity plants in Royal Botanic Gardens. This cost would be considerably more in 21st century dollars and if the circumstances included outbreaks in commercial apple or pear growing districts.

Replanting a hectare of apples was estimated to be \$10,000 in the DIRA (p. 91). However the process of replanting an orchard seems not to have been taken into account. The steps involved are:

- Removal of trellis and watering systems,
- Removal and destruction of existing trees,
- Removal or modification and replacement of protective canopies,
- Soil treatment with methyl bromide to avoid replant disease*,
- Purchase of trees (1500 to 2,500 @ \$10 each): \$15,000 to \$25,000,
- Replacement of infrastructure, and
- Planting trees

These steps would lead to costs well over \$40,000 per hectare. Add to that cost the loss of production over time to optimal cropping, and costs are really escalating. The \$10,000 quoted in the DIRA would not even come close to the cost of replanting a modern orchard.

* If the replanting takes place after methyl bromide has been phased out, one possible process of soil preparation is to plant a crop of sorghum, wait for it to mature, plough it into the ground, add up to 10 tonnes of compost matter per hectare, plough that in and then wait for the appropriate time to plant. This system adds further expense and increases the time to achieve optimal cropping by at least 1 year.

The additional costs for operational changes on orchards would be significant for each individual business.

This section argues that the costs of ‘control or eradication’ have been significantly underestimated in the 2005 DIRA and the rating for this section should be upgraded to ‘G’.

b) Domestic Trade or Industry

The experiences of the Victorian Apple and Pear Industry during the Fire Blight outbreak in the Royal Melbourne Botanical Gardens and the South Australian Apple and Pear Industry during the alleged outbreak in the Adelaide Botanic Gardens, when the state borders were immediately closed and all interstate trade ceased were such that the rating of ‘E’ is considered to be appropriate for this area of consequences.

The consideration of the costs of restriction of trade, costs to the nursery industry, costs to the packing and storage sector, costs to packaging suppliers, costs to suppliers and repairers of agricultural machinery, costs to the banking and finance industry, flow on costs to the retail sector, drop in apple and pear supplies, costs to the processing sector, costs to the transport and freight sector, costs to fertilizer and chemical companies and costs to the honey industry would all be significant.

c) International Trade

Loss of export markets and export opportunities would be of significant cost to the industry. A rating of ‘D’ is considered to be appropriate for this activity.

d) Environment

The issues surrounding the use of antibiotic sprays are certainly to be taken into account here, but so are other areas of environmental impact.

The impact on Australian native flora is “unknown” and the cost is also therefore unknown. Before it is assumed that the impact would not be discernible, this area of potential impact needs to be assessed with some scientific rigour.

The other area of environment that has not been assessed is the area of amenity plants. In areas where there is a Fire Blight outbreak all public and private amenity plants will need to be removed and replaced. This activity was carried out as part of the Fire Blight outbreak in Melbourne and was a significant cost.

The rating of ‘A’ for this assessment needs to be reconsidered in the light of the costs of the impact on amenity plants and the unknown impact and costs that would be incurred should Fire Blight become established in Australian native flora.

e) Communities

The extent of loss to “communities” and therefore to the entire country could be extreme and the rating here deserves to be increased from ‘D’ to ‘E’.

It is important to note here that the most recent research, and so the available figures, are nearly ten years old and so cannot be relied upon to be accurate.

In most orchards in Australia the losses identified as being incurred should Fire Blight break out would be sufficient to move a viable business into a trading position where it would no longer be viable. General economic figures usually consider the industry as a whole whether that view is taken on a national, regional or district basis. The results of recent analysis by Plant Health Australia are alarming enough when the economy of the Goulburn Valley as a whole is taken into account but when the figures are translated to a business by business basis the overall economic impact is likely to be far, far greater.

There is no doubt that the loss of half of a pear crop and a significant percentage (arguably greater than 20%) of an apple crop would be enough to drive almost all orchards into insolvency.

Whenever major natural catastrophes occur, government and community organisations provide a range of services including counselling for those affected. An outbreak of Fire Blight would certainly fall into that category in any apple and pear growing community. Counsellors are brought in under such circumstances because there are well-founded fears for the mental health of those feeling the impact of the event. It is no exaggeration to say that the financial impact of a Fire Blight outbreak on many family businesses will lead to depression and possibly suicide.

The flow on effects to family members, employees, contractors, suppliers and many, many others in the community would be enormous. Consideration of the impacts beyond the immediate and dispassionate lines on an economist-generated graph will certainly lead to the conclusion that the impacts on the Australian community will be significant. This justifies the upgrading of the communities impact rating.

2.3 Overall Consequences Rating

The Australian Apple and Pear Industry suggest that the consequences rating for Fire Blight should be “**extreme**” however it is also of the opinion that some of the sub-sets of the consequences equation have been underestimated. There is not doubt at all that the consequences rating cannot be anything less than “**high**”.

SECTION 3: THE MODEL IN CONTEXT.

Statistical Methodology and Modelling.

Executive Summary

This Australian Apple and Pear Industry through Apple and Pear Australia Limited examined the statistical methodology and modelling of the 2005 DIRA (BA 2005), in particular to examine whether the statistical methodology and modelling is appropriate to the task, and correctly executed within the document; whether the conclusions drawn are consistent with the methodology and modelling, and soundly based; and whether conclusions are robust to the many uncertainties inherent in the modelling.

A key criticism of the revised 2005 DIRA (BA 2005) is that the so-called bucket model is used throughout to interpret and assist with the elicitation of model probabilities. This has the effect of ignoring the natural variation inherent in pest and disease rates. Disease and pest transmission processes typically have hot-spots in time and space where the prevalence is much higher than the overall average rate associated with the bucket model, and it is these hot spots that represent the greatest threat of disease or pest incursion. The bucket model ignores this important source of variation which affects risk calculations.

The Australian Apple and Pear Industry finds that the modelling used by the RAP is, in the case of Fire Blight, overly sensitive to single probabilities which are assessed by the RAP to be very small. However, these small probabilities cannot be judged with any accuracy, and are not based on any actual data. Industry finds the model to be unduly sensitive to relatively small changes to these small probabilities, so much so that it places the conclusions of the model with respect to Fire Blight in grave doubt and scientifically unsound.

In addition Industry finds that uncertainty about model parameters is not transparently documented, but seems to be selected arbitrarily in many cases; that expert uncertainty about a model parameter is not clearly distinguished from natural variation in the parameter, from year to year and place to place; that the assessment of consequences seems arbitrary and overly simplistic; that uncertainty is thrown away in the assessment of risk and therefore not appropriately considered; that the 50th percentile is used in risk estimation without sufficient appreciation of the implications for risk management of the distribution of likelihoods for entry establishment and spread; that the systems approach to risk reduction is applied without sufficient justification that the separate measures will act independently to reduce risk; and that as a result of these factors and the other issues discussed below, it is highly likely that the risk associated with the import of apples from New Zealand has been substantially under-estimated.

3.1 Introduction

The Australian Apple and Pear Industry through Apple and Pear Australia Limited examined the statistical methodology and modelling of the 2005 DIRA (BA 2005), in particular to examine whether the statistical methodology and modelling is appropriate to the task, and correctly executed within the document; whether the conclusions drawn are consistent with the methodology and modelling, and soundly based; and whether conclusions are robust to the many uncertainties inherent in the modelling. A substantial number of criticisms of the statistical methodology and modelling were made by APAL in its submission (APAL 2004) in response to the February 2004 draft IRA (BA 2004). This report will review these criticisms and examine whether the 2005 DIRA (BA 2005) has addressed them, as well as examining the current draft on its own terms.

3.2 Review of Previous Criticisms

Previous criticisms were expressed in sections 7 and 10 of the APAL submission (APAL 2004). The major criticisms were that uncertainty in estimates of modelling input had been inadequately and misleadingly modelled, inappropriate assumptions had been made in the modelling, and that conditional probabilities had been incorrectly applied. We now examine these previous criticisms in the context of the 2005 DIRA (BA 2005). Note that the order in which we discuss these criticisms has no bearing on the relative importance of each criticism.

3.2.1 Combined effect of pests

In the February 2004 draft IRA (BA 2004), it was found that no consideration was given to the increased risk due the combined effect of a number of pests. This criticism has not been addressed in the 2005 DIRA (BA 2005), and our comments in Section 10.4.1. of the June 2004 APAL submission (APAL 2004) remain pertinent:

*“The risk assessment strategy treats each disease or pest of importance separately. But if we look at the risk of an adverse effect on the industry, the number of significant pests or diseases is an important consideration. One may argue that if there are more significant pests or diseases that must be protected against, the allowable risk associated with each individual pest or disease must be lower in order to maintain Australia’s ALOP for an industry sector. For example if there are five significant disease threats for industry A, and 20 significant disease threats for industry B, and assuming a probability of 0.001 (high end of very low) for each of them, the probability of a significant disease event in industry A is $1 - (0.999)^5 = 0.005$. However, for industry B it is $1 - (0.999)^{20} = 0.02$. Assuming the same economic consequence for the introduction of any of the pests or diseases, the risk for industry B is approximately four times as great. **The allowable level of risk for each pest or disease must be adjusted***

according to the number of significant potential pests or diseases in order to maintain an appropriate level of protection for an industry as a whole.”

APAL 2004, Section 10.4.1.

3.2.2 Qualitative Likelihood framework

In Section 10.2.1 of the APAL submission of June 2004 (APAL 2004), Industry criticised the qualitative likelihood framework of the February 2004 draft IRA (BA 2004), because it implied that experts became more certain about low probability events. The 2005 DIRA (BA 2005) dispenses with the qualitative likelihood framework in part, and likelihood ranges are estimated directly as uniform distributions between a minimum and maximum value, or triangular distributions with minimum, maximum and most likely values. **Industry observes however that there are many cases where estimates are made of low probability events that appear to be no more than re-statements of the qualitative categories of the February 2004 draft (BA 2004), and in these cases the same criticism applies:**

“When likelihoods and probabilities are elicited from expert opinion, no account is taken of the fact that people’s judgement of unlikely events is generally poor, and quite uncertain. The qualitative likelihood framework used (see Table 11, page 48) instead implies that people are much more certain about negligible, extremely low and very low probabilities than they are about low, moderate or high probabilities, and that as probabilities get smaller, people get more certain about them. This does not reflect what is known about people’s ability to judge the probability of unlikely events, and so imputes a precision to these categorical likelihood assessments that is questionable.”

APAL 2004, Section 10.2.1.

3.2.3 Modelling based on single apple

Industry was critical of the 2004 RDIRA (BA, 2004) for basing the modelling on a single apple both in regard to the estimation of probabilities of establishment and spread, and because clustering effects were ignored. This criticism remains unaddressed for non-insect pests in the 2005 DIRA. Our comments in Sections 10.2.3.2.2 and 10.4.8 of the June 2004 APAL submission (APAL 2004) remain pertinent:

“The fact that the RDIRA bases its modelling on a single apple is also problematic. As the RDIRA states on page 68, “Minimum population needed for establishment-if possible, the threshold population that is required for establishment should be estimated.” It is unlikely that this threshold population will

be reached, for many pests, by the discard of a single apple. This may be why the value “negligible” (in most cases) is given to the input likelihood for the probability that exposure of susceptible hosts within the exposure group would result from the utility point discarding a single infected apple. It is quite conceivable that were experts asked to consider the likelihood of exposure in the context of a cluster of waste apples, or indeed an entire shipment for the case of flying insects, these likelihoods would be considerably higher.”

APAL 2004, Section 10.2.3.2.2

“The assessment is based throughout on probabilities and likelihoods related to a single apple. However this obscures and misrepresents some of the major processes relating to the establishment and spread of a pest or disease. For example, it is most unlikely that infested or diseased apples will occur evenly distributed among the apples which are imported as is assumed in the RDIRA (see, for example, Hughes & Madden, 2002, and also Section 1.4.10). They are most likely to occur in a cluster, as a carton, a number of cartons, or a pallet load of fruit originating from the same orchard and packing house.

Disease processes are likely to be strongly influenced by such clusters of infested/infected fruit, and these influences should be taken into account in the modelling. It may also be argued that it is much more realistic to ask an expert to judge the likelihood of disease or pest establishment given that such a cluster of diseased or infested apples arrives at a utility point. Such an approach would lead to more accurate assessment of likelihoods for two reasons. Firstly, modelling based on aggregations such as cartons or pallets better reflects the actual mechanism of disease or pest occurrence and spread. Secondly, likelihoods associated with cartons or pallets will be larger, and so more easily and accurately assessed.”

APAL 2004, Section 10.4.8

Some changes to the treatment of insect pests in the 2005 DIRA (BA 2005) go some way to addressing our criticisms for insect pests, however we find that these changes do not adequately address our concerns. These revisions are discussed more fully in Sections 3.3 and 3.12. Additionally the problems associated with determining probabilities for single apple events still remain, and the impact of this in the final calculation of risk remains. Section 3.13 considers this further.

3.2.4 Pest categorisation rules

Industry criticised the February 2004 (BA 2004) draft for having inconsistent rules to decide whether it was likely that a pest would appear on the importation pathway. This has been addressed in the 2005 DIRA (BA 2005) revised draft by replacing the previous set of rules with a single test of whether or not the pest is associated with mature apple fruit. This avoids the inconsistency previously noted, but avoids any explicit consideration of pests or diseases which may be associated with packing materials. The 2005 DIRA (BA 2005) states that this is because pests associated with packing material are contaminants, and are already dealt with under current quarantine arrangements. They therefore need no further consideration in the IRA. **Industry notes that explicit consideration of interception data from the Pest and Disease Information Database is no longer mentioned, and clarification should be sought that such data is still considered in determining whether a pest is associated with mature apple fruit.**

3.2.5 Arbitrary uncertainty in input likelihood

Industry criticised the February 2004 draft (BA 2004) because inputs to the model were framed as qualitative likelihoods which arbitrarily assigned an uncertainty to each likelihood which had no relationship to the actual uncertainty that may pertain to any likelihood value in the model. The output distribution was therefore also arbitrary, and use of any percentile is therefore misleading. The December 2005 revised draft (BA 2005) no longer frames likelihoods in qualitative categories with arbitrarily defined uncertainties, but describes all input likelihoods in terms of a probability distribution, typically a uniform or triangular distribution. **An appendix by the Bureau of Rural Sciences (pp 307-310, BA 2005) asserts that these input distributions were chosen to reflect the actual uncertainties in each case. Methodologically, this is a substantial improvement, in line with our previous criticism. However whether this methodological improvement translates to better and more reliable conclusions depends on how well the input likelihood distributions actually represent both the natural variability in the likelihood, and the uncertainty about its exact value. Unfortunately, there is no way that this can be assessed from the 2005 DIRA (BA, 2005), because justifications for the parameters of these input distributions are rarely given, and the reasoning behind their choice is not detailed. The appendix by the Bureau of Rural Sciences invites Industry to take it on trust that these input distributions were appropriately chosen given the state of uncertainty in expert knowledge, however transparency requires that the reasoning behind these choices should be made clear.** Given that many input likelihoods and model parameters appear to be no more than re-statements of qualitative likelihoods of the February 2004 draft (BA 2004), and that the

uncertainty is discussed and justified in few cases, it appears reasonable to assume that, while some improvements have been made, the input likelihoods are still marred by a high degree of arbitrarily chosen uncertainty. **Industry repeats its previous criticism that “...uncertainty should be meaningful, expressing as appropriate natural variability and/or lack of precise knowledge. It should be based on the state of scientific and expert knowledge and opinion, rather than arbitrarily assigned...”**. Industry cannot assess whether this is the case for the most part of the input likelihoods, as mostly no justification or explanation has been given. The justifications and reasoning behind the uncertainty assigned to each input likelihood must be made available in order for a comprehensive critique of the risk model and for it to be scientifically acceptable. Further issues with the handling of uncertainty are discussed in Section 8.

- 3.2.6 Uncertainty in probability of entry establishment and spread**
In the previous criticism, in Section 10.4.11.2 of the APAL submission (APAL 2004), Industry discussed the importance of considering the uncertainty in the distribution of the probability of entry establishment and spread. The 2005 DIRA (BA 2005) fails to address this criticism. It continues to use the 50th percentile (the median) of this distribution to assign a risk by way of the risk estimation matrix (Table 11, p 39, BA 2005) discarding the important information contained in the spread of this distribution. This is critical information, because it should enable Industry to comment on whether the risk category is appropriately chosen. For example, if the probability distribution of entry establishment and spread has support only within the “**Low**” qualitative category, then industry has no problem with the risk assessment given for *E. amylovora* in the 2005 DIRA (p94 BA 2005), given that all other erroneous factors are addressed. Fortunately, this appears to be the case with *E. amylovora*, with the 95th percentile (Table 21, page 88 BA 2004) still well within the “**Low**” qualitative range. However, Industry’s own simulations based on the information in the 2005 DIRA (BA 2005) show that the distribution for the probability of entry establishment and spread is highly skewed to the right. There is an admittedly small chance that the probability of entry establishment and spread will be quite large, up to 0.62, in our simulations. This is well into the “medium” category, and pushing towards the “high” category. A rigorous risk assessment should take into account this spread with at least a distribution over risk values, say giving a 5% chance of high risk.

In the case of the unrestricted risk for Fire Blight (*E. amylovora*), this is of little consequence, as the median for the probability of entry establishment and spread, in any case, results in a risk that is above Australia’s ALOP, requiring risk management measures to be assessed. However this is not the case with the restricted risk for Fire Blight. The

December 2005 revised draft IRA (p 101, BA 2004, part B) reports that areas free from disease symptoms in conjunction with chlorine treatment are sufficient to reduce the risk below Australia's ALOP. They report the median value of the distribution for the probability of entry establishment and spread to be 4.7×10^{-4} , and assign it a qualitative category of extremely low. This then gives a risk estimate of “**Very Low**”, ostensibly within Australia's ALOP. However the distribution for the probability of entry, establishment and spread is highly skewed to the right, as can be seen in Figure 1. Over twenty percent (22.38% from Figure 1) of the simulated values fall in the “**Very Low**” likelihood/probability category. There is thus an approximately 20 percent chance that the risk is “**Low**”, and so above Australia's ALOP. This should certainly be taken into account – as the only consistent interpretation is that it is not possible to ensure that Australia's ALOP is met based on the two risk management measures suggested.

This is a serious methodological shortcoming that potentially affects to all pest risk assessments, both restricted and unrestricted. Further issues in the handling of uncertainty are discussed in Section 3.8.

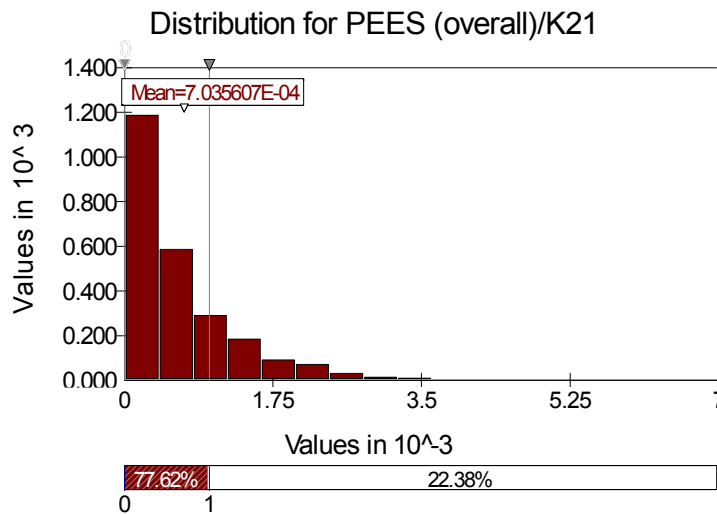


Figure 1. Simulated @RISK distribution for probability of entry, establishment and spread for Fire Blight (*E. amylovora*) with risk management measures sourcing from areas of symptom freedom, and chlorine treatment of harvested fruit. A vertical line is shown at a likelihood of 0.001, which divides the “Extremely Low” qualitative category from the “Very Low” qualitative category. As can be seen, over 20% of the simulated values lie in the “Very Low” category. Based on 1000 iterations of the @Risk model.

3.2.7 Use of the 50th Percentile

In the February 2004 revised draft (BA 2004), the 50th percentile was used to define the quantitative likelihood category for the purposes of combining with consequence estimates in the risk estimation matrix. In section 10.4.12 of the APAL submission (APAL 2004) Industry pointed out that the fiftieth percentile can substantially underestimate the likelihood when compared to the mean, for example, when the probability distribution for entry, establishment and spread is skewed to the right:

“If the midpoints of the uniform distributions used for quantitative assessment were assumed to correctly represent the most probable values of expert judgement for likelihoods then the use of the single pre-specified 50th percentile to characterize this uncertainty leads to underestimates of risk compared with that based on the midpoints.

On page 69 it is stated that, “The 50th percentile was chosen as the likelihood to be used because it provides a more robust measure of central tendency for skewed (asymmetrical) distributions”.

Although this statement is true in general for distributions, this statement is not applicable to the case of the “@RISK” simulations of the RDIRA. In the following discussion, we show that use of the 50th percentile in the RDIRA’s @Risk Monte Carlo simulation estimates of probabilities leads to underestimates of risk compared with a deterministic method that assumes that the midpoints of the uniform distributions used for quantitative assessment correctly represent the most probable values of expert judgement for the likelihoods. It should be noted that it is generally not the case that these midpoints do actually represent the most probable values of expert judgement for the likelihoods as these midpoints unnecessarily reduce the choice of most probable values to six distinct values excluding 0 and 1, see Table 11, page 48.

The arbitrary use of uniform distributions with the RDIRA’s “@RISK” simulations and the use of the 50th percentile generally produces probability estimates less than the corresponding midpoint analysis by an amount which varies considerably from case to case. We investigated this by simulation and give some results below.

For example, we consider the probability of importation of apples according to pathway 1 (page 57, Table 13, $\text{prob}(\text{path } 1) = \text{Imp1} \times \text{Imp2} \times \text{Imp4} \times \text{Imp6} \times \text{Imp8}$), for Fire Blight

(*Erwinia amylovora*) with likelihoods given on page 87, Figure 13, and interpreted as uniform distributions as in Table 11, page 48. Pathway 1 has by far the largest probability for this pest. We divide $\text{prob}(\text{path1})$ by its value computed using midpoints of quantitative likelihoods corresponding to the qualitative descriptions (Table 11, page 48). We obtain a variable which has mean equal to 1, and compare percentiles of the resulting distribution to the mean of 1. Based on 100000 simulations, we obtain

50th percentile is 0.920

75th percentile is 1.42.

The histogram of simulation values is shown in figure 10.1, which has a distribution skewed to the right. We note that the 50th percentile is 0.920 and so the 50th percentile is 92.0% of the midpoint estimate of $\text{prob}(\text{path1})$, that is, smaller than the midpoint estimate.

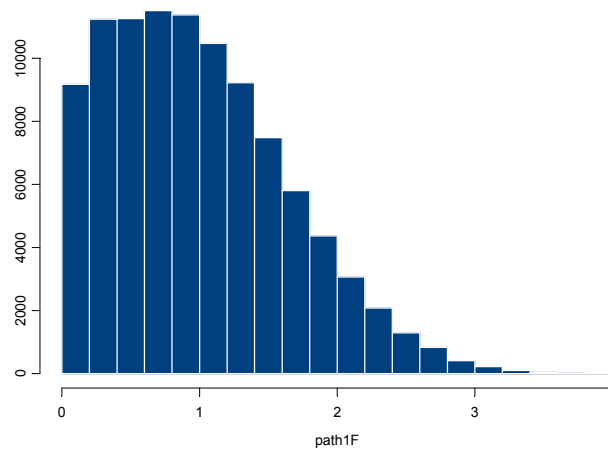


Figure 10.1. Simulations of the probability of importation pathway 1 for Fire Blight

When the likelihood distribution for the volume of trade (pert (100m, 200m, 400m), page 56) is incorporated into the calculation and the resulting distribution divided by 200m, the 50th percentile is 0.925 compared with the midpoint value of 1.00. This shows that the “@RISK” simulation approach used with the 50th percentile tends to underestimate the volume of infested/infected apples imported in a year.

*We repeated this analysis of the probability of path 1 for European Canker (*Nectria galligena*) using the likelihood estimates in Figure 15, page 127. We obtained simulation based percentile estimates of $\text{prob}(\text{path1})$ divided by the midpoint estimate based on 100000 simulations as follows.*

50th percentile is 0.644

75th percentile is 1.39

The histogram of these values is given in Figure 10.2, and shows a distribution which is very skewed to the right.

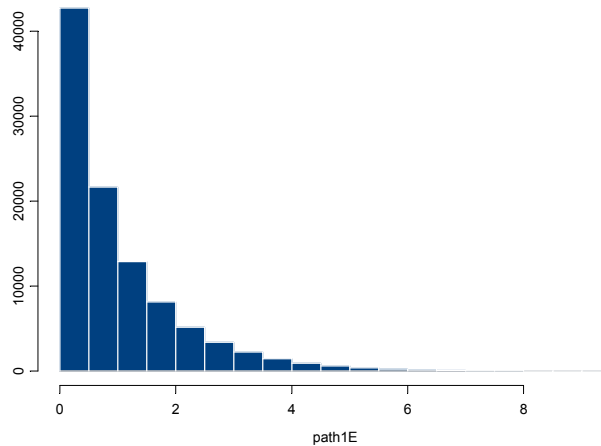


Figure 10. 2. Simulations of the probability of importation pathway 1 for European Canker.

For this case we note that the 50th percentile is 0.644 and so the 50th percentile is 64.4% of the midpoint estimate of $\text{prob}(\text{path1})$, that is substantially smaller than the midpoint estimate.

When the likelihood distribution for the volume of trade ($\text{pert}(100\text{m}, 200\text{m}, 400\text{m})$, page 56) is incorporated into the calculation and the resulting distribution divided by 200m, the 50th percentile is 0.643 compared with the midpoint value of 1.00. This shows that the “@RISK” simulation approach used with the 50th percentile tends to underestimate the volume of infested/infected apples imported in a year.

Here we note that the midpoint of the uniform is also its mean. So that if the uniform distributions were replaced by any

distributions, not necessarily restricted to the range of the uniform distribution but of course restricted to the interval (0,1), with mean equal to the corresponding midpoint of the uniform distribution, then the @Risk simulations using these distributions for probabilities of pathways would produce distributions for probabilities of pathways having means equal to the probability values based on the midpoint analysis as described above. Without knowing these distributions, the value of the 50th percentile of the @Risk simulation distribution for a probability of a pathway could be greater, smaller or equal to that obtained from the midpoint analysis.

These examples illustrate that the RDIRA's "@RISK" Monte Carlo simulation approach produces 50th percentile likelihood estimates of probabilities of pathways and volumes of infested/infected apples which can be substantially less than those obtained by using the midpoints of the uniform distributions and that these amounts vary considerably from case to case. Such an approach leads systematically to an underestimate of risk in the RDIRA compared with an estimate which uses the midpoints of intervals."

APAL 2004, Section 10.4.12

Industry's simulations show that this is still the case in the 2005 DIRA (BA, 2005). For example, in the unrestricted risk for Fire Blight (*E. amylovora*), the median is given as 0.058. The simulations recover this value, and also those for the 5th and 95th percentiles, but indicate a mean of 0.079, due to the highly skewed nature of the distribution. While this is not a problem in the context of the unrestricted risk for Fire Blight (*E. amylovora*), as either value concludes the risk is above Australia's ALOP, it is more contentious in the restricted risk scenario. Examination of Figure 1 shows that the mean (0.0007), due to the skewness of the distribution for the likelihood of entry establishment and spread, is approximately 50% greater than the median (0.00047). While still in the "**Extremely Low**" category, it is very close to the border with the Low category, at a likelihood of 0.001.

Whether the mean, median or some other percentile is used as a single summary statistic of a probability distribution for the purpose of risk estimation has implications for the assumed loss function for estimation of the likelihood. This has not been appreciated in the 2005 DIRA (BA, 2005). Industry discusses this in Section 3.6.2.

3.2.8 Conditional Probabilities

Industry criticised the February 2004 revised draft IRA (BA 2004) for not appreciating the conditional nature of likelihoods in the importation and distribution scenarios. This problem was found in a number of places in the February 2004 draft (BA 2004), including

- the importation scenario;
- estimating conditional probabilities as if they were marginal probabilities;
- risk management for Fire Blight;
- probability of Exposure; and
- probability of establishment and spread.

Industry discusses each of these specific aspects in the following sections.

3.2.8.1 Importation Scenario

In the previous criticism (Section 10.4.6, APAL 2004), Industry pointed out that the values of each importation likelihood are conditional upon the path in which it is considered. An adjustment has been made in the 2005 DIRA (BA, 2005) taking this into consideration for imp3, but not for other likelihoods in the importation model, on the basis that the conditioning has been examined and found not to be an issue for other importation steps. It is pleasing to see this positive change being made, but the assertion of the 2005 DIRA (BA, 2005) that the other importation likelihoods do not need to be conditioned on their pathways is questionable. Industry further examines this in Section 0.

3.2.8.2 Estimating conditional probabilities as if they were marginal probabilities

Industry noted in the previous criticism (APAL 2004) that without a clear appreciation of the conditional nature of importation and distribution steps, technical experts may tend to under-estimate the conditional probabilities, by treating them as marginal probabilities:

“In general, for likelihoods to be multiplied together as in Table 13 on page 57, and Table 14 on page 61, they must be conditional probabilities (see for example Grimmet & Welsh, 1986, or Vose, 2000, pages 36-37). That is, they must be calculated assuming that each prior step on the pathway has already occurred. This important distinction has not been adequately explained in the RDIRA. It is particularly important that experts who are assessing input likelihoods are clear on the implication of this, as the tendency may be to underestimate a conditional probability of an already unlikely event, simply because it is unlikely. This is, however ‘double counting’, a mistake already

discussed in Section 10.4.4, in reference to the restricted risk analysis of Fire Blight.”

APAL 2004, Section 10.4.6

The appendix by the Bureau of Rural Sciences makes it clear that there is still work to do in this area, as it states that “while additional steps could have been conditioned it was considered that mixing would lead to the marginal estimates being sufficient for the later steps, given the other approximations in the model”. It is quite clear that marginal estimates are most certainly not sufficient in the later stages of the model. Marginal estimates are incorrect. Probabilities must still be conditioned on the previous steps of the pathway, regardless of whether that conditioning requires a different value for different pathways. To illustrate the difference, consider a hypothetical pathway consisting of two steps. The first step, imp1, represents the probability that infected fruit will be detected and discarded during harvest. The second step, imp2 represents the probability that an infected piece of fruit will be disinfected during processing. Even though in this case there is only one pathway, imp2 is conditional on imp1 already being negotiated. If we consider the number of infected and uninfected apples at each step of the pathway, we may have something like the following:

	Originally	After Imp1	After Imp2
Infected	1000	500	100
Uninfected	20,000	20,000	20,400

The marginal probability that the fruit will be infected after imp2 is $100/20,500 = 0.005$. However the conditional probability of being infected, given that it was infected after imp1, is $100/500 = 0.2$. The marginal probability already incorporates the base rate of infection, multiplied by conditional probabilities imp1 and imp2. To confuse importation steps with marginal probabilities would severely underestimate probabilities associated with each importation path.

3.2.8.3 Risk Management for Fire Blight

In APAL (2004), Industry pointed out that imp4 and imp5, being conditional on prior steps in the pathway, would not be reduced by sourcing apples from symptom free orchards. The 2005 DIRA (BA 2005) has responded to these criticisms by accepting that imp4 will remain the same, and by greatly reducing the impact on imp5.

Industry accepts that these changes are a fair response to the criticism.

3.2.8.4 Probability of Exposure

In APAL (2004), Industry observed that the probabilities of exposure were listed as negligible in most cases, appearing to have been estimated on a marginal basis, rather than the correct conditional basis, that is conditioned on a diseased apple being discarded in close proximity to a susceptible host. Industry notes that no change has been made in the 2005 DIRA (BA, 2005). However an examination of supporting evidence indicates that at least one publication thinks the value ought to be higher than 10^{-6} , the maximum value of the range adopted in the 2005 DIRA (BA, 2005). Probability of exposure must be assessed in relation to a diseased apple being discarded in close proximity to a host plant. On this basis Roberts et al. (1998) would appear to indicate that a plausible value for the probability of exposure is in the range 10^{-7} to 5×10^{-5} for Fire Blight (*E. amylovora*) on average, a factor of 50 greater than assumed in the December 2005 revised draft (BA 2005). Rerunning the @Risk model provided by Biosecurity Australia, substituting this value for probability of exposure for susceptible household plants from consumer waster, while leaving all other probabilities of exposure unchanged, results in a median probability of entry, establishment and spread of 1.76×10^{-2} , in the “**Very Low**” qualitative probability range, and a risk estimate of “**Low**” – above Australia’s ALOP. This is a critical factor in view of the sensitivity of the model to changes in this value – a point we take up further in Section 3.13.

3.2.8.5 Probability of Establishment and Spread

In APAL (2004), Industry criticised the February 2004 revised draft IRA (BA 2004) for not appreciating that probability of spread is conditional on the probability of establishment. Industry questioned why spread from an established infestation in wild or amenity plants should be considered less probable than spread from any other exposure group, once the pest has become established in the exposure group. The 2005 DIRA (BA, 2005) continues to indicate different probabilities of spread given establishment in the different exposure groups. For example, the probability of spread of Fire Blight (*E. amylovora*) is given as in the range 0.7 to 1.0 once the disease is established in nursery plants or commercial fruit crops, but only 0.3 to 0.7 once established in household and garden plants, and only 0.05 to 0.3 once established in wild and amenity plants (p 87, BA 2005).

This same issue arises when considering the factors affecting the probabilities of establishment and spread. Some of the same factors

are listed as being relevant to both probabilities, but because probability of spread is conditioned on establishment, the same factors may not be used to reduce the probability of both. For example, if only certain climatic conditions are favourable to the pest, and these exist only in a proportion of Australia, it is reasonable to reflect this in a reduced probability of establishment. However, these same factors must not be used to reduce the probability of spread, as once the pest is established, we may assume it has done so where climatic or other conditions are favourable. Since spread is conditional on establishment, spread must be assessed assuming that the climatic and environmental factors that favour establishment are already in effect. The probability of spread cannot be reduced, for example, because only a proportion of the geographical region has suitable climatic conditions for establishment or spread. Establishments will not have taken place in these areas! A simple example illustrates this. Suppose spread is only supported in half of locations due to climate, so $p(\text{spread})=0.5$. Similarly establishment is only supported in half of locations so $p(\text{establishment})=0.5$. Given that the pest has become established, we may assume that climatic conditions are favourable, so $p(\text{Spread given Establishment})$ will be much closer to one than 0.5, assuming that climate is the major factor influencing spread. The probability of establishment and spread, $P(\text{Establishment \& Spread}) = P(\text{Establishment}) \times P(\text{Spread given Establishment}) \approx 0.5$, not $P(\text{Establishment}) \times P(\text{Spread}) = 0.25$.

Industry notes in particular that the same environmental factors may be considered relevant for probabilities of exposure, establishment and spread. For example, in both Fire Blight and European canker, high rainfall and humidity are considered relevant to all of these probabilities. However it is not clear what weight each of these factors was given in the final determination, as this is not spelled out in the 2005 DIRA (BA, 2005). **However where environmental conditions have been used to justify a restriction of these probabilities, it is quite clear that the overall probability of exposure, establishment and spread will be underestimated**, for the reasons given above.

3.2.9 Clustering

In APAL (2004), Industry criticised the fact that clustering of infested fruit had not been considered in the model described in the February 2004 revised draft IRA (BA 2004). We pointed out in Section 10.4.5 that this results in underestimating the variability, or uncertainty in likelihood estimates:

“The modelling used assumes that the infection status of an individual apple is independent of other apples. It is noted in footnote 17 on page 56 that the assumption of independence is not always appropriate, but that this can be over looked because the volume of imported apples is likely to be large. While footnote 17 is correct with respect to proportions, it over looks the fact that the assumption of independence may seriously over estimate the precision to be attached to the estimate of the proportion of infected fruit imported.

For example, if infections occur in batches of M apples, such that either all the apples in a batch are infected or not infected, then the variance in the number of infected apples under a binomial infection model is multiplied by M. A beta-binomial model is typically used to account for the inflation of variance due to clustering of infection/infestation (see for example Hughes & Madden, 2002)

The consequence for the model is that greater uncertainty is introduced. The probability of establishment or spread may therefore be significantly greater than that estimated.

The same issue arises again in step 4, page 63, in reference to the probability of a host plant becoming exposed to a pest. It is almost certainly not the case that the probability of exposure from n infected apples in the one place at the same time is equal to the probability of exposure from n infected apples at n different times and places. The approach taken in the RDIRA overlooks this distinction, which is related to the problem of the infection “hot spot” which may significantly increase the probability of establishment and spread.”

APAL 2004, Section 10.4.5

Whether the infective potential of 100 (for example) infected pieces of fruit in 100 different locations is the same as 100 infected pieces of fruit concentrated in one location will depend on the biology of each pest. Neither the issue of underestimated variability, nor the issue of difference in infective potential due to clustering has been adequately addressed, in our opinion, in the 2005 DIRA (BA, 2005). With insect pests, a variety of scenarios are considered, based on the number of insect pests expected at various utility points. While this is ostensibly a mechanism for dealing with clustering in insect pests, the scenarios are generated by a model which takes no account of clustering, or the variations in infection rate (“hot-spots”) that it may produce. The scenarios that are considered are likely to be misleading – being produced by a model which overly smooths the situation. Since the model has not been changed with respect to its treatment of clustering, our criticisms remain pertinent, in spite of the use of the scenarios in the consideration of insect pests. While the

consideration of such scenarios is a welcome improvement to the methodology, they will be misleading due to the deficiencies in the model which generates them. This is further discussed in Section 3.3.

In the 2005 DIRA (BA 2005), two scenarios are considered, in which the bulk of fruit is channelled through either urban or orchard wholesalers. While this is a positive development to deal with uncertainties in the distribution scenario, it does not address the issues raised above about clustering. Whichever of these distribution scenarios applies, the same clustering issues have been unaddressed in each, and each is open to the same consequent inaccuracies. Industry further discuss the issue of clustering, and the importance of adequately taking it into consideration in the discussion of the BRS comments on modelling (Appendix 1, p307, BA, 2005), in Section 3.6.1.

3.2.10 Use of tables to combine qualitative likelihoods

In section 10.2.3.3 of the previous criticism (APAL 2004), Industry criticised the use of tables to combine qualitative likelihoods, which could instead be quantitatively combined through multiplication, preserving the information about uncertainty inherent in each estimate, rather than arriving at an arbitrary uncertainty associated with the resulting qualitative category. This criticism has been fully addressed in the 2005 DIRA up to the production of the probability of entry establishment and spread. Industry still have concerns that uncertainty is correctly carried through the consequence analysis and final assessment of risk, and this is discussed in Section 3.5.

3.2.11 Correct use of terminology

In section 10.2.3.3 of the previous criticism (APAL 2004), Industry criticised the sloppy use of terminology in the February 2004 revised draft (BA 2004). Reference was continually made to the probability of entry establishment *or* spread when the probability of entry establishment *and* spread was clearly intended. This has been corrected in the 2005 DIRA (BA 2005).

3.2.12 Assessment of Consequences and Estimation of Risk

Industry criticised the way consequences were assessed and risk estimated (Sections 10.2.4 and 10.2.5, APAL 2004) on the grounds that consequences reflected political and economic value judgements, and that more rigorous economic modelling is quite feasible, and desirable. Industry has since formed the view that the operation of the rules for calculating consequences are contrived and arbitrary, and do not provide the transparency and rigour necessary of import risk assessments which potentially place large industry sectors at risk of adverse consequences. The risk estimate itself, based on Table 19 of the 2004 RDIRA (BA, 2004), Industry criticised as unsophisticated,

and pointed out that a large body of long standing work deals with the estimation of risk in a more rigorous and quantitative fashion, based on utility and probability distributions. A major criticism is that uncertainty had no formal role in the estimation of risk, and was discarded at the choice of a qualitative likelihood category for the entry establishment and spread of a pest. These criticisms have not been addressed in the 2005 DIRA (BA, 2005), and the treatment of consequences and the estimation of risk remains substantially unchanged from the February 2004 revised draft (BA 2004). The Industry's comments in Section 10.4.14 of the APAL submission (APAL 2004) remain pertinent:

“Uncertainty should be carried through the model, from the beginning right through to the final assessment of the risk (pages 75 to 76, Table 19). The risk modelling software actually produces a probability distribution for the annual probability of entry establishment or spread. This entire distribution, assuming appropriate handling of uncertainty, is the appropriate input for the risk estimation stage, not a single categorical estimate based on a measure of central tendency. If it was felt necessary to persist with categories of qualitative likelihood, weightings should be assigned to each category, according to the distribution for the annual probability of entry, establishment or spread. These weightings would then carry over to the risk estimation category of Table 19.

*For example, if the distribution for the annual probability of entry, establishment or spread implied 10% probability of being very low, a 50% probability of being low, and a 40% probability of being moderate, then assuming consequences are evaluated to be low, the risk would have a 10% chance of being negligible, a 50% chance of being very low, and a 40% chance of being low. In the current methodology, this would be judged an acceptable level of risk, as the 50th percentile would indicate a very low probability, which when combined with low consequences, gives a very low risk. However, there would be a 40% chance that the actual risk would exceed the ‘very low risk’ level. **This principle has not been taken into account in the RDIRA.***

APAL 2004, Section 10.4.14

Since the original appraisal of the 2004 RDIRA (BA 2004), further critical weaknesses of the risk estimation scheme have become apparent, and these are discussed in Section 3.5.

3.2.13 Verification inspections in risk management for Fire Blight

In section 10.3.1 and 10.4.10 of the APAL submission June 2004, Industry stated that the effect of inspection on imp6 and imp8 is substantially overestimated:

*“In the section of the RDIRA referring to “Risk management for Quarantine Pests” (pages 467 to 492), the verification inspection is introduced for the pests Apple Leafcurling Midge (pages 482 to 483), Leafrollers (page 484) and Wheat Bug (pages 486 to 489). Inspections take place either in New Zealand (importation step 6) or Australia (importation step 8). A rejected consignment will contain both infected/infested apples and clean apples. Thus the effects of verification inspection apply to both infested/infected and clean fruit, not just the former. For simplicity in the modelling, inspection is assumed to be at the final step applying to both infested/infected and clean fruit. The probability of acceptance of a consignment will depend on the proportion of infested/infected apples in the consignment, their distribution through boxes and pallets, and the sampling scheme. According to the RDIRA, the introduction of verification inspections justifies changes to likelihoods for importation steps 6 or 8 (see pages 482, 484, 486 and 488). **However the effect of inspection is substantially overestimated in the RDIRA.** This is due both to a methodological misunderstanding concerning the effect of inspection on the proportion of infested/infected apples which are imported, and to a failure to consider clustering in the occurrence of infected/infested apples.”*

APAL 2004, Section 10.3.1

Industry discussed this at some length, saying:

“The effects of inspection are overestimated because of (i) methodological errors and (ii) the likely clustering of infested/infected apples which has not been taken into account. As a result, restricted likelihoods have been underestimated in the RDIRA.

The RDIRA assesses the effect of verification inspections for the pests Apple Leafcurling Midge (pages 482 to 483), Leafrollers (page 484) and Wheat Bug (pages 486 to 489). For Wheat Bug the likelihood for importation steps 6 or 8 (but not both) is reduced from the unrestricted likelihood estimate of high to the restricted likelihood of very low (Table 129, page 483). Using midpoints of likelihoods (Table 11, page 48), 0.85

for high, 0.0255 for very low, the implied effect of inspection is to reduce the likelihood for step 6 or 8 by a factor equal to 0.0255/0.85 or 0.03. We will show below that this is a substantial overestimate of the effect of inspection.

The effect of inspection can be found using various assumptions. One assumption is that the inspection is 100% effective with no error and this depends on the nature of what is being inspected and how. No inspection error is assumed for Leafcurling Midge and Wheat Bug but not for Leafrollers (see pages 482 and 483, 484, 486 respectively). Another assumption depends on the distribution of the infested items throughout the consignment and whether this is random (homogeneous) or clustered. The report assumes (page 482) that “Verification inspection of fruit is to inspect 600 units of randomly selected apples from a homogeneous consignment (or lot).”

The report assesses the effect of inspection (pages 482 & 483) as follows, “This would provide a confidence level of 95% that not more than 0.5% of the units in the consignment are infested/infected by the pest.” This statement does not imply that values of the restricted likelihoods should be reduced, as the RDIRA states they should be, compared with the unrestricted likelihoods. We provide an argument below.

*The confidence level statement in the paragraph above is associated with the following argument. Let t be the probability that an apple is infested by the pest or the proportion of infested apples in a consignment. If 600 apples are selected from a consignment then the consignment is accepted if there are no infested apples in the sample of 600. Assuming apples are independently infested with probability equal to t , an assumption equivalent to the homogeneous consignments assumed by the RDIRA, then the probability of accepting the consignment is $(1-t)^{600}$, an approximation which holds provided the consignment size is sufficiently large relative to 600. When $t = 0.005$ the probability of accepting the consignment is 0.05 and when t is greater than 0.005 this probability is less than 0.05. However, acceptance of the consignment implies infested/infected apples are present in the consignment. If the consignment size is large compared with 600, and this would generally be the case and we assume this, then **knowledge that no infested/infected apples are to be found in a sample of 600 does not change the proportion or probability of the apples in the remaining part of the***

consignment being infested/infected from t . (See for example Vose, 2000, pages 361 to 364 for a discussion on sampling to assess disease prevalence)

What is changed by inspection is the distribution of t over consignments which are accepted. If every consignment had the same value of t then the value of t would not be changed by inspection. Accepted consignments would satisfy the condition that no infested/infected apples were found in the sample of 600.

The effect of inspection can be applied at importation step 8 or step 6 (page 54). We will assume it is step 8 but similar results hold if inspection is applied at step 6. Suppose t is the probability that an individual apple is infested/infected prior to step 8 (this can be found by adding all the probabilities for the 10 pathways on page 57 except that Imp 8 is omitted from all calculations) then we can take this probability as the proportion of infested/infected apples in a consignment. Suppose t varies over consignments with distribution $p(t)$ then the effect of inspection is to change this distribution to

$$p(t)(1-t)^{600} / \int_0^1 p(t)(1-t)^{600} dt$$

This follows by applying conditional probability (see for example Lindley, 1997) as follows.

The expression above is $p(t \mid \text{acceptance})$, that is the distribution of t assuming the consignment has been accepted. We have

$$p(t \mid \text{acceptance}) = p(\text{acceptance} \mid t)p(t) \div p(\text{acceptance})$$

and

$$p(\text{acceptance} \mid t) = (1-t)^{600}$$

and

$$p(\text{acceptance}) = \int p(\text{acceptance} \mid t)p(t)dt$$

giving the result above.

The effect of inspection is to be found by comparing $p(t)$, which is the distribution before inspection, with $p(t | \text{acceptance})$, the distribution after inspection. A possible way is to compare the mean of these two distributions and consider the ratio of the latter to the former as the effect of inspection and then to multiply the unrestricted likelihood by this ratio to obtain the restricted likelihood for step 8. We illustrate this below.

For Wheat Bug, using the midpoint values for the qualitative likelihoods in Figure 43, page 446, we obtain $t = 0.0038$ and the following analysis shows the possible effect of inspection at importation step 8. We assume a distribution for t which takes the values 0.0025 and 0.005 with equal probability, giving a mean of 0.00375.

When the value of t is 0.0025 then the probability of accepting the consignment is 0.22, and, as above, when the value of t is 0.005 then the probability of accepting the consignment is 0.05.

The effect of inspection is found by the above result for $p(t | \text{acceptance})$ but using summation instead of integration. Then we find that $p(t=0.005 | \text{acceptance})$ is equal to $0.05/(0.05+0.22)$ or 0.19, and $p(t=0.0025 | \text{acceptance})$ is equal to $0.22/(0.05+0.22)$ or 0.81 with mean value of t after acceptance equal to 0.00290. Thus the effect of inspection is to change the mean value of t , the proportion of infected apples in the consignment, from 0.00375 to 0.00290, giving the effect of inspection as the ratio 290/375 or 0.77.

The estimated effect here of inspection is to multiply High (midpoint 0.85) by 0.77 to give a likelihood value of 0.65, in the moderate range, not very low as in the RDIRA.

This result therefore suggests that in Table 133 for Wheat Bug the effect of inspection to change the unrestricted likelihood for step 8, Imp 8, from high to the restricted likelihood value very low is incorrect and moderate is a more appropriate value.

For Apple Leafcurling Midge using likelihoods from Figure 17, page 153, and the midpoint likelihood analysis for the ten paths leading to importation step 8 as above, we obtain $t = 0.072$. Then the probability of accepting the consignment using the formula $(1-t)^{600}$ implied by the RDIRA is $3.4e-20$, so

that no apples would be imported if inspection were applied at importation step 8 as all would be rejected at the inspection stage. For Leafrollers using likelihoods from Figure 23, page 221, and the midpoint likelihood analysis for the paths leading to importation step 8 as above, we obtain $t = 0.034$. Then the probability of accepting the consignment using the formula implied by the RDIRA is $(1 - t)^{600}$ and it is estimated as $9.7e-10$, so that no apples would be imported if inspection were applied at importation step 8, as all would be rejected at the inspection stage. However, in this example the RDIRA states (page 484) that inspection does not lead necessarily to 100% detection but the RDIRA gives no evidence for the size of the likely inspection error. What is required is the probability that an apple is infested and when inspected it is detected correctly but this is not given. Thus it would appear that if a consignment were to be accepted it would be on the basis of inspection error and consequently the effect of inspection is impossible to determine for this case. There is no evidence in the RDIRA to provide a value for the restricted likelihood for importation at step 8 and therefore should take the same value as the unrestricted likelihood, high, and not low as in the RDIRA (Table 130, page 484).

The combined effect of inspection can be considered for the pests mentioned here. If apples are infested independently and we ignore Leafrollers because of unknown inspection error, then using midpoint values of the qualitative likelihood categories implies that the probability that an apple is not free of both Wheat Bug and Apple Leafcurling Midge is equal to $1 - (1 - 0.00375) \times (1 - 0.072)$ or 0.0755. This gives the probability of acceptance equal to $3.5e-21$. **This implies that no consignments of apples would be accepted under the RDIRA's inspection scheme.**

The assumptions of the RDIRA can be questioned further with respect to whether the consignment is homogeneous with respect to the distribution of infested apples (see last line, page 482, for example). For pests it is reasonable that infested apples will be clustered within cartons, which results from apples picked from the same tree or hot spots of infestation/disease in the orchard or packed at the same time and place. If one assumes that 600 apples are sampled by sampling 6 cartons of apples, each with 100 apples, and that apples are infested or not uniformly within cartons then the sample of 600 apples becomes a sample of 6 cartons. The

value of t remains the same but the effect of Inspection is now given by the probability of acceptance as $(1 - t)^6$ which has the value 0.970 for $t=0.005$ and 0.985 for $t=0.0025$. As the value $(1 - t)^6$ is very similar for both values of t the effect of inspection is negligible and consequently the restricted likelihood is little changed from the unrestricted likelihood value, High. This will be true for a wide range of small values of t as well so this result will hold generally under these assumptions.

The sampling scheme could be to sample 600 boxes and one apple from each box, with boxes randomly selected from the consignment, and then the original formula $(1 - t)^{600}$ would be obtained and the theory above would apply.

The analyses above represent cases depending either on the assumption of homogeneity in the distribution of infested/infected apples within a consignment, or its lack thereof. Generally, the sampling scheme for inspection would reflect what is actually known about the heterogeneity of the distribution of infested apples and be carried out in a stratified manner, sampling pallets, cartons and apples. The RDIRA indicates that only the homogeneous case has been considered which is in error as there is likely to be heterogeneity.

A similar argument could be constructed for inspection in New Zealand before transportation with similar conclusions for importation step 6.

Thus the RDIRA has not considered the effect of verification inspection appropriately in two respects as described above. In the first, the correct theory has not been explained and seen to be applied correctly and in the second, no account of possible clustering or heterogeneity of infested apples has been considered.

In conclusion, the RDIRA overestimates the effect of inspection on the likelihoods for importation steps 6 and 8. In Tables 129 (page 483), 130 (page 484), 132 (page 486), 133 (page 487), 134 (page 134) the restricted likelihoods for importation step 6 or 8 should be no smaller than moderate whereas the RDIRA gives these values as low or very low. These likelihoods are based on the assumption that apples are imported and using the RDIRA's sampling scheme

appropriately it is suggested that no consignments would be accepted for importation.

APAL 2004, Section 10.4.10

It seems clear that there are still problems with the way that inspections are thought to impact on likelihoods in the importation scenario, and this is discussed in detail for Apple leaf-curling midge in Section 3.12.

3.2.14 Flying Pests not correctly modelled

Industry was critical of the way flying insect pests were modelled in the 2004 DIRA (BA, 2004). The criticisms appeared in Section 10.4.9 of APAL (2004), and were that

- **flying insects do not need to be discarded with apple waste, but may escape at any stage of the distribution network, from either waste or non-waste streams.**
- **accommodations reputedly made for flying insects are impractical, are likely to be misleading, and were not described in any substance.**
- **No evidence of these accommodations appeared in values for proportions in the distribution model.**

Consideration of various scenarios has been added to the distribution model for flying insect pests in the 2005 DIRA (BA, 2005), in an attempt to address these criticisms. While Industry agrees that this is a methodological improvement, Industry is concerned that these scenarios are still based on a flawed model. Industry discusses this further in Section 3.3.

3.3 Approach to modelling flying pests.

On pages 31 to 34 of the 2005 DIRA (BA, 2005, Part B) the section “*Approach to Modelling arthropods*” is given. This modelling is related to the pathogen modelling, pages 17-31 (BA, 2005, Part B), and this carries the quantitative modelling right through to the calculation of the probability of entry, establishment and spread in Table 8 (p 31, BA, 2005, Part B) with all steps connected through mathematical formulae. For arthropods, five steps are described and steps 1 and 2 are similar to the model for pathogens. Step 3 considers quantitative modelling for the number of infested fruit that might be distributed to utility points. However step 4 ‘Estimation of partial probability of entry, establishment and spread for each utility point exposure group combinations’ is very different from pathogen modelling as the values are not obtained by formulae from earlier steps but the values are chosen by the RAP and their choice of values are informed by the calculations of steps 1 and 2. Since all the 20 partial probabilities of entry, establishment and spread for each utility point exposure group combinations are combined together using the formula of Table 9 (BA, 2005, Part B) to calculate the probability of entry, establishment and spread, it is important for reasons of transparency and soundness that the 2005 DIRA

gives clear evidence as to how the RAP made its decisions on the 20 partial probabilities of entry, establishment and spread. **It would appear that the 2005 DIRA is largely missing sound evidence to support the values of partial probabilities of entry, establishment and spread. This is certainly the case for apple leafcurling midge and this is documented in section 3.10.**

3.4 Consequence Assessment

Consequences are assessed through the operation of arbitrary rules which are based on the geographic localisation of the consequences to local state or national regions. An impact level is assigned in each category of consequence, and these impact levels are combined by mapping them on to the risk categories. These rules are arbitrary because there is no reasoned transparent justification for them. Industry contends that such rules can be adjusted so that almost any outcome can be produced. Yet there is no detailed analysis of the economic consequences of the introduction of a particular pest. It would seem self evident that the economic consequences, for a start, must be determined by additional real costs incurred in production, for the industry as a whole, rather than by the geographical area which is affected. Such costs are just the beginning, as the many indirect costs must also be estimated – as is correctly pointed out in the 2005 DIRA (BA 2005). While Industry has no disagreement with the categories of direct and indirect costs considered, it certainly disagrees with the *modus operandi* by which these costs are considered. It is insufficient simply to categorise these costs based on geographical areas affected, or other crude measures of severity. While there are extensive reports of the estimated loss of production and consequent costs, for example, in the discussion of the consequences of Fire Blight, there is no attempt to draw together these estimates into a single economic cost to justify the quantum of impact awarded. **Industry strongly argues for an economic impact analysis on the industry as a whole, taking into account both direct and indirect costs, across the full spectrum of categories defined in the 2005 DIRA (BA, 2005). This is especially important for pests such as Fire Blight which have serious consequences. Otherwise the consequence analysis is out of step with the rest of the modelling – and the risk is found by combining a sophisticated estimate of the probability of entry establishment and spread with a simplistic estimate of the consequences.**

3.5 Risk Estimation

Table 11 on page 39 of 2005 DIRA (BA, 2005, part B) gives rules for the combination of Likelihood of entry, establishment and spread and consequences of entry, establishment and spread to give a risk estimate. Industry criticises this on a number of points.

- (i) Industry notes that the likelihood is found for **at least one** entry, establishment and spread event whereas the consequences are determined for **one** entry, establishment and spread. When the likelihood value is close to 1.0 then the expected number of events N is related to the

likelihood value p by $1-p = e^{-N}$ and multiple events can be expected to occur. This aspect is not taken into account in Table 11.

- (ii) Industry notes the risk value for both the likelihood values '**high**' and '**moderate**' are the same across all consequence values. Since the '**moderate**' range of values is 0.3 to 0.7, risks are determined to be the same for events which occur with probability 0.3 and those which are certain to occur (probability equal to 1) and there is no discrimination in terms of risk between such events.

The '**low**' category value of likelihood is from 0.05 to 0.3 and determines a lower level of risk by one category than a '**high**' or '**moderate**' likelihood value. Since these likelihood values can be interpreted qualitatively, an interpretation of '**low**' as high as 0.3 would seem extreme. Events with an almost low likelihood value (0.301 say) have the same risk as a certain event, suggesting this definition of '**low**' is too high. This would suggest that the risk estimation matrix needs to be redefined and recalibrated.

- (iii) The risk estimation procedure assumes that risk can be categorised as belonging uniquely to one of the categories given, that is, high, medium, low, very low etc. However depending on the nature of the distribution for the probability of entry establishment and spread, there may be significant uncertainty in the final risk category. That is the probability of entry, establishment and spread may give support to a number of risk categories. This must be explicitly addressed by stating what support each risk category receives. There is a clear difference in policy required for a situation in which both the median and the 95th percentile of the probability of entry establishment and spread indicate a very low risk, and the situation in which the median is still indicating a very low risk, but because of the skewness and spread of the probability of entry establishment and spread, the 95th percentile indicates a medium risk. These two quite different scenarios are treated as if the risk is equal in the 2005 DIRA (BA, 2005). This could lead to risks being critically underestimated.
- (iv) An economic analysis of the consequences is feasible, rather than the crude categorisation employed in the 2005 DIRA. This can be combined with the probability distribution of the probability of entry establishment and spread to find the expected cost associated with the importation. To do this rigorously, the expected cost of importation must consider all significant pests.

3.6 Comments on Appendix 1

The Appendix 1 (BA, 2005, Part B, pages 307 – 310) involves the input to the IRA process by the Bureau of Rural Sciences. Various topics are considered and we have commented on them separately but we make specific comments on topics as below.

3.6.1 Model Structure

- (i) The “virtual bucket of apples” model.
- The comments here indicate that the RAP was to consider the trade in apples as a “virtual bucket of apples”. This means that there is no explicit temporal or spatial or clustering structure taken account of in the model, meaning that the bucket is imagined to have all the apples from trade from New Zealand in it. The variable such as imp2 is “*the likelihood that picked fruit is infected or infested*”, given that the orchard is infected. Thus in the @Risk simulation this value is fixed for all orchards which were infected. It is stated that the RAP were to use this “bucket” model to interpret likelihoods such as imp2 as proportions. Such an approach in the @Risk modelling therefore ignores all the natural variability that might arise from the harvesting of apples from different orchards with different infection rates and it is this natural variation in infection rates that might lead to higher risk. A simulation approach to investigate this natural variation due to clustering in space or time might be to split the total trade in to a small number of proportions of the total and assign each proportion a multiple of the “bucket model” value of imp2 so that the average of the values of (proportion x multiple) is 1, such as a proportion 33.3% of trade gets a multiple of 2, and 66.7% gets a multiple of ½. The final likelihood of entry, establishment and spread simulation values are found as the weighted combination of the 2 x imp2 (weight = 0.667) and 0.5 x imp2 (weight = 0.333) simulations. It would however be appropriate to use multiples consistent with available data. For example, in correspondence from Bob Mcfarlane, Senior Advisor Plant Exports, New Zealand and Dr Bill Roberts, Apple IRA Taskforce dated 16 May 2005, Fig X “*An analysis of the field incidence of black spot in fruit submitted to six Nelson packhouses over three seasons*” gives the level of black spot infection over the ranges, 0, <1%, 1-2%, >2%. For 2002 and Braeburn a mean infection rate is 0.77% with percentages of submitted lines (typically 15-50 bins of fruit) infection rates as follows:

Level of black spot infection.	0	<1%	1-2%	>2%
Percentages of lines with given infection rate.	48.9	37.0	5.0	9.0

The 2005 DIRA (BA, 2005, PartB) on page 220 assumes that all orchards are infected so this table gives the natural variation expected between bins of the infection rate with mean 0.77%. The 2005 DIRA (BA, 2005, PartB) on page 221 assumes a mean value of infection of 2.5% arising from a $U(10^{-3}, 5 \times 10^{-2})$ distribution for imp2. If we scale up the values of the level of black spot infection in the above table so that the average infection rate is 2.5% then we obtain the following values:

Level of black spot infection.		<3.25%	3.25-6.5%	>6.5%
Percentages of lines with given infection rate.	48.9	37.0	5.0	9.0

Thus about 11% of bins might be expected to have infections rates above 5% whereas the $U(10^{-3}, 5 \times 10^{-2})$ distribution assumes none.

The bucket model eliminates the natural variability that is to be found in infection rates and accordingly reduces the range of variability of values such as imp2. The variability of the $U(10^{-3}, 5 \times 10^{-2})$ value only represents the RAP's uncertainty about average rates and has nothing to say about the variability to be observed between bins for example of actual infection rates. Such a restriction is a weakness of the 2005 DIRA (BA, 2005) and should be corrected.

(ii) Biological aspects of clustering

In the establishment and spread stage, the 2005 DIRA (BA, 2005) does not address an aspect of clustering which is significant but because it is a bucket model is ignored. Let $p(N)$ be the probability of establishment and spread resulting from the importation of N infected or infested apples arriving at a particular location at a particular time. A key issue that needs to be addressed is how $p(N)$ is related to $p(1)$ for one apple. Does the relationship

$$1 - p(N) = (1 - p(1))^N \\ \approx 1 - Np(1)$$

hold, or are there thresholds or nonlinear effects as one might expect. **The bucket model essentially assumes a linear model of this form as it distributes apples to locations for establishment in a uniform way with respect to infestation. A clustering model would have clusters of infested apples at given locations. Industry doubts whether the RAP has taken into account such important factors.**

3.6.2 Percentile Reported

In the 2005 DIRA (BA, 2005), BRS argue that the mean of the simulation distribution from @Risk should be reported and used to make decisions. If one has a probability distribution about an unknown quantity then Bayesian statistical theory (Bernardo and Smith, 1994, pages 255-258) can be used to obtain an estimate of the unknown based on the probability distribution. This estimation involves introducing a loss function into the decision process. The mean of the distribution is the expected loss under the squared loss function, $(\hat{t} - t)^2$, with t the unknown and \hat{t} the estimate. So the mean arises with loss the same for under-estimates as over-estimates and the loss increases as the square of the error. The 50th percentile is the expected loss if the loss function is the absolute loss $|\hat{t} - t|$, so the median arises with loss the same for under estimates as over estimates and the loss increases as the size of the error. The 95th percentile arises as the expected loss if the loss is $(\hat{t} - t)$ for $\hat{t} > t$ and $19(t - \hat{t})$ for $\hat{t} < t$. Thus if the estimate is too big we make 1 unit of loss for each unit of error whereas if the estimate is too small we make 19 units of loss for each unit of error. This situation would seem to be much more in accord with the estimate of the likelihood of entry, establishment and spread which is what is required in the 2005 DIRA (BA, 2005). **Certainly from Australia's point of view a cautious approach with a higher loss for underestimates than overestimates should be the case giving support to use of the 95th percentile estimate and certainly a percentile greater than the 50th as an estimate.**

A further reason for using a percentile greater than the 50th is that 2005 DIRA (BA, 2005) fails to take into account natural variability and therefore under estimates overall uncertainty, as discussed in Section 3.6.1.

3.7 Assessment of probabilities in the Importation scenario

In Section 10.2.3 of APAL (2004) Industry argued that in the 2004 RDIRA (BA, 2004) likelihoods for importation steps (Imp 1, Imp 2, etc) should be determined taking into account previous steps in pathways and not be determined independently of what those previous steps might be. In the 2005 DIRA (BA, 2005, Part B) this has been partly recognised in Figure 1 (p19), Table 4 (p23) and the text on page 20 in that Imp 3 has been given two different values, Imp 3a and Imp 3b, depending on whether fruit is picked from infected or infested orchards (Imp 3a) or picked from uninfected orchards (Imp 3b). Imp 3 gives the proportion of clean fruit contaminated during picking or transport to the packing house. In 2005 DIRA (BA, 2005, Part B) page 21, Imp 3b is given the same value irrespective of the pest in question. Imp 3a is given a value which is pest specific. It would seem that for some specific pests the value of Imp 3b would be pest specific. This would certainly be case for some risk management measures

which involve fruit being picked from variously defined “*pest free areas*” and those fruit could possibly be transported through areas not pest free and packed in the same packing houses as fruit from areas not designated as “*pest free areas*”.

Thus the use of one value for Imp 3b, that is uniformly distributed between 0 and 10^{-6} , irrespective of pest and risk management procedures would seem to be unsound.

From consideration of Table 4, page 23 of 2005 DIRA (BA, 2005, Part B) the values of Imp 5 should take different values in Path 3 and Path 4 compared with Path 7 and Path 9. Imp 5 represents the proportion of clean apples that would become infested or infected during routine processing, packing and cold storage before transport.

Path 3 and Path 4 involve fruit picked from uninfected or uninfested orchards whilst Path 7 and Path 9 involve clean fruit picked from infected or infested orchards. **No consideration was given in 2005 DIRA (BA, 2005, Part B) to giving different values to Imp 5 to take into account sourcing from uninfected/uninfested orchards. This would seem to be unsound and lead to inaccuracies in the model outcomes.**

3.8 Handling Uncertainty

In APAL (2004) Section 10.4.11 Industry criticised the way that uncertainty was modelled. In terms of determining values for the likelihoods for importation steps (Imp 1, Imp 2 etc), BA(2004) used the qualitative likelihood description, ‘**High**’, ‘**Moderate**’ etc defined in Table 12, page 41 of the 2005 DIRA (BA, 2005, Part B). In the numerical modelling using the Software @ Risk these qualitative values were substituted by uniform distributions, Uniform (0.7, 1) etc, (Table 12, page 41; BA, 2005, Part B) without apparently explicitly considering the numerical values for likelihood assessment in many cases. This approach is known as the so-called semi-quantitative model. In the 2005 DIRA (BA, 2005, Part B) pages 41, 42, ‘Model in Context’, it is stated that the RAP took into account various aspects of the semi-quantitative model. In Appendix 1, page 308 2005 DIRA (BA, 2005, Part B) in the Section ‘Elicitation of Expert Opinion’, some points made to the RAP by biometricians of the Bureau of Rural Sciences are given. These points, we agree, constitute sound advice to the RAP based on the criticisms given in APAL (2004). Industry’s point in APAL (2004) is that much sounder modelling can be done by incorporating the experts’ knowledge appropriately elicited into the @ Risk simulations rather than following the semi-quantitative method of BA (2004).

The differences that have occurred in comparing 2004 RDIRA (BA, 2004) with 2005 DIRA (BA, 2005, Part B) are that likelihood assessments for Importation steps (Imp 1, Imp 2 etc) have been assessed using explicit probability distributions; the uniform defined over a minimum and maximum value; and a

triangular distribution defined over a minimum and maximum value with a most likely value.

Use of the Uniform distribution is criticised because of its putting all uncertainty/probability uniformly between two values. For example ‘**Moderate**’ is defined as Uniform (0.3, 0.7) in Table 12, page 41 2005 DIRA (BA, 2005, Part B) so that the value 0.299 gets no probability whereas 0.3 gets the same as 0.5 and 0.7 so the uniform distribution has an abrupt change in support for values. Thus would not generally accord with experts’ opinions. That is, how can one be certain that the value 0.299 is impossible while the value 0.3 is quite plausible, as plausible as all values in the range 0.3 to 0.7?

The triangular distribution has a fixed range as well where the probability at the end of the range is essentially zero. Thus if a proportion, for example the proportion of picked fruit that is infected/infested, had values reported in the literature that ranged from, say, 1% to 5%, for example, with both 1% and 5% being actual reported values, then one’s uncertainty about the proportion would generally exceed the range 1% to 5% because

- (i) the values upon which the 1% and 5% are reported depend on data which have their own variability, that is, the 5% would be reported with a standard error.
- (ii) The reported range 1% to 5% would generally only represent a small number of investigations when data were collected, for example, over a limited number of years, so that the range 1% to 5% would not be representative of the full variability of the values to be expected.

Thus to represent the full variability one needs to take a range which is beyond values reported in the literature. Generally, the RAP did not do this and consequently the uncertainty in assessment of values is misrepresented.

For example, in the assessment of Importation Step 2 for Fire Blight (page 50, 2005 DIRA (BA, 2005, Part B)) Imp 2 is given a $T(10^{-3}, 3 \times 10^{-2}, 5 \times 10^{-2})$ distribution (minimum value 10^{-3} , most likely value 3×10^{-2} , maximum value 5×10^{-2}). In the ‘Summary’ of the consideration given to the literature on Fire Blight in the 2005 DIRA (pages 57, 58; BA, 2005, Part B)), an average value of 4.9% is quoted for the Fire Blight infestation rate of apples sourced from orchards with fire blight symptoms but the Imp 2 has a range of 10^{-3} to 5×10^{-2} which gives little support to the value 4.9% or 4.9×10^{-2} . To represent the reported data accurately it would seem appropriate to have a maximum value somewhat larger than 5×10^{-2} to take account of the fact that 4.9% is the reported **average** value and there must be some variation around this average so that the maximum value for the Triangular distribution should be in excess of 5×10^{-2} .

In conclusion, the 2005 DIRA (BA, 2005, Part B) does not appear to represent the uncertainty of given values in an accurate manner consistent with the descriptions in the text.

3.9 Discussion of Inspection Standards

3.9.1 Introduction

The 2005 DIRA states on p96 that *"a practical inspection regime should be specified as free from visual symptoms at an inspection intensity that would, at a 95% confidence level, detect visual symptoms if shown by 1% of the trees"*. It is implicitly assumed that the inspection process cannot be perfect (100% confidence) in some way (unspecified by the RAP) and hence Industry have to make do with imperfection (the inspection scheme fails) and specify it using uncertainty, here 95% confidence that it gets it right. In the following discussion, Industry will attempt to explain exactly what this statement means, and the implications for any inspection protocol.

3.9.2 Underlying rate of symptom visibility

The 1% refers to an assumed underlying proportion of trees showing visual symptoms, the rate of symptom visibility. The implication of assuming this underlying proportion to be 1% is the assumption that a 1% rate is an important benchmark, and we would like to detect this or any higher proportion of trees showing symptoms with a high degree of confidence. If the underlying proportion of trees showing symptoms turns out to be less than 1%, then Industry is far less confident of finding any symptom bearing trees in our sample. As the underlying proportion becomes lower, there is an increasing chance the region will be mistakenly declared symptom free. The implication is that a proportion of symptom bearing trees less than 1%, is for all practical purposes, representing much the same risk as an entirely symptom free area. In terms of risk management in the 2005 DIRA, the relevant question is whether the 1% benchmark reduces the import risk sufficiently. If not, then a case may be made for insisting on a reduction of the 1% assumed rate to a lower figure. Practically speaking, this would require the inspection of more trees in each export block.

3.9.3 Confidence Level

Sampling inspection schemes work on the basis on selecting N items from a block and if more than x are found with symptoms then the block is rejected. In the 2005 DIRA, AQIS schemes would reject a block if at least one defective is found in the sample. The 95% confidence level refers to how sure we can be that we reject the block, given that it is infested with an underlying rate of 1% symptom visibility. In this case, we assume rejection when at least one tree with symptoms is found. The 95% confidence is calculated as the probability we have found at least one tree

with visible symptoms given that, on average, 1 in 100 trees shows visible symptoms. If we were to look at just 50 trees, for example, there is a good chance that none of them would show symptoms. Even if we were to look at 100 trees, chance dictates that we would not always get one tree with visible symptoms. In fact, whenever we are selecting only a sample of trees to look at, there is a chance we may, through randomness, select only those trees which are symptom free, and so miss all the trees with symptoms. The more trees in the sample, the smaller this chance of missing one with symptoms will be until you inspect all trees in the block and then you detect all trees with symptoms. The 95% confidence interval gives a 5% chance of missing all trees with symptoms in the sample. In other words, if you were to send in 100 inspectors, one after the other, each of them randomly selecting a different sample of trees to inspect, then assuming they all followed the same protocol, on average, 95 of them would find 1 or more symptom bearing trees, while 5 of them would find no symptom bearing trees.

In other words, the 95% confidence interval tells us that there is a 5% chance that the protocol will declare an area to be symptom free when in fact there is a 1% visible symptom rate. If the symptom rate is higher than 1%, the same protocol will have a smaller chance of declaring symptom freedom erroneously and conversely if the symptom rate is smaller this chance will be larger than 5%.

3.9.4 Sample size required

The two figures of 95% and 1% can be used to work out the sample size required for an inspection. The standard modus operandi is to assume a binomial distribution, where trees are independently showing symptoms (that is, no clustering). This assumes the block size is large, say more than 3000 trees, and trees are selected at random for inspection (or symptoms occur randomly or both). If this is not the case the following has to be modified appropriately and we discuss this in a fuller way below in section 0. In this case, the probability of showing symptoms for each tree is $p=0.01$, N is the number of trees in a sample, which you need to find, and x is the number of trees in the sample showing symptoms. If you detect symptoms in the sample, then $x \geq 1$ and the 95% confidence interval can be expressed as

$$p(\text{detection}) = p(x \geq 1) = 1 - p(x = 0) = 1 - (1 - 0.01)^N = 1 - 0.99^N \geq 0.95$$

where you must select the sample size N so that detection occurs with at least 95% confidence.

Some algebra then allows you to solve for N and rounding up, you would expect that a sample of 300 trees would be needed to satisfy this standard.

3.9.5 Sampling Scheme

The 300 trees to be inspected need to be carefully selected according to a sampling scheme that takes proper account of the tendency for trees which show symptoms to be clustered in time and space. Trees must be located close enough together so that significant outbreak clusters can be detected before they grow too large. Also geographical coverage is important, so that samples are taken from all regions. This is required to prevent an undetected outbreak occurring in one section of an orchard. These requirements can be conflicting, and their adequate satisfaction may require a larger sample size than that given above, which is based on the assumption that the same probability of showing visible symptoms applies to every tree, independently of the status of its neighbours, or indeed any other tree. In many disease and pest situations, this assumption will not apply, as the disease or pest spreads from areas of infestation to neighbouring areas. **The choice of sample scheme then becomes something that must be adequately informed by the nature of the pest or disease, and the manner of its spread.** Also frequency and timing of sampling inspections is a critical issue. For example, if the incubation period for a pest is three weeks, then inspections four weeks prior to harvest can not be considered to play a useful role. Once again, this must be based on the nature of the pest or disease, and the rapidity of its spread. The importance of timing is recognised in the 2005 DIRA, in connection with the sampling standard for Fire Blight on page 96, where an optimal time is suggested for inspections. **Ultimately then, the choice of sample size, sampling scheme, and timing of inspections must be based on an understanding of the pest or disease in question, and while purely statistical considerations establish a useful baseline, they should always be interpreted in the light of the nature of each particular pest. Thus an inspection regime which may appear to satisfy the criteria, 95% confidence of detection with an underlying 1% rate of symptom visibility, may be completely invalidated by issues such as clustering and timing.**

3.9.6 Inspection Sensitivity

An additional issue that must be considered is the fact that inspections will not be 100% reliable. That is, an individual tree may be declared to be free of visible symptoms, while in fact symptoms are indeed present. This may be due to the inspector missing those symptoms for whatever reason, for example, fatigue, poor light conditions, insufficient time allotted to the inspection, and so on. There is a certain probability that visible symptoms will be missed in any particular tree, and this probability will differ for each particular protocol for detecting symptoms in a tree. In order to assess whether any given protocol will meet the standard, information must be provided on the probability that a tree will be declared free of symptoms mistakenly. The relevant figure is the

inspection sensitivity, the probability that visible symptoms are detected on a tree given that visible symptoms are present on the tree. The sensitivity must always be less than or equal to one, and in practical cases will always be less than one. For example, if the sensitivity is 0.85, then out of 100 trees showing symptoms, the inspection will only turn up 85 of them on average. The implication is that the underlying rate of trees with visible symptoms will appear to be lower than it really is. The standard specified in the 2005 DIRA, for example, specifies an underlying symptom rate of 1%. However if the inspection sensitivity is 0.85, this underlying rate will appear to be 0.85%, not 1%. Therefore in order to meet the specified standard, we need to take a sample size N based on a 95% confidence of detecting a 0.85% symptom rate. This would require a sample size of

$$N \geq \frac{\log 0.05}{\log(1 - 0.0085)} = 351$$

As the inspection sensitivity decreases, the sample size required to compensate must increase.

3.9.7 Definition of visible symptoms

It follows from the preceding discussion that unless “*visible symptom*” is unambiguously defined, neither the inspection sensitivity nor the inspection protocol (including sample size) can be reliably assessed. Indeed, by changing the definition of “*visible*”, one could virtually allow any desired rate of infestation while maintaining the 95% confidence of detecting a 1% rate of visible symptoms. Thus this definition is of fundamental importance, and it is a matter of some concern that this is not specifically defined in the 2005 DIRA.

3.9.8 Conclusions

Industry concludes that the standard specified in the 2005 DIRA of “at a 95% confidence level, detect visual symptoms if shown by 1% of the trees” has a number of implications of concern. These implications include an assessment that a rate of 1% of trees with visible symptoms is the appropriate level for determining whether the import risk is sufficiently reduced; that a 95% confidence interval is appropriate, implying a 5% chance that blocks will be judged symptom free when in fact visual symptoms are present in 1% of trees; that a sample size of 300 trees is implied, assuming perfect inspections; and that the sample size will increase as inspection sensitivity decreases from 100%. This last point requires any protocol to provide some justification for the sensitivity of inspections. Industry notes that the above framework is based on the assumption that trees show symptoms independently of any other trees, including their neighbours. However this is most unlikely to be true for most pests and diseases, which means that the nature of the pest or disease must

also be considered when establishing a meaningful sampling or inspection scheme. In particular, its means of spread, and timing issues such as the time between inspections, and the time between inspection and harvest, and any other relevant factors, must form part of an inspection protocol, based on the attributes of each particular pest. Finally, without a detailed definition of “visible symptom”, no protocol can be effectively assessed against the standard specified in the 2005 DIRA, and indeed, the standard is virtually meaningless.

In Section 3.10, Industry continues to discuss some of the implications of adopting this inspection standard in the case of Fire Blight risk management, assuming that a protocol can be devised which ensures this standard will be met.

3.10 Fire Blight – Risk Management

3.10.1 Large Areas Free of Symptoms

Industry considers here the risk management measures for Fire Blight and in particular the section ‘*Areas free from disease symptoms*’ (BA, 2005, Part B, pp 96 – 97). In paragraph 4 of p96 it is stated.

“The RAP concluded that a practical inspection regime should be specified as free from visual symptoms at an inspection intensity that would, at a 95% confidence level, detect visual symptoms if shown by 1% of the trees”.

This section goes on to reduce the values of Imp 2, Imp3 and Imp5 as a consequence of implementing this risk management scheme. Here Industry investigates how a sampling scheme with “*an inspection intensity that would, at a 95% confidence level, detect visual symptoms if shown by 1% of trees*” could be put into practice.

The simplest sampling scheme with these properties is based on sampling and inspection of N trees and deciding that the orchard is “free of visual symptoms” if none of the N trees shown visual symptoms. The requirement of the sampling scheme is that, with probability equal to 5%, all trees in the sample of N should be free of symptoms if in the orchard 1% of trees had visual symptoms. It is assumed that the orchard has a large number of trees, so that N is small relative to the number of trees. From section 0 above we have $N = 300$.

The calculation in this section which follows would be accurate if the symptom-free area involved had 20,000 trees and reasonably accurate for

3,000 trees. **No mention in the 2005 DIRA (BA, 2005, Part B) is made of the number of trees in a symptom-free area.**

The point about such inspection sampling schemes is that they do not in themselves change the number of infected trees in the area, this remains at the same proportion. What changes, as the proportion of infected trees increases, is the probability that the sample of 300 trees will contain at least one infected tree. In APAL (2004, Section 10.4.10) Industry gave details about how the overall proportion of infected fruit is changed by inspection. In particular if all areas had 1% of trees displaying visible symptoms then the sampling scheme would eliminate 95% of areas whilst 5% of areas would be declared symptom free, but the proportion of trees with symptoms would still be 1%. Sampling would affect the percentage of trees displaying visible symptoms on average as follows.

If for example half the areas had 1.5% of trees displaying visible symptoms and half had 0.5% displaying visible symptoms (an average of 1%) then the effect of sampling would change the average proportion displaying visible symptoms to

$$\frac{0.015 \times (0.985)^{300} + 0.005 \times (0.995)^{300}}{(0.985)^{300} + (0.995)^{300}} \\ = 0.0052 .$$

That is most of the accepted areas would be the 0.5% infected areas.

Industry is concerned that the “*areas free from disease symptoms*” risk management measure gives an effective reduction of 58 – fold for the value of Imp 2 without sound reasoning. It is noted from Table 24, p97 of the 2005 DIRA (BA, 2005, Part B) that the unrestricted value of Imp 2 (the likelihood that picked fruit is infested/infected with *E. amylovora*) is $T(10^{-3}, 3 \times 10^{-2}, 5 \times 10^{-2})$ with a mean value of 0.029 and most likely value of 0.03, whereas the restricted value, after accounting for the risk management measure of “*orchards free from blight symptoms*”, is $U(10^{-6}, 10^{-3})$ with a mean of 0.0005. This gives the “*areas free from disease symptoms*” risk management measure an effective reduction of 58 – fold for the value of Imp 2.

Given that there is no explicit evidence in 2005 DIRA (BA, 2005, Part B) to suggest what the proportion of trees with Fire Blight symptoms is in New Zealand, although pages 49 – 50 of 2005 DIRA (BA, 2005, Part B) give data on the proportion of orchards with Fire Blight symptoms, it is impossible to quantify the effect of the “*areas free from*

disease symptoms” risk management measure. To do this requires data on the incidence of Fire Blight symptoms at the tree level in order to assess the efficacy of the statistical inspection scheme described above in reducing the average incidence by tree of Fire Blight symptoms. It also requires the proportion of diseased fruit coming from trees with and without symptoms.

If the 2005 DIRA (BA, 2005, Part B) had provided a value for the incidence of Fire Blight symptoms on trees (rather than orchards) then it would be possible to quantify the effect of the “*areas free from disease symptoms*” risk management measure.

It has to be recognised that diseased apples can be picked from symptom free trees so that in order to achieve the 58-fold reduction in the value of Imp 2 it would be necessary to reduce the average proportion of diseased trees by a factor of more than 58.

In order to provide some quantitative estimate of the effect of the risk management measure, it is required to know the proportion of disease symptom free trees and the proportion of diseased apples sourced from disease symptom free trees.

In particular on p96 (last paragraph) of 2005 DIRA (BA, 2005, Part B) reference is made to “*the average number of apples carrying Fire Blight bacteria was 10 times greater among apples from orchards with Fire Blight symptoms from orchards in general. The proposal goes further than this in requiring all apples to be sourced from orchards free of Fire Blight symptoms and therefore justifying a greater reduction in Imp 2. The reductions in Imp 3 and Imp 5 largely follow from this*”.

First it should be noted that the (risk management) proposal does not guarantee that apples are sourced from orchards free of Fire Blight symptoms. The implemented statistical sampling scheme could allow orchards with quite possibly 1% or more of trees infected with Fire Blight and having symptoms and possibly all apples picked carrying Fire Blight bacteria. This would give a value of Imp 2 equal to 1% because apples would be sourced from 1% of trees being diseased.

The risk management measure (Table 24, p97; BA2005) reduces Imp 3 by a factor of 27 and Imp 5 by a factor of 17. The same remarks given above for Imp 2 apply to Imp 3 and Imp 5 because without providing further information at the tree level the effect of the measure “*areas free from disease symptom*” is not possible to quantify at the level given in 2005 DIRA (BA, 2005, Part B).

These remarks above with respect to symptom free areas carry through to the systems approach for risk management (pages 100 – 104; BA, 2005) with the consequence that the values of Imp 2, Imp 3 and Imp 5 used in Tables 27, 28 and 30 are not substantiated in the text. The consequence is that the calculations made to determine that Australia's ALOP has been met are not sound.

3.10.2 Small Areas Free of Symptoms (A)

If areas are defined as being 300 trees and these are inspected for symptoms on trees and rejected if any trees with symptoms are found then this is an alternative way of meeting the inspection intensity mentioned on page 96 of the 2005 DIRA (BA, 2005, Part B). The 95% confidence and 1% of trees having symptoms results in a sample size of 300, under the assumption of independence as discussed in Section 0. Areas can be defined by such a number of trees and an area is rejected if any trees found within it have symptoms. Consequently, the situation is different from the Large Areas Free of Symptoms scenario envisaged above as the areas have 100% compliance with freedom of visual symptoms.

Possibly it is this scenario which was envisaged by the RAP in coming to its conclusions summarised by Table 24, page 97 of the 2005 DIRA (BA, 2005, Part B). On page 96 of 2005 DIRA (BA, 2005, Part B) a statement concerning a 10 fold reduction in the proportion of apples carrying fire blight bacteria is made, comparing apples sourced from orchards with symptoms and orchards in general.

For Table 24 of the 2005 DIRA (page 97, BA, 2005 Part B) this 10 fold reduction is increased to a 58 fold reduction for Imp 2 for the symptom free measure without any substantiation in the text. Such a substantiation would require prevalence information at the tree level.

It is quite possible that Imp 3 and Imp 5 would not be reduced from their unrestricted values under this scenario as there might be, for a given orchard and packing house, a number of nearby 300 tree areas which had been found to have trees with symptoms of the disease. Consequently apples from disease free areas would most likely come into contact with diseased apples and trash whilst being transported to the packing shed (Imp 3) or contaminated during packing (Imp 5).

3.10.3 Small Areas Free of Symptoms (B)

Suppose areas are defined in terms of 600 trees and the sampling is applied to this sized area. In this case in order to obtain 95% confidence that the proportion of trees with symptoms is no more than 1% we require a sample of size $N = 235$. In the table below we give the probability that areas will be accepted with a given proportion of trees with symptoms. This amounts to the probability of the sample of $N = 235$ containing no

trees and the trees with symptoms being in the remaining $600 - 235 = 365$ trees not sampled.

Proportion of trees with symptoms	Number in area of 600 trees	Probability area accepted
0.5%	3	22.4%
1.0%	6	5%
2.0%	12	0.2%

Thus if the proportion of trees with symptoms were 0.5%, 22.4% of areas would be accepted as being “symptom free” even though 0.5% (or 3 in 600) trees have symptoms. There is no reduction in the proportion of trees with symptoms just that some areas would be accepted and some rejected leaving just under a quarter of the areas with the status of ‘*area free of symptoms*’. The conclusions to be drawn here are similar to those for the Large Areas considered above in section 3.10.1.

3.10.4 Systems Approach to risk reduction

When the various risk reduction measures are applied in isolation, none of them manages to meet Australia’s ALOP, prompting the use of a “Systems Approach” based on combining risk reduction measures. A basic assumption behind this approach appears to be that the different measures can be combined independently, that is the application of one measure does not influence the effectiveness of a second measure. However this assumption is questionable. For example on page 100, the combination of areas of freedom from visible symptoms and chlorine disinfection are assessed. The assumption is made that sourcing from symptom free areas and the reduction factor due to chlorine disinfection act independently. It is assumed, in other words, that the chlorine will reduce the level of infection by the same factor with and without sourcing from symptom free areas. However, this is an over simplification. The chlorine is most effective for surface contamination, less so for infestations protected by the calyx, and ineffective for internal infestations. In so much as the sourcing of apples from symptom free areas will change the mix of apples with these types of infestations, the chlorine treatment will have a different effectiveness. If for example, using a symptom free source, reduces the proportion of apples with external and calyx infections, for which chlorine is most effective, and does not reduce the proportion of apples with internal infections, then the reduction in infection rate due to chlorine disinfection can be expected to be reduced after sourcing from a symptom free area.

In the 2005 DIRA (BA, 2005, part B, p101), it is asserted that symptom free areas and chlorine infestation meet Australia's ALOP, in relation to Fire Blight (*E. amylovora*). Yet this is on the basis of the median indicating a probability of entry establishment and spread of 4.7×10^{-4} . This is only a factor of two below the cut off for the very low range at 10^{-3} . No consideration has been given to the uncertainty represented in this calculation, which may well put things over the ALOP. In the combination of cold storage, symptom freedom and chlorine disinfection, the mean PEES is only 2.4×10^{-4} . A mere factor of four would take this into the low category and outside Australia's ALOP. This would apply if the trade, for example, doubled from expectations, and chlorine disinfection effectiveness was half what was claimed.

3.10.5 Conclusion

Given the points made above, that the median probability of entry establishment and spread is only a factor of two away from placing the risk outside Australia's ALOP, that uncertainty in this probability has not been considered (see Sections 3.5 and 3.8), that clustering has not been considered (see Section 3.2.9), which almost certainly will give rise to atypical import lots with rates of infestation much higher than the average, that independence between risk reducing measures has been assumed without careful consideration of how these factors might impinge on each other, and considering how the effect of inspections on reducing the rate of infestation has been over-stated, the assessment of the risk management methods does not convince us that Australia's ALOP will be met in the case of Fire Blight. The conclusion on page 104 that a combination of chlorine treatment and symptom free areas would be sufficient to reduce the risk presented by Fire Blight to below Australia's ALOP is in our opinion unsound when the margin is so small.

3.11 European Canker

3.11.1 Uncertainty in Imp 1 and Imp 2

On page 106 of the 2005 DIRA, Imp 1 is assessed as a triangular distribution with a minimum value of 10^{-2} , a maximum value of 6×10^{-2} , and a most likely value of 3×10^{-2} . However this assessment applies to the overall trade from the entirety of New Zealand, including those areas in which the disease is unlikely to occur. Yet on page 108 Industry reads that "*Latorre et al. (2002) report that variations of 0.01% to 48.3% incidence have been obtained on one-year old twigs taken from the same orchard ...*". Clearly the environmental conditions which vary from season to season can have an enormous impact on the prevalence of this disease. This is not reflected in the range of variation assigned to imp1, which would instead imply that the disease prevalence is relatively constant from

season to season. This variation in incidence should however have its major impact in Imp 2, as the variation reported by Latorre et al. (2002) is concerned with the incidence on twigs within an infected orchard. Industry would expect that the range of variation for incidence of the disease on apple fruit would be of the same order, suggesting that the range for Imp 2 of 10^{-6} to 10^{-3} has been understated.

3.11.2 Unrestricted risk value of Imp 2

On pages 109 – 111 of the 2005 DIRA (BA, 2005, Part B) the value of the likelihood, Imp 2, for Importation Step 2 is considered. From page 20 of the 2005 DIRA (BA, 2005, Part B), Imp 2 is defined as “*the proportion of fruit coming from an infected or infested orchard that is infected or infested*”. It is necessary to recall that Imp 2 is a conditional probability, here conditioning on fruit coming from an infected or infested orchard. However on page 109 of the 2005 DIRA (BA, 2005, Part B) Imp 2 is defined as follows: “*Likelihood that picked fruit is infested/infected with *N. galligena* : uniform distribution with a minimum value of 10^{-6} and a maximum value of 10^{-3} . $U(10^{-6}, 10^{-3})$* .” This definition of Imp 2 is not conditional on the fruit being sourced from an infected/infested orchard. It does not accord with the definition used earlier on page 20 of the 2005 DIRA (BA, 2005, Part B).

Since the value of Imp 1 is not equal to certainty and it has a most likely value of 3×10^{-2} (p106; BA, 2005 Part B) it is important to consider the value of Imp 2 as conditional. Using the definitions of Imp 1 and Imp 2 on page 20 of the 2005 DIRA (BA, 2005, Part B) the unconditional probability that an apple is infected/infested with *N. galligena* is given by the product $\text{Imp 1} \times \text{Imp 2}$. According to the mean values given for Imp 1 (3.3×10^{-2} ; page 106, BA, 2005, Part B) and Imp 2 (5×10^{-4} ; page 109, BA, 2005 Part B) the probability an apple is infested is $3.3 \times 10^{-2} \times 5 \times 10^{-4}$ or 1.65×10^{-5} .

There is little quantitative information on pages 109 – 111 of the 2005 DIRA (BA, 2005, Part B) which supports an average proportion value of 1.65×10^{-5} or 0.00165% of apples being infected/infested. At the bottom of page 109 it is mentioned that 7 out of 3300 (0.21%) rotted fruit sent for examination at HortResearch between 1999 and 2005 were found to be infected with *N. galligena*. These seven samples were all from the Waikato region. The figure of 0.21% is a marginal probability of overall incidence in rotting fruit, which is not directly pertinent to the estimation of Imp2. If one were to assume that all these cases were independent, then the marginal rate of European canker after Imp 2 could be estimated as $0.21\% \times (\text{incidence of rot}) = 0.21\% \times 0.3 = 0.063\%$. Here we use the fact that “*from 1988 to 2003, more than 450 fresh apple fruit were intercepted at the barrier by AQIS staff from countries where European canker is*

present, including 53 apple fruit from New Zealand. Common fruit rotting fungi were isolated and identified on about 30% of the fruit but there were no records of N. galligena being isolated". The 2005 DIRA (BA, 2005, Part B, p110). This marginal value is much the same as the average value of 0.05% assigned to Imp 2 in the 2005 DIRA (BA, 2005, part B, p 109), supporting our contention that marginal and conditional probabilities have been confused in the estimation of Imp 2. However Imp 2 should be conditioned on the orchard being infected. In other words, $\text{Imp1} \times \text{Imp2} = 0.063\%$; so that $\text{Imp2} = 0.063\% / 0.03 = 2.1\%$. This value of 2.1% is approximately 40 times larger than the average of the uniform distribution between 10^{-6} and 10^{-3} which is assigned to Imp2 in the 2005 DIRA (BA 2005, Part B, p 110)

However this does not take into account clustering, which seems to be a factor since all seven cases came from Waikato. Therefore in order to better estimate Imp 2, Industry would need to know how many orchards in Waikato gave rise to these seven infested samples, and for each of these orchards, how many samples they contributed to the 3300 samples of rotting fruit. In the worst case, if all seven infected samples came from a single infected orchard, and they were the only samples in the 3300 from that orchard, Industry would have to conclude that Imp2 could be as high as to 0.3×1 , or 30%! Certainly, Industry can say that Imp2 is likely to be greater than 0.02, and possibly substantially so. Since Waikato accounts for only 2.3% of New Zealand apple production (BA 2004, part A, p27), it seems reasonable, in the absence of other information, to assume that 2.3% of the 3300 samples of rotting fruit came from Waikato. Under this assumption, about 75 of the 3300 rotting fruit samples would have come from Waikato. Assuming that all orchards in Waikato were infected, Imp2 would then be estimated as $0.3 \times 7 / 75$, approximately 2.7%, or 54 times greater than the average of the range assigned in the 2005 DIRA (BA 2005, part B). However, the assumption that all Waikato orchards were infected may not be the case at all, which would mean only a fraction of the 75 Waikato samples came from infected orchards, pushing Imp2 even higher. Our conclusion based on the quantitative information provided is that Imp2 is at least 40 times greater than the value assessed, with a substantial risk that it is even greater.

This conclusion is certainly consistent with the report that AQIS intercepted 53 apple fruit from New Zealand and no records of *N. galligena* being isolated (BA 2005, Part B, p110), which is supportive of infected/infestation rates of up to 2%. Thus the **evidence presented in the 2005 DIRA (BA, 2005, Part B) gives weight to an incidence rate of 0.063% whereas the value implied by the values of Imp 1 and Imp 2 gives a rate of 0.00165%. It would therefore appear that the RAP has incorrectly assigned a value to Imp 2 which is too small. The available data in the 2005 DIRA (BA, 2005, Part B) suggest that Imp 2 should**

be increased by a factor of at least 0.063%/0.00165% or about 40 times.

3.11.3 Risk Management value of Imp 2

Two risk management measures are assessed for European canker. The first, sourcing the fruit from a pest free area, is discussed on pages 136 – 137 of the 2005 DIRA (BA, 2005, Part B). It is proposed that the effect on Imp 2 would be to reduce its value to 0. However the effect of sourcing fruit from a pest free area is to reduce the value of Imp 1 and not Imp 2. Since Imp 2 is always conditioned on the fruit being sourced from an infected orchard, its value is unaffected by sourcing apples only from a pest free area. In this circumstance, no apples will follow the pathway through Imp2. Instead, Imp1 must be adjusted to 0, to indicate that no source orchard is infected. Since the disease can exist with symptomless infection there is a chance that fruit can be infected/infested even though the fruit is sourced from a pest free area. Thus to be in accord with the model's definitions it would seem necessary to change the value of Imp 1 and not the value of Imp 2. It would seem that the same error of interpretation of what Imp 2 represents was made for the unrestricted risk as has been made here, that is Imp2 has been interpreted as a marginal rather than the correct conditional probability.

The second risk reduction strategy is to adopt pest free production areas, which require that symptoms of the disease are not apparent during harvesting and processing, or during periodic inspections. This is asserted to reduce Imp2 and Imp5.

The 2005 DIRA comments that *“apples sourced from orchards free of cankers would therefore be relatively less likely to be infected or infested with N. galligena, when compared with apples produced under the unrestricted risk scenario”* (BA, 2005 Part B, p 137). They then apply a thousand-fold, on average, reduction, to Imp2, from Uniform (10^{-6} , 10^{-3}) to Uniform (0, 10^{-6}). However we have seen above that Imp2 was overestimated by a factor of at least 40 to 50 times. The thousand fold reduction should therefore apply to a value at least in the vicinity of 2% to 3%, to give an average of 2.5×10^{-5} . A distribution of uniform (0, 5×10^{-5}) would therefore seem more appropriate.

3.12 Effect of Inspection Sampling – Apple Leafcurling Midge

In APAL (2004, Section 10.4.10) Industry stated how the 2004 DIRA (BA, 2004) had been incorrect in taking into account the effect of inspection sampling on the probability of importation. The restricted risk analysis for apple leafcurling midge in the 2005 DIRA (BA, 2005, Part B pp168 – 173) considers the effect of inspection sampling on changing the probability of importation based on two sets of data about the prevalence of apple leafcurling midge, “the published data” and the “August 05 data”. It would appear that the analysis discussed on p171 of the

2005 DIRA (BA, 2005, Part B) is correct. That is, we would agree with the conclusion that a 3000 sample size is required in order to achieve the required effectiveness for sample inspection followed by fumigation, if necessary. The 600 sample size would not be adequate as explained on p171 of the 2005 DIRA (BA, 2005, Part B). Given that the '*worst case*' prevalence of 0.17%, in terms of the effectiveness of the sampling and fumigation, falls within the 'August 05 data' range (0.1% - 0.38%) of prevalence, it would seem that the conclusion to require a 3000 sample size per lot is necessary for the restricted risk estimation conclusions presented in Table 53, page 171 of the 2005 DIRA (BA, 2005, Part B).

A caveat is that the calculations have assumed that the sample is a random sample of apples in the lot. In p116 of APAL (2004) Industry mentions the possibility of pests being clustered within cartons. Assuming that apples are packed into cartons of 100 apples, it is quite possible that the 3000 sample size is taken as 30 cartons of 100 apples each. If the prevalence of 0.17% of apple leafcurling midge occurs at the carton level, with all apples in the carton infected/infested then the sample size becomes effectively 30 and not 3000. If this were the case then the conclusions about the effectiveness of the 3000 size inspection sampling and fumigation for reducing the risk to meet Australia's ALOP would not be correct.

In conclusion, the risk management measures suggested for apple leafcurling midge suggested on pp168 – 173 of the 2005 DIRA (BA, 2005, Part B) would appear to be reasonable provided that sampling is prescribed as a random sample of size 3000 from the lot.

3.12.1 Calculation of likelihood of entry, establishment and spread for Apple leafcurling midge

The calculation of likelihood of entry, establishment and spread is one of the two components required to obtain the risk estimate using Table 11 of page 39 of the 2005 DIRA (BA, 2005). The other component is the consequences of entry, establishment and spread.

For apple leafcurling midge the likelihood/probability of entry, establishment and spread (PEES) is obtained by multiplying one minus partial probability of entry, establishment and spread (PPEES) for utility, host combinations as described by Table 9, page 33 of the 2005 DIRA (BA, 2005, Part B). For apple leafcurling midge there are three tables of PPEES values: Table 44 on page 160, Table 45 on page 161 and Table 54 on page 172 of the 2005 DIRA (BA, 2005, Part B).

For the final calculation in order to determine the restricted risk estimation assuming 0.005% prevalence (achieved by 3000 size inspection sample and fumigation if necessary), Table 54 gives the relevant PPEES values. From Table 54 it should be noted that all probability values are $U(0, 10^{-6})$,

with a mean of 5×10^{-7} with two exceptions: the orchard wholesalers/commercial fruit crops value given as a $U(10^{-2}, 0.3)$ distribution, with a mean of 0.155; and the orchard wholesalers/wild and amenity plants value with a $U(10^{-6}, 10^{-3})$ distribution, with a mean of 0.0005. In terms of calculating the probability of entry establishment and spread given in Table 55 page 172 of the 2005 DIRA (BA, 2005, Part B) the median/mean value is very well approximated by

$$1 - (1 - 0.155)(1 - 0.0005)(1 - 5 \times 10^{-7})^{18}$$

or approximately $1 - (1 - 0.1555)$ or 0.1555

with all terms approximated by 1 in the product except the first. This gives the value 0.1555 in excellent agreement with the value 0.16 given for the median in Table 55 of the 2005 DIRA (BA, 2005 Part B, p172) for the value of probability of entry, establishment and spread. Thus the value of the probability of entry, establishment and spread is largely determined by the $U(10^{-2}, 0.3)$ value given to the partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops in Table 54 of the 2005 DIRA (BA, 2005 Part B, p172) with the other 19 values in the table for the purpose of this calculation taken as 0. **In the relevant part of the text (page 171, last paragraph) there appears to be little, if any, support or discussion given to this value of the partial probability of entry, establishment and spread but its value is absolutely crucial to the risk estimation in this case.** If the single $U(10^{-2}, 0.3)$ distribution were replaced by a distribution with a mean greater than 0.3 and all other entries of Table 54 keeping the same value, then restricted risk estimation would be 'low' and not meet Australia's ALOP. Thus for this restricted risk estimation it is critical to consider the value of $U(10^{-2}, 0.3)$ used in Table 54 of the 2005 DIRA (BA, 2005 Part B, p172) and how it might be supported because this value essentially determines the risk estimation. **There is no text in the 2005 DIRA (BA, 2005, Part B) to support this single choice of the $U(10^{-2}, 0.3)$ distribution for the partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops for this risk management scenario in Table 54.**

Industry can contrast this case of Table 54 with two other values of the partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops provided and these are given in Tables 44 (page 160), Table 45 (page 161) of the 2005 DIRA (BA, 2005, Part B).

Table 44 gives the value of partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops as $U(0.5, 0.9)$ and the text on p162 of the 2005 DIRA (BA, 2005, Part B) gives the reasoning. A critical aspect is the expected weekly numbers of insects arriving at the orchard wholesalers/commercial fruit crops combination given in Table 42 of the 2005 DIRA (BA, 2005 Part B; p155). The median numbers are 1223 and 41104 for each of 7 utility points (orchard wholesalers) estimated under two scenarios for the split of imported fruit between urban based re-packers and wholesalers and orchard packing houses determined by the value of P1 (see pp25 – 26 of BA, 2005 Part B). This analysis is based on a mean value of 4.1% of the infestation rate for apple leafcurling midge (p148; BA, 2005 Part B) which largely determines the numbers 1223 and 41104 given above from Table 42.

Table 45 (p161; BA, 2005 Part B) gives the values of partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops as $U(0.3, 0.7)$ based on the expected weekly numbers of insects arriving at the orchard wholesalers/commercial fruit crops combination in Table 43 (p156; BA, 2005 Part B).

The median values are 62 and 2058 based on the August 2005 data with an average prevalence or infestation rate of 0.0016%. **Text is given on p162 of the 2005 DIRA (BA, 2005 Part B) in the section headed ‘Probability of entry, establishment and spread - orchard wholesalers’ but no quantitative information is given to support this $U(0.3, 0.7)$ distribution and this choice is unsubstantiated by the text.**

Finally the value of $U(10^{-2}, 0.3)$ is given for partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops in Table 54 (p172; BA, 2005 Part B) but the equivalent of Tables 44 and 45, giving the expected weekly numbers, is not provided, nor is any other evidence. Industry presents below the summary evidence for partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops.

	Mean prevalence	PEES value	PEES mean	Expected weekly

				numbers
Table 44	4.1%	$U(0.5, 0.9)$	0.7	1223, 41104
Table 45	0.16%	$U(0.3, 0.7)$	0.5	62, 2058
Table 54	0.005%	$U(10^{-2}, 0.3)$	0.155	Not Available

On the basis of a ratio relationship between mean prevalence and expected weekly numbers we might extrapolate and estimate the weekly numbers of insects arriving for the 0.005% prevalence as 2 and 64 (calculated as 1/32 of 62 and 2058; $1/32 = 0.16\%/0.005\%$).

There is no support given in 2005 DIRA (BA, 2005) that if there were about 30 insects arriving each week at 7 commercial packing houses then the probability of entry, establishment and spread has an average value of 0.155 (or a distribution $U(10^{-2}, 0.3)$). It would therefore be reasonable to conclude that there is not a solid basis for the risk estimation of Table 56 (p172, BA 2005 Part B) meeting Australia's ALOP as this is highly dependent upon the value of $U(10^{-2}, 0.3)$ for partial probability of entry, establishment and spread for orchard wholesalers/commercial fruit crops given in Table 54 (p172; BA 2005, Part B). Thus to declare that Australia's ALOP is being met by these risk management methods is unsound.

3.13 Model Sensitivity

In Industry's assessment of the spreadsheet model associated with the 2005 DIRA (BA, 2005), Industry found that the outcomes with respect to Fire Blight were highly dependent on the values assigned to the model parameter "probability of exposure", which is given as a uniform distribution between zero and 10^{-6} , for all exposure groups and utility points (BA 2005, part B, p81). This corresponds to a qualitative category of negligible as given in the 2004 RDIRA (BA, 2004). However changing just one of these exposure probabilities, the probability that a discarded apple from the consumer utility point will cause infection in household plants, has profound consequences for the ultimate risk determination. In the case of Fire Blight, changing this from Uniform($0, 10^{-6}$) to Uniform($10^{-7}, 5 \times 10^{-5}$), the corresponding value in Roberts *et al* (1998), results in a median probability of entry establishment and spread of 1.76×10^{-2} , in the Very Low qualitative probability range, and a risk estimate of Low – above Australia's ALOP.

Based on the paucity of available evidence for this model parameter, and the failure to consider the effect of clustering and natural variation, and the very low probabilities being considered, the range for probability of exposure

proposed in Roberts et al. (1998) is no less plausible than the ‘Negligible’ distribution adopted in the 2005 DIRA (BA, 2005). To base firm decisions on the resulting risk estimate under these conditions is unsound.

3.14 Conclusions

Industry concludes that the 2005 DIRA (BA, 2005), while containing much that is improved over the previous draft, retains several important methodological flaws which seem very likely to result in underestimating the risk of importing apples from New Zealand to Australia. A key criticism of the 2005 DIRA (BA 2005) is that the so called bucket model is used throughout to interpret and assist with the elicitation of model probabilities. This has the effect of ignoring the natural variation inherent in pest and disease rates. Disease and pest transmission processes typically have hot-spots in time and space where the prevalence is much higher than the overall average rate associated with the bucket model, and it is these hot spots that represent the greatest threat of disease or pest incursion. This effect has not been considered in the construction and documentation of the model, and attempts to deal with it through consideration of scenarios are not convincing, as these scenarios are themselves generated by the same deficient model.

Industry found that the modelling used by the RAP is in the case of Fire Blight sensitive to single probabilities which are very small. These small probabilities cannot be judged with any accuracy, and are not based on any actual data. Industry found the model to be unduly sensitive to relatively small changes to these small probabilities, so much so that in the case of Fire Blight the conclusions of the model are dubious and unsubstantiated by evidence cited in the 2005 DIRA (BA, 2005).

In addition Industry found that uncertainty about model parameters is not transparently documented, but seems to be selected arbitrarily in many cases; that expert uncertainty about a model parameter is not clearly distinguished from natural variation in the parameter, from year to year and place to place; that the assessment of consequences seems arbitrary and overly simplistic; that uncertainty is thrown away in the assessment of risk and not properly considered; that the 50th percentile is used in risk estimation without sufficient appreciation of the implications for risk management of the distribution of likelihoods for entry establishment and spread; that the systems approach to risk reduction is applied without sufficient justification that the separate measures will act independently to reduce risk; and that as a result of these factors and the other issues discussed, it is highly likely that the risk associated with the import of apples from New Zealand has been substantially under-estimated.

3.15 References

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SECTION 4: The IRA standard for inspection of areas for Fire Blight symptom freedom

4.1 Introduction

The 2005 DIRA states on p96 that “a practical inspection regime should be specified as free from visual symptoms at an inspection intensity that would, at a 95% confidence level, detect visual symptoms if shown by 1% of the trees.” It is implicitly assumed that the inspection process cannot be perfect (100% confidence) in some (unspecified by the IRA) way and hence you have to make do with imperfection (the inspection scheme fails) and specify it using uncertainty, here 95% confidence that it gets it right. In the following discussion, the Industry will explain exactly what this statement means to the industry, and the implications for any inspection protocol.

Underlying rate of symptom visibility

The 1% refers to an assumed underlying proportion of trees showing visual symptoms, the rate of symptom visibility. The implication of assuming this underlying proportion to be 1% is the assumption that a 1% rate is an important benchmark, and you would like to detect this or any higher proportion of trees showing symptoms with a high degree of confidence. If the underlying proportion of trees showing symptoms turns out to be less than 1%, then you are far less confident of finding any symptom bearing trees in our sample. As the underlying proportion becomes lower, there is an increasing chance the region will be mistakenly declared symptom free. The implication is that a proportion of symptom bearing trees less than 1%, is for all practical purposes, representing much the same risk as an entirely symptom free area. In terms of risk management in the 2005 DIRA, the relevant question is whether the 1% benchmark reduces the import risk sufficiently. If not, then a case may be made for insisting on a reduction of the 1% assumed rate to a lower figure. Practically speaking, this would require the inspection of more trees in each export block.

Confidence Level

A sampling inspection schemes work on the basis on selecting N items from a block and if more than x are found with symptoms then the block is rejected. In the 2005 DIRA, AQIS schemes would reject a block if at least one defective is found in the sample. The 95% confidence level refers to how sure you can be that you reject the block. In this case, you assume rejection when at least one tree with symptoms is found. The 95% confidence is calculated as the probability you have found at least one tree with visible symptoms given that, on average, 1 in 100 trees show visible symptoms. If you were to look at just 50 trees, for example, there is a good chance that none of them would show symptoms. Even if you were to look at 100 trees, chance dictates that you would not always get one tree with visible symptoms. In fact, whenever you are selecting only a sample of trees to look at, there is a chance you may, through randomness, select only those

trees which are symptom free, and so miss all the trees with symptoms. The more trees in our sample, the smaller this chance of missing one with symptoms will be until you inspect all trees in the block and then you detect all trees with symptoms. The 95% confidence interval gives you a 5% chance of missing all trees with symptoms in the sample. In other words, if you were to send in 100 inspectors, one after the other, each of them randomly selecting a different sample of trees to inspect, then assuming they all followed the same protocol, on average, 95 of them would find 1 or more symptom bearing trees, while 5 of them would find no symptom bearing trees.

In other words, the 95% confidence interval tells you that there is a 5% chance that the protocol will declare an area to be symptom free when in fact there is a 1% visible symptom rate. If the symptom rate is higher than 1%, the same protocol will have a smaller chance of declaring symptom freedom erroneously and conversely if the symptom rate is smaller this chance will be larger than 5%.

4.2 Sample size required

The two figures of 95% and 1% can be used to work out the sample size required for an inspection. The standard modus operandi is to assume a binomial distribution, where trees are independently showing symptoms (that is, no clustering). This assumes the block size is large, say more than 3000 trees, and trees are selected at random for inspection (or symptoms occur randomly or both). If this is not the case the following has to be modified appropriately and will be discussed in a fuller response to the IRA. In this case, the probability of showing symptoms for each tree is $p=0.01$, N is the number of trees in a sample, which you need to find, and x is the number of trees in the sample showing symptoms. If you detect symptoms in the sample, then $x \geq 1$ and the 95% confidence interval can be expressed as

$$p(\text{detection}) = p(x \geq 1) = 1 - p(x = 0) = 1 - (1 - 0.01)^N = 1 - 0.99^N \geq 0.95$$

where you must select the sample size N so that detection occurs with at least 95% confidence.

Some algebra then allows you to solve for N :

$$1 - 0.99^N \geq 0.95$$

$$\Leftrightarrow -0.99^N \geq 0.95 - 1$$

$$\Leftrightarrow 0.99^N \leq 0.05$$

$$\Leftrightarrow N \log 0.99 \leq \log 0.05$$

$$\Leftrightarrow N \geq \frac{\log 0.05}{\log 0.99}$$

$$\Leftrightarrow N \geq 298.1$$

Rounding up, industry would expect that a sample of 300 trees would be needed to satisfy this standard.

How the 300 trees are to be chosen is another topic, which will be discussed more fully in this report on the 2005 DIRA.

4.3 Inspection Sensitivity

An additional issue that must be considered is the fact that inspections will not be 100% reliable. That is, an individual tree may be declared to be free of visible symptoms, while in fact symptoms are indeed present. This may be due to the inspector missing those symptoms for whatever reason, for example, fatigue, poor light conditions, insufficient time allotted to the inspection, and so on. There is a certain probability that visible symptoms will be missed in any particular tree, and this probability will differ for each particular protocol for detecting symptoms in a tree. In order to assess whether any given protocol will meet the standard, information must be provided on the probability that a tree will be declared free of symptoms mistakenly. The relevant figure is the inspection sensitivity, the probability that visible symptoms are detected on a tree given that visible symptoms are present on the tree. The sensitivity must always be less than or equal to one, and in practical cases will always be less than one. For example, if the sensitivity is 0.85, then out of 100 trees showing symptoms, the inspection will only turn up 85 of them on average. The implication is that the underlying rate of trees with visible symptoms will appear to be lower than it really is. The standard specified in the 2005 DIRA, for example, specifies an underlying symptom rate of 1%. However if the inspection sensitivity is 0.85, this underlying rate will appear to be 0.85%, not 1%. Therefore in order to meet the specified standard, there would be a need to take a sample size N based on a 95% confidence of detecting a 0.85% symptom rate. This would require a sample size of

$$N \geq \frac{\log 0.05}{\log(1 - 0.0085)} = 351$$

As the inspection sensitivity decreases, the sample size required to compensate must increase.

4.4 Definition of visible symptoms

It follows from the preceding discussion that unless “visible symptom” is unambiguously defined, neither the inspection sensitivity nor the inspection protocol (including sample size) can be reliably assessed. Indeed, by changing the definition of “visible”, one could virtually allow any desired rate of infestation while maintaining the 95% confidence of detecting a 1% rate of visible symptoms. Thus this definition is of fundamental importance, and it is a matter of some concern that this is not specifically defined in the 2005 DIRA.

4.5 Conclusions

The Australian Apple and Pear Industry conclude that the standard specified in the 2005 DIRA of “*at a 95% confidence level, detect visual symptoms if shown by 1% of the trees*” has a number of implications of concern. These implications include an assessment that a rate of 1% of trees with visible symptoms is the appropriate level for determining whether the import risk is sufficiently reduced; that a 95% confidence interval is appropriate, implying a 5% chance that blocks will be judged symptom free when in fact visual symptoms are present in 1% of trees; that a sample size of 300 trees is implied, assuming perfect inspections; and that the sample size will increase as inspection sensitivity decreases. This last point requires any protocol to provide some justification for the sensitivity of inspections. Finally, without a detailed definition of “visible symptom”, no protocol can be effectively assessed against this standard, and indeed, the standard is virtually meaningless.

SECTION 5:

FIRE BLIGHT

EXECUTIVE SUMMARY:

The extremely devastating nature of Fire Blight in countries where it is already known to exist is a fact that horticulturists as well as plant pathologists all over the world readily accept. If the disease is introduced into Australia its potential to cause very serious losses to the pome fruit industry has been clearly acknowledged in all the import risk analyses that have hitherto been carried out by Biosecurity Australia (BA) with respect to the importation of apples and pears. Fire Blight has the nature of causing devastating losses not only in the initial stages of its introduction into an area or a country but also periodically in cycles thereafter.

Since Fire Blight was first observed in the USA in 1793 it has progressively spread now to 46 other countries with a large majority of the introductions having occurred after the 1950's. However, the exact means by which the disease has been introduced to any of these countries, with the exception of only Egypt, still remains unknown.

Yet fruit, which in nature does get infested and infected, does bear disease symptoms, and exported around the world in millions of tones is not even speculatively suspected by authorities in apple exporting countries as being able to introduce the disease to countries where it has not been previously known. The infestations that apple fruit carry could be either on the surface, in the calyx or in the stem-end cavity (epiphytic); the infections are internal and could be endophytic, without exhibiting any symptoms, or with discernible symptoms.

The Australian Apple and Pear Industry response has considered a wide range of issues and is based on relevant scientific evidence that has already been published; however, where such evidence is not available in the literature relevant research published on other species of bacteria or other related scientific works will be cited to support the points made. Where no evidence whatsoever is available a conservative approach will be taken to drive home the point on the lines that "*absence of evidence does not necessarily mean evidence of absence*".

Basically, the broad purpose of this part of the response is to show that if New Zealand apples were to be imported the three risk management measures (plus consignments free of trash) proposed in the 2005 DIRA do not lower the risk of introducing Fire Blight into Australia. This would mean that the level of risk that Australia would accept, if the import of apples is allowed, will be above the Appropriate Level of Protection (ALOP) stipulated in the 2005 DIRA.

In the light of current understanding of the disease the Australian Apple and Pear Industry cannot visualise or imagine a set of risk mitigation measures (with or without a systems approach) that would lower the Unrestricted Annual Risk to a level that would not exceed Australia's ALOP.

The presentation of material in all three parts of the document is good, although the Australian Apple and Pear Industry does not necessarily agree with the RAP with respect to several areas. These will become evident when the Industry response is examined in detail. However, the Australian Apple and Pear Industry was pleased to find that a good proportion of the literature cited by Industry in its response to the 2004 RDIRA has been adopted by the RAP in the 2005 DIRA, even though the interpretation of the papers may not have been the same in some cases. Anyway, citing those papers has certainly made the Industry's task in responding to the new IRA much easier.

The detailed review on the disease and the pathogen, *E. amylovora*, in Part C of the document, gives a balanced picture with an exhaustive coverage of the literature. It was quite noticeable that the review extensively discusses the "epiphytic" phase of the life cycle of the pathogen, by citing numerous papers describing the epiphytic existence of the organism.

In assessing the unrestricted risk as "**Moderate**", after factoring in "Consequences" as "**High**", the RAP has taken a more realistic approach compared to that taken by them in 2004 RDIRA. However, the conclusion it has arrived at in assessing the restricted risk as "**Very Low**" is not sustainable as the risk mitigation measures considered, taken singly or in the form of a systems approach, cannot deliver the stated outcome.

Quite apart from the risk of introducing Fire Blight into Australia there is another risk that is as important as introducing Fire Blight. This is the likelihood of importation of strains of *E. amylovora*, with infested/infected apples, that are resistant to streptomycin.

The RAP has identified the importation of trash (Part B, page 48) as a potential pathway for the introduction of *E. amylovora* into the country. The Industry believes the evidence from the literature demonstrate that trash in the form of small stem pieces, twigs and leaves may be infected or infested with *E. amylovora* and would pose a real risk in introducing Fire Blight into countries free of the disease.

A pathogen is said to exist as an endophyte when it resides within its host tissue without necessarily causing symptoms of the disease. Apples carrying endophytic infections cannot be distinguished externally from healthy fruit. However, they may begin to show symptoms of fruit blight several weeks after harvest under conditions favourable for disease development and may act as potent sources of inoculum as it happens in Missouri (Goodman 1954). As it is with calyx infestations there are no treatments available for eliminating these endophytic infections.

More recently, Azegami *et al* (2006) experimentally demonstrated the systemic movement of Fire Blight bacteria from the stem into the fruit. These results show that bacteria can pass through the abscission layer into the fruit, even though the mature fruit lack symptoms.

2005 DIRA has made reference to the following areas of new science which were discussed in considerable detail in the APAL's response to 2004 RDIRA:

- (a) Viable but non-culturable bacteria (VBNC),
- (b) Biofilms/aggregates,
- (c) Sigma factor.

2005 DIRA does not seem to consider these areas of new science as relevant to the assessment of risk with respect to the importation of apples from countries having fire blight. In this response the Australian Apple and Pear Industry has discussed in considerable detail the subject of VBNC and its relevance to conclusions drawn on the basis of results obtained by culturing the pathogen on or in culture media.

The significance of the occurrence of the VBNC state of *E. amylovora* on the surface of the mature apple fruit or in the calyx of the fruit is primarily with respect to the detection of the pathogen using solid media. As the organism is non-culturable it will not be detected on culture media. Biosca *et al* (2006) conclude that the existence of such viable but non-culturable (VBNC) cells of *E. amylovora* could lead to an underestimation of the pathogen population from environmental sources when using only cultural methods. Ordax *et al* (2006a; 2006b) found that the removal of copper ions with copper complexing agents was effective in all cases of restoring the culturability of copper-induced VBNC cells, but their ability to recover such cells varied depending on the time after the entry of *E. amylovora* into the VBNC state.

E. amylovora cells in apple calyces exist under adverse conditions especially with respect to nutrients. Under such conditions *E. amylovora* cells are very likely to enter the VBNC state as a mechanism for survival. Use of copper based bactericides in late autumn, winter and particularly in spring about 10 days prior to flowering, as practised in New Zealand, in the management of black spot, would also contribute to *E. amylovora* cells entering the VBNC state. Consequently, they may not be detectable by culture plating methods.

Thus, this physiological cell state could be involved in the recurrent infections of Fire Blight, and therefore, be responsible of its difficult control. In fact, the occurrence of phytopathogenic bacterial cells in the VBNC state could have serious implications in plant pathology, since epidemiological studies are usually based on plate counts of culturable cells (Wilson and Lindow, 2000)" (Ordax *et al* (2005; 2006a; 2006b).

Following a review of the more recent literature on pest survival the Australian Apple and Pear Industry is convinced that the RAP should carefully consider the following areas of new science with respect to the import risk analysis on the importation of apples from New Zealand: multicellular behavior, biofilms/aggregates, sigma factor and quorum sensing.

There is increasing evidence that *E. amylovora* engages in multicellular behaviour. Bacterial multicellular behaviour begins when free living planktonic bacteria engage in quorum sensing.

Although it is not yet documented that *E. amylovora* is capable of developing a particular multicellular structure like biofilm, *E. amylovora* utilizes mechanisms associated with multicellular behaviours such as quorum sensing and the multidrug efflux system and has demonstrated characteristics which are common to biofilm producing bacteria *viz* the

presence of flagella, the production of EPS as well as presence of particular genes that participate in TTSS and expression of sigma factors.

In the short time since the relatively recent discovery of bacterial biofilm on plant surfaces, the capacity of *E. amylovora* to produce identified biofilm precursors has been demonstrated. It is in this context that the incomplete but developing understanding of this new science invites caution, so as to not be misled by the present absence of observed biofilm associated with *E. amylovora*.

The protocol proposed by the RAP (2005 DIRA), with a single inspection carried out 4-7 weeks after full bloom, is considered by the Industry as inadequate.

This is an enormous task that is difficult to achieve though essential to reduce the risk to the importing country; the practical difficulty here would be, in the first place, to detect from ground level small (3-5 mm in diameter) but active cankers found on twigs and branches at the top of the tree.

It is evident that epiphytic bacteria in the calyx sinus and endophytic bacteria pose the greatest risk with respect to importation of fruit from New Zealand. The scientific evidence presented below clearly indicates calyx infestations and endophytic infections are present in mature fruit even in the absence of any apparent disease symptoms in orchards; this is because there are no areas in New Zealand that are free of Fire Blight. Thus, although it is not possible to harvest fruit that are totally free of such infestations/infections, a protocol comprising a minimum of 3 orchard inspections is required.

The occurrence of *E. amylovora* in apple fruit calyces or internal fruit tissue has been reported by Sholberg *et al* (1988), van der Zwet *et al* (1990) and Clark *et al* (1993) from trees free of Fire Blight symptoms but they were in close proximity to trees with symptoms.

The examples cited clearly demonstrate that the presence of Fire Blight symptoms on pome fruit or other alternative hosts in close proximity to symptom free apple trees could result in both endophytic infections and epiphytic calyx infestations/infections in immature as well as mature fruit.

In countries having Fire Blight the disease may occur in an orchard that did not show any apparent symptoms in the previous year or years; similarly, an orchard may not exhibit any apparent symptoms in the current year although symptoms have appeared in the preceding year or years. This is quite a common phenomenon and Fire Blight researchers are still perplexed by this as it cannot be explained simply by the present knowledge of the epidemiology of the disease (van der Zwet and Keil, 1979). Van der Zwet *et al* (1988) attributed it to the lack fundamental knowledge of the causal bacterium and its mode of infection.

The Industry believes that there is sufficient scientific evidence to prove that

- (a) fruit harvested from orchards or trees free of Fire Blight symptoms in close proximity to host plants showing disease symptoms carry fruit infestations/infections;

- (b) orchards free of symptoms in the current season but had symptoms in previous years carry fruit infestations/infections.

Thus, in selecting export orchards a protocol which excludes

- (i) orchards in close proximity to Fire Blight hosts showing symptoms
 - (ii) orchards that have exhibited symptoms in the two previous years
- would at least to some extent reduce the proportion of these infestations/infections. Coupled with these steps and the 3 orchard inspections recommended, statistically representative samples of immature and mature fruit at harvest should be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004).

The Australian Apple and Pear Industry fully agrees with the concerns expressed by 2005 DIRA as to the difficulty which aggregates/biofilms pose to the efficacy of washing apples. The Industry also agrees with the 2005 DIRA statement (on page 63) that *“epiphytic bacteria, especially those in the protected calyx cavity, would not be removed in dump tanks, at least in close calyx cultivars”*.

The Industry does not have enough information to be satisfied that even those 53% of packing houses that use the chlorine based system or alternative are able to maintain the crucial parameters that contribute to some level of sanitation. Even if chlorination levels were scrupulously maintained at 5-50 ppm, the expected efficacy of sanitation is likely to be marginal.

In terms of importation steps, chlorine may affect low levels of reduction in bacterial numbers in Importation Steps 4 and 5, but will not reduce Importation Step 3 (contamination during picking and transport) even with a 100 ppm level as the RAP assumes.

The biggest challenge for washing apples would be to maintain the quality of the sanitizing water in the tanks. When batches of apples are processed in dump tanks, the level of available chlorine would be expected to quickly deteriorate as organic matter would react with the chlorine in dump tanks. Non automatic systems cannot guarantee maintenance of the required chlorine level. With respect to automated systems it is necessary that the contact time is sufficient to achieve the expected disinfection rate.

The Australian Apple and Pear Industry concludes that epiphytic populations of *E. amylovora* are highly fluctuating and that fluctuations are driven by a variety of environmental and other factors, including weather and the size of transient populations and the survival advantage conferred by common surface variability and trauma.

Under Importation Step 4 there is no mention in the 2005 DIRA of the sanitation of equipment in packing houses that export apples would come into contact with during packing house operations. Unless measures are taken regularly to ensure sanitation of this equipment there is a very high possibility that export apples will get cross contaminated from non-export apples *via* such equipment.

The Australian Apple and Pear Industry would like to point out that the washing operations of export apples and non export blocks are not separated, therefore the sources of cross-contaminations are multiple.

The Australian Apple and Pear Industry's assessment is that trash or soil as well as apples will introduce *E. amylovora* to the wash waters. The contamination of water has a cumulative effect. In the unrestricted scenario where the pest is present in the source orchard, it is fair to assume that *E. amylovora* would accumulate in the wash waters and that they would become a source of inoculum.

Theoretically *E. amylovora* should be able to enter its hosts through any surface either through natural openings like stomata or lenticels or through wounds caused by wind damage, hailstorms etc. Infection of blossoms occurs through natural openings, including stigmas, anthers, stomata on the styles, fruit surfaces and sepals, hydathodes, nectarhodes (Thomson, 2000). In shoots invasion of the host tissue following entry occurs largely in actively growing young leaves. Entry into mature tissue is predominantly through wounds. However, infections occurring in apple or pear orchards in late summer following hailstorms are known to cause severe symptoms and inflict serious damage to the trees.

The exact mode of infection of the host by *E. amylovora* is still not properly understood.

It is apparent that the means by which Fire Blight has been introduced to over 95% of the countries where it is currently known to occur is based on pure speculation. Apple and pear fruit may have been exported to numerous pome fruit growing countries from the time the disease was first reported in the USA in 1793. However, it is a mystery as to why among these suspected means of introductions fruit has not been to date implicated, especially when it is known that fruit could be both infected (without exhibiting external symptoms) and infested (calyx).

Using the information below, fruit from orchards apparently free of Fire Blight symptoms have been shown to have calyx infestations and endophytic infections. For this reason and for reasons stated above, Industry considers the restricted likelihoods given by the RAP in Table 24 of the 2005 DIRA, implying a 10 to 10⁵ fold reduction of the unrestricted likelihoods for Imp 2, 3 and 5, is excessive with this mitigation measure.

Although the Australian Apple and Pear Industry acknowledges that some reduction in the likelihoods for Imp 2 and Imp 3 would occur the magnitude of the reductions for the two Imps in the 2005 DIRA is considered excessive (Table 24 in the 2005 DIRA document). Industry's median values for unrestricted risk are 0.2, 0.175 and 0.5 respectively for Imp 2, Imp 3 and Imp 5. It may be noticed that these values are marginally lower than those allocated by APAL in 2004 (in its response to 2004 RDIRA) as a result of allowance being made for inspections done from spring to mid-summer even in the case of unrestricted risk. Similarly, Industry would assess the restricted likelihoods as 0.16, 0.125 and 0.5 respectively for Imp 2, Imp 3 and Imp 5 (Table 3). It is apparent that the effect of "areas free from disease symptoms" has been overstated in 2005 DIRA.

CONCLUSIONS AND RECOMMENDATIONS:

1. The Australian Apple and Pears Industry's estimations of likelihoods given for the Importation Steps under Unrestricted and Restricted Risk, presented below, have been worked out against the backdrop of the scientific evidence.
2. The Australian Apple and Pear Industry believe that currently, there are no known methods that could eliminate the bacteria in the calyces and those deep in the stem-end cavity.
3. The Australian Apple and Pear Industry is fully convinced of the significance of epiphytic populations of *E. amylovora* in the import risk analysis of New Zealand apples, especially with respect to Importation Steps 2, 3 and 5.
4. The Australian Apple and Pear Industry believe that in some of the earlier research done in the USA, when commercial trade in apples with other countries was not an issue, the importance of epiphytic bacteria in the epidemiology of Fire Blight and, therefore, of the disease cycle was consistently emphasized.
5. The 2005 DIRA states that at the time of harvest epiphytic populations of bacterial numbers are likely to be very small. The Australian Apple and Pear Industry believe this statement is not entirely accurate. Rapid decline was observed in reports with poor harvesting techniques (Ceroni 2004) or in short inoculation studies (Norelli 2004). When the results of more sensitive techniques used by Thomson and Gouk (1999) were examined, it was found that towards the end of the season as much as 90% of leaves were infested with *E. amylovora*.
6. The Australian Apple and Pear Industry believe that streptomycin resistance are of two type's viz. chromosomal based resistance and plasmid based resistance. Although plasmid based resistance is less common than the chromosomal type it is more dangerous than the chromosomal type as the resistance genes could be easily transferred to other bacteria, some of which may be important human and animal pathogens.
7. The Australian Apple and Pear Industry believe that in the absence of validation of the efficacy of the harvesting techniques which incorporates the current state of knowledge with respect to bacterial behaviour, the absence of bacterial detection can tell very little. There is an urgent need to evaluate the harvesting techniques to establish the reliability of previously published results and the relevance of those results as a foundation for the conclusions drawn by 2005 DIRA.
8. The Australian Apple and Pear Industry believe that the physiological cell state – VBNC - could be involved in the recurrent infections of Fire Blight, and therefore, be responsible of its difficult control. In fact, the occurrence of phytopathogenic bacterial cells in the VBNC state could have serious implications

- in plant pathology, since epidemiological studies are usually based on plate counts of culturable cells (Wilson and Lindow, 2000)” (Ordax *et al* (2005; 2006a; 2006b).
9. The Australian Apple and Pear Industry believe that for inspections to have any effect at least three inspections must be carried out during the growing season outlined as follows:
 - a) **The first inspection would be in spring just before bud break.**
The purpose of this inspection is to exclude from the export program those orchards having any obvious overwintering cankers on the trees.
 - b) **The second inspection would be at full flowering.**
The purpose of this inspection is to exclude those orchards with any primary blossom blight symptoms and also any overwintering cankers that may have escaped attention in the first inspection.
 - c) **The third inspection would be at time of harvest.**
The purpose of this inspection is to exclude those orchards with any secondary blossom blight symptoms, shoot blight symptoms on suckers or water shoots and any cankers that may have escaped attention during the first and second inspections.
 10. The Australian Apple and Pear Industry recommend that an extra orchard/block inspection be carried if hail, excessive rain or wind storms are experienced in the orchard/block area.
 11. The Australian Apple and Pear Industry recommend that coupled with orchard inspections statistically representative samples of immature and mature fruit must be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004).
 12. The Australian Apple and Pear Industry believe that there are problems that are likely to be encountered in using ISPM 22 with respect to the export of New Zealand apples to Australia and need to be considered within the risk mitigation protocols:
 - a) The definition of the term “area” used in the context of ALPP in ISPM 22 appears to be much broader and covers a larger area than just an orchard or a block in an orchard.
 - b) How would MAFNZ determine the levels of *E. amylovora* populations (pest population) in a given area in order to designate it as an ALPP?
 - c) What specific *E. amylovora* population level would MAFNZ consider a given area would qualify to be declared an ALPP?

- d) If MAFNZ is to consider low disease prevalence as equivalent to low pathogen/pest prevalence what specific Fire Blight symptoms level would qualify a given area to be declared as an ALPP?
 - e) To consider low disease prevalence as equivalent to low pathogen/pest prevalence is strictly not correct. How would MAFNZ circumvent this problem?
 - f) Under the primary specific requirement “phytosanitary measures” for establishing ALPP is the secondary requirement “reducing pest levels and maintaining low prevalence”. This would entail regular inspection of export orchards/blocks (ALPP) and removal of any diseased material found. Such action is in conflict with any protocol the RAP would agree to with respect to risk mitigation measures (2005 DIRA), because the purpose of the protocol inspections are to eliminate orchards/blocks that show disease symptoms.
13. The Australian Apple and Pear Industry recommend that in selecting orchards/blocks for sourcing apples for export, it will be essential not to include orchards/blocks that are in close proximity to host plants or orchards showing disease symptoms.
 14. The Australian Apple and Pear Industry recommend that in selecting orchards/blocks for the export program those showing symptoms must be strictly excluded from the program at least for a period of two years.
 15. The Australian Apple and Pear Industry believe that bacterial internalization may offer the bacteria additional protection from sanitation during subsequent processing and have the opposite effect with respect to risk mitigation.
 16. The Australian Apple and Pear Industry is concerned that some of the Orchard Management practices in New Zealand listed in the 2005 DIRA (page 50) if carried out routinely in source orchards would lead to erroneous results on Restricted Risk. The practices in question are:
 - (1) pruning out infected shoots; this would lead to wrong conclusions by inspectors in regard to the disease status of the orchard.
 - (2) frequent inspections of the orchard (*and pruning and burning infected material*). If these are done under assessment of unrestricted risk then it should not be considered again under assessment of restricted risk; it amounts to double counting.
 17. The Australian Apple and Pear Industry have assessed the risks relating to the Importation Steps and recommend the following:-
 - a) The Australian Apple and Pear Industry agrees with the assessment of Imp1, likelihood for this importation given in the 2005 DIRA (likelihood – 1).

- b) The Australian Apple and Pear Industry are assigning to Imp 2 a most likely value of 2×10^{-1} , a minimum value of 2×10^{-2} and a maximum value of 5×10^{-1} .
 - c) The most likely value assigned by the Australian Apple and Pear Industry for Imp 3 is 1.75×10^{-1} ; the minimum value assigned is 2×10^{-2} and the maximum value 5×10^{-1} .
 - d) The Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 4.
 - e) The Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 5.
 - f) The Australian Apple and Pear Industry agrees with the values assigned in the 2005 DIRA for Importation Step6 viz a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1).
 - g) The Australian Apple and Pear Industry agrees with the values assigned in the RDIRA –2005 for Importation Step7 viz a most likely value of 5×10^{-7} , a minimum value of 0 and a maximum value of 5×10^{-7} .
 - h) The Australian Apple and Pear Industry agree with the value of 1 assigned in the 2005 DIRA for Importation Step8.
18. The Australian Apple and Pear Industry recommend that sanitation of packing house equipment should be included in any protocol drawn up in connection with export of apples to Australia.
19. The Australian Apple and Pear Industry believe that the washing operations of export apples and non export blocks are not separated, therefore the sources of cross-contaminations are multiple and as a result recommend that separation of washing operations be part of the risk mitigation protocol
20. In view of the higher costs for the control of Fire Blight worked out by the Australian Apple and Pear Industry in comparison to that given in the 2005 DIRA, Industry considers it more appropriate to assess the Consequences as “**Certain**” (1) rather than “**High**” as given by the RAP. However, as the range for “**High**” according to Table 12 in the 2005 DIRA is from 0.7 to 1, the rating of “**High**” allocated for Consequences is acceptable for convenience of comparison with the 2005 DIRA estimation of Unrestricted risk.

5.1. INTRODUCTION:

The extremely devastating nature of Fire Blight in countries where it is already known to exist is a fact that horticulturists as well as plant pathologists all over the world readily accept. If the disease is introduced into Australia its potential to cause very serious losses to the pome fruit industry has been clearly acknowledged in all the import risk analyses that have hitherto been carried out by Biosecurity Australia (BA) with respect to the importation of apples and pears. Fire Blight has the nature of causing devastating losses not only in the initial stages of its introduction into an area or a country but also periodically in cycles thereafter. Thus, recently, in 1998, a very serious outbreak of Fire Blight occurred in the Hawkes Bay area in New Zealand. It resulted in losses that amounted to NZ\$ 10 million (Vanneste 2000). In the USA, an epidemic in 2000 in the southwest Michigan area that started as a mild blossom blight infection, later developed into a severe shoot blight resulting in the death of over 220,000 trees and the removal of more than 340 ha of apple orchards. The total economic loss as a result of this epidemic had been estimated at US\$ 42 million (Longstroth 2000).

Since Fire Blight was first observed in the USA in 1793 it has progressively spread now to 46 other countries with a large majority of the introductions having occurred after the 1950's. However, the exact means by which the disease has been introduced to any of these countries, with the exception of only Egypt, still remains unknown. In the case of Egypt it was established that LeConte pear trees imported from Florida in 1964 introduced Fire Blight to that country. It is somewhat interesting to note in the literature that various authors speculatively attribute the introductions to disseminating agents like air currents, nursery stock, fruit boxes and even birds; with the exception of nursery stock, none of the other agents, including birds, is infected by the Fire Blight bacterium. Yet fruit, which in nature does get infested and infected, does bear disease symptoms, and exported around the world in millions of tones is not even speculatively suspected by authorities in apple exporting countries as being able to introduce the disease to countries where it has not been previously known. The infestations that apple fruit carry could be either on the surface, in the calyx or in the stem-end cavity (epiphytic); the infections are internal and could be endophytic, without exhibiting any symptoms, or with discernible symptoms.

The present response by the Australian Apple and Pear Industry (Industry) to the "*Revised Draft Import Risk Analysis on the Importation of New Zealand Apples – December 2005*" (2005 DIRA) is based on science on the disease that has been reported in the literature to date. However, it is important to bear in mind the following with respect to scientific reports on the subject:

- (a) The most urgent matters to be researched by countries affected by this devastating disease is in relation to the management and control of the disease, not whether the disease is going to be introduced with apple fruit into another country free of Fire Blight. Would it be fair to expect such countries to invest

time and money investigating matters that are of very little or no relevance to them but are important to countries with big pome fruit industries trying to prevent the introduction of this disease?

- (b) As to whether an apple fruit carrying the Fire Blight bacterium, *Erwinia amylovora*, in its calyx could act as a source of primary inoculum, and how these bacteria could be transferred from the fruit to a susceptible host, to cause a new infection the following season (ie overwintering) is a question that is of utmost significance only to countries free of the disease, but have economically important pome fruit industries to sustain and protect against this devastating disease. This would be a question of very little or no significance at all to countries with Fire Blight, as there are enormously more significant sources of inoculum these countries have to deal with, research, manage and control. Unfortunately, it would be a huge quarantine risk for those countries free of the disease to import virulent *E. amylovora* cultures to conduct research on these areas themselves. On the other hand, would it be fair to expect countries having Fire Blight to invest time and money investigating matters that are of very little or no relevance to them?
- (c) Apart from not investigating research areas that are of no relevance and importance to countries having Fire Blight, even if these have been investigated results may not be reported as there would be nothing to be gained for them by reporting such matters.
- (d) In regard to certain events there are no plausible scientific explanations or evidence as to how and why these occur. Various theories may be proposed to explain the occurrence of these events but without any sound evidence for the theories forwarded. Where important decisions have to be taken in connection with these matters a conservative approach, on the side of caution, would be the best course of action, for, as one Fire Blight researcher put it at a Fire Blight Workshop in 1986 “absence of evidence does not necessarily mean evidence of absence.”

In the light of above the Australian Apple and Pear Industry response will be based on relevant scientific evidence that has already been published; however, where such evidence is not available in the literature relevant research published on other species of bacteria or other related scientific works will be cited to support the points made. Where no evidence whatsoever is available a conservative approach will be taken to drive home the point on the lines that “*absence of evidence does not necessarily mean evidence of absence*”.

The concept of the Disease Triangle (Figure 5.1), depicting the interaction between the host, pathogen and the environment, which is the foundation to the discipline of plant pathology, will form the fundamental basis for the response. For disease to occur all the components of the triangle must be present, with the environment being favourable for infection and development of disease.

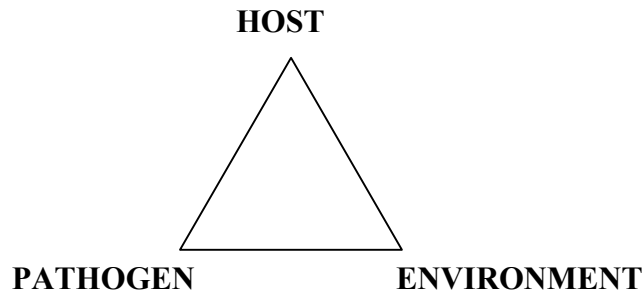


Figure 5.1 Disease triangle showing the interacting components of host, pathogen and the environment

In the case of Fire Blight the host component principally includes apple, pear, hawthorn, firethorn, cotoneaster, quince and sorbus; 129 other species of plants belonging to the family *Rosaceae* have also been found to be susceptible to a lesser degree. The pathogen component is the bacterium *E. amylovora*. The environment component comprises both meteorological and edaphic factors. Temperatures between 21-26 °C and high humidity are optimal for disease development. In regard to edaphic factors, rich soils which promote vigorous succulent growth of trees are particularly favourable for disease development.

Basically, the broad purpose of this response is to show that if New Zealand apples were to be imported the three risk management measures (plus consignments free of trash) proposed in the 2005 DIRA do not lower the risk of introducing fire blight into Australia. This would mean that the level of risk that Australia would accept, if the import of apples is allowed, will be above the Appropriate Level of Protection (ALOP) stipulated in the 2005 DIRA. Consequently, the Fire Blight pathogen (*E. amylovora*) will become available to susceptible host plants in sufficiently large numbers, under environmental conditions favourable for the disease, to complete the Disease Triangle leading to the establishment and spread of the disease in Australia. The Australian Apple and Pear Industry acknowledges and clearly understands that Australia does not have a “Nil Risk” policy with respect to produce imports; the acceptable risk needs to be either “negligible” or “very low”.

The specific objectives of the Australian Apple and Pear Industry response to the 2005 DIRA are:

- to show that an epidemiologically significant (the epidemiological significance referred to here applies only to countries free of Fire Blight) proportion of apple fruit harvested from orchards/blocks in New Zealand, either with or without apparent symptoms of Fire Blight, will carry some levels of epiphytic and endophytic *E. amylovora*; epiphytic bacteria will be on

the surface of fruit, in the calyx sinus or in the stem end cavity. Endophytic bacteria will be in the core and pulp areas of the fruit.

- to show that detection and estimation of bacterial numbers, especially epiphytic populations, using conventional washing techniques to recover the bacteria, would lead to significant underestimation and to conclusions of their absence, due to the formation of bacterial aggregates firmly attached to the surface of host tissue.
- to show that the presence of the bacteria on or in host tissue may not always be detected by culturing due to the occurrence of viable but non-culturable (VBNC) bacteria; the VBNC state in *E. amylovora* has been shown to be induced by nutrient stress and by copper ions. This would lead to conclusions of absence of *E. amylovora*.
- to show that sourcing of fruit from orchards/blocks with no apparent symptoms would only marginally reduce the infestation/infection levels.
- to show that at present there is no practical chemical or other treatment known that could eliminate the endophytic bacteria and bacteria in the calyx sinus or some of the bacteria deep in the stem end cavity.
- to show that cold storage will not kill bacteria in the calyx or elsewhere; it only increases the longevity of the bacteria. Any reduction observed would be a result of decline due to length of time in storage. Pre-cooling apples would facilitate internalisation of bacteria on the surface and have the opposite effect.
- to show that the very best that could be achieved with the 3 combined proposed risk mitigation measures (systems approach) would not exceed a 3 fold reduction of the unrestricted risk estimate; by this the Industry does not mean a 3 fold reduction in bacterial population levels in the fruit.
- In view of the aforementioned the unrestricted annual risk would be above **“Moderate”** and approaching **“High”** (0.7), when the **“High”** consequences (assigned by the RAP as well as by the Industry) is factored into the model. Thus, the minimum restricted annual risk would be greater than **“Moderate”** (0.3 – 0.7).

In the light of current understanding of the disease the Australian Apple and Pear Industry cannot visualise or imagine a set of risk mitigation measures (with or without a systems approach) that would lower the Unrestricted Annual Risk to a level that would not exceed Australia’s ALOP. As stated above and discussed in detail below, at present there is no chemical or other treatment known which is practicable, that could eliminate the endophytic bacteria and bacteria in the calyx sinus. It would mean that despite this risk if the decision is taken to import New Zealand apples then there is no other choice except for the industry to accept these apples with a moderate level risk. Envisaging this possibility the Australian Apple and Pear Industry would propose a basis for a protocol that would hopefully lower the Unrestricted Annual Risk to a **“Low” or slightly above “Low” level, which, of course, would still exceed Australia’s ALOP.** The various steps comprising actions needed to be taken in the protocol are given in the conclusions for each of the major sections and Importation Steps discussed below.

5.2 COMMENTS ON THE GENERAL FEATURES OF THE 2005 DIRA RELATING TO FIRE BLIGHT

The presentation of material in all three parts of the document is good, although the Australian Apple and Pear Industry does not necessarily agree with the RAP with respect to several areas. These will become evident when the Industry response is examined in detail. However, the Australian Apple and Pear Industry was pleased to find that a good proportion of the literature cited by Industry in its response to the 2004 RDIRA has been adopted by the RAP in the 2005 DIRA, even though the interpretation of the papers may not have been the same in some cases. Anyway, citing those papers has certainly made the Industry's task in responding to the new IRA much easier.

The detailed review on the disease and the pathogen, *E. amylovora*, in Part C of the document, gives a balanced picture with an exhaustive coverage of the literature. It was quite noticeable that the review extensively discusses the “epiphytic” phase of the life cycle of the pathogen, by citing numerous papers describing the epiphytic existence of the organism. However, it was evident that there was some reluctance to refer to the pathogen as an epiphyte, except at the stage in the life cycle of the pathogen when it is multiplying exponentially on the stigma surface of the flowers. This is the new trend with Fire Blight researchers despite the fact that a large body of earlier research firmly established the existence of an epiphytic phase, especially on buds and stems of host plants (van der Zwet and Keil 1979). The latter publication by van der Zwet and Keil (1979), reviews the earlier research that supports the epiphytic nature of the pathogen and illustrates the life cycle of *E. amylovora* giving a pivotal role for the epiphytic phase; the epiphytic phase is also referred to by van der Zwet and Keil (1979) as the “resident phase”. The epiphytic phase is very significant in the assessments of likelihoods for unrestricted risk and restricted risk with respect to Importation Steps 2, 3, 4 and 5 in 2005 DIRA.

In regard to Part B of 2005 DIRA, the material presented, including the literature cited, is considered fair; however, the likelihoods assessed by the RAP for unrestricted risk with respect to Importation Steps 2, 3, 4 and 5 were considerably less than those that could be expected if these assessments were realistically based on the material presented by the RAP. Similarly, the likelihoods for restricted risk with respect to the same importation steps were much lower than what could be expected, because of an over-rating of the effectiveness of the risk mitigation measures, especially “*Areas free from disease symptoms*” and “*Disinfection treatment*”. Also, the 2005 DIRA has not given sufficient consideration to areas like the possible importation of trash with very large fruit consignments, areas of new science, antibiotic resistance and other topics which will be listed and discussed in detail below.

A few of the comments made with respect to Part B also apply to the material presented on Fire Blight in Part C. (2005 DIRA)

In assessing the unrestricted risk as “**Moderate**”, after factoring in “Consequences” as “**High**”, the RAP has taken a more realistic approach compared to that taken by them in 2004 RDIRA. However, the conclusion it has arrived at in assessing the restricted risk as “**Very Low**” is not sustainable as the risk mitigation measures considered, taken singly or in the form of a systems approach, cannot deliver the stated outcome. One of the reasons for this is the underestimation of likely levels of epiphytic *E. amylovora* in the calyx sinus of fruit with respect to both unrestricted and restricted risk. The Australian apple and Pear Industry accepts that fruit from an orchard or block that is free of visible symptoms would have a lower level of calyx infestation, but not as low as that estimated by the RAP.

In regard to inspecting orchards/blocks a practical problem arises as to how “free from disease symptoms” is going to be achieved. The presence of small active cankers on twigs and small branches, which are very important in the epidemiology of the disease, at the top of the tree canopy cannot be seen from the ground level. Also, the 2005 DIRA does not seem to consider the influence of trees with symptoms that may be in close proximity to the export orchard/block, and the disease history of the export orchard/block itself in the preceding 3 years. Another reason is that disinfection treatments will have no effect on calyx infestations.

5.3 MATTERS OF SERIOUS CONCERN TO THE INDUSTRY IN RELATION TO APPLE IMPORTS FROM COUNTRIES HAVING FIRE BLIGHT

Before proceeding to discuss in detail the response to the 2005 DIRA, the Australian Apple and Pear Industry considers it necessary to briefly outline below the areas that are of serious concern to the pome fruit industry in relation to importation of apples from countries having fire blight. Although these topics have been referred to in the 2005 DIRA their extreme significance in assessing the unrestricted and restricted risk has not been fully appreciated, and in some instances the RAP has been dismissive in regard to their importance. **At the very outset it is necessary to mention that Industry’s estimations of likelihoods given for the Importation Steps under Unrestricted and Restricted Risk, presented below under Section 5.6, have been worked out against the backdrop of the scientific evidence that support the following concerns, and concerns stated under Section 5.4.**

5.3.1 Calyx infestations/infections of fruit:

The most difficult and practically insurmountable problem associated with imports begins in the orchards. In the case of New Zealand there are no areas in the country that are free of Fire Blight infection. This means that orchards or blocks that are apparently free of any Fire Blight symptoms

may still have immature or mature fruit carrying *E. amylovora* on the surface of the fruit as well as in the calyces (APPENDIX 5.1(A) and the stem-end. Although eliminating all of the bacteria on the surface of the fruit may not be possible, eliminating most of them including even some of the bacteria in the stem-end may be achievable by disinfection treatments combined with washing by using high-volume and high pressure water; **however, currently, there are no known methods that could eliminate the bacteria in the calyces and those deep in the stem-end cavity.** The reason for this (formation of air pockets) is acknowledged in the 2005 DIRA document and also discussed later in this response. **It is primarily because of this presently insurmountable task that the risk posed by calyx infested/infected fruit cannot be lowered to the ALOP.** 2005 DIRA has cited some of the papers under the sub-headings “infestation of mature fruit” and “infection of mature fruit” in relation to Importation Step 2. In APPENDIX 5.1(A), the Australian Apple and Pear Industry has listed these as well as other papers on surface and calyx infestations and infections, with very brief summaries for each of these papers.

5.3.2 Survival and dissemination of bacteria in the calyx:

Although there are no reports in the literature of *E. amylovora* bacteria from naturally calyx infested/infected fruit been shown to be transferred to a susceptible host it does not mean that it does not occur or cannot occur in nature. These are studies that may not be undertaken by countries having Fire Blight because of the insignificance of outcomes of such studies to those countries when there are larger and enormously more potent sources of inoculum for infection in these countries. However, it is a fundamental norm in biology that in nature every organism needs to find some means to propagate itself for its survival. This is a principle accepted not only in plant pathology but also in human and veterinary medicine. When infested/infected fruit, even with low levels of infection, begin to flow into Australia in large volumes (200 million pieces of fruit per consignment per year) year after year it would be naïve to imagine that the bacterium would not find a foothold in the presence of abundant susceptible hosts and under environmental conditions that are favourable for infection and disease development in areas like the Goulburn Valley (Victoria), Stanthorpe (Queensland), Orange (NSW) and several other regions (Roberts 1991a). Even if the disease may not occur in the first year of imports, it could occur with a progressive build up of inoculum with subsequent imports. This would complete the disease cycle depicted above in Figure 1, and the disease will become established in the country. Various aspects of this subject will be discussed in greater detail elsewhere in this response. In particular, the significance of considering relevant areas of new science in the **in-depth understanding** of the survival of *E. amylovora* on and in fruit is discussed below under

“Important areas of New Science that need to be considered by the IRA Team” in Section 5.5.

5.3.3 Epiphytic populations:

The Australian Apple and Pear Industry is fully convinced of the significance of epiphytic populations of *E. amylovora* in the import risk analysis of New Zealand apples, especially with respect to Importation Steps 2, 3 and 5. Apart from the exponential epiphytic growth of *E. amylovora* on the stigmas of host and non-host flowers the pathogen is known to exist in an epiphytic form on leaves, buds, twigs and stems; van der Zwet and Keil (1979) have reviewed the early literature on the subject. McManus and Jones (1995) detected *E. amylovora* in 39 to 100% of leaves sampled from a scion orchard of apples free of any Fire Blight symptoms. In relation to the assessment of risks associated with fruits the presence of epiphytic bacteria on leaves, buds, twigs and stems is of considerable importance in that these bacteria would contaminate fruit during picking and transport to the packinghouse; such material getting into the dump tank will provide added inoculum for contamination. Also, infested twigs and leaves that may come as trash with the imported fruit would bring the bacteria into Australia (the subject of trash is discussed below in more detail). In some of the earlier research done in the USA, when commercial trade in apples with other countries was not an issue, **the importance of epiphytic bacteria in the epidemiology of Fire Blight and, therefore, of the disease cycle was consistently emphasized;** this is clearly illustrated in the monograph titled “FIRE BLIGHT, A Bacterial Disease of Rosaceous Plants” published by the USDA in 1979 (van der Zwet and Keil 1979), and reported in a number of scientific papers that have been published. Some of these papers are cited elsewhere in the response. Probably keeping in line with more recent views held by Fire Blight researchers, the 2005 DIRA too seems to conclude that *E. amylovora* is not a successful epiphyte. Yet, as recently as 2001, late Dr Paul Steiner, one of the most respected Fire Blight researchers from the USA, stated as follows “*Erwinia amylovora is a competent epiphyte capable of colonizing and multiplying on the surface of plants and it makes little difference whether the plants colonized are susceptible or resistant to fire blight*” (Steiner 2001).

The Australian Apple and Pear Industry agree with the 2005 DIRA general outline that there is no consistency in *E. amylovora* epiphytic occurrence of plant surfaces. Industry does not dispute observations that bacteria exposed to desiccation, solar radiation and other stresses are vulnerable. Exposure is mediated by plant surface structures such as stomata, trichomes and hydathodes and bacterial survival is facilitated by attachment. The epiphytic stage of the life cycle of *E. amylovora* on leaves and plant parts may not be as prominent as the most pronounced presence on infested flowers or cankers. However, the epiphytic presence

and slow growth of *E. amylovora* on plant surfaces cannot be excluded as a source of inoculum reservoir. Furthermore, epiphytic survival can occur in the absence of disease symptoms (see APPENDIX 5.1(A). *E. amylovora* was found on 100% of leaves from an orchard where no fire blight symptoms were detected; (McManus and Jones 1995). For those reasons clean fruit can be contaminated by epiphytic bacteria from other plant surfaces.

The Australian Apple and Pear Industry is not satisfied that the research by Mass Geesteranus and de Vries (1984), and Gottwald *et al.* (2002) accurately reflects the microhabitat of bacteria on the leaf. The scientific understanding of the epiphytic environment of the leaf is incomplete (Lindow and Brandl 2003). Lindow and Brandl (2003) conclude that “*we are only beginning to be able to assess what these conditions actually are, since the scale of the microhabitats that leaves present to bacteria is much smaller than that of even the smallest physical probes.*” The 2005 DIRA document insists that most pathogenic bacteria do not survive desiccation and exposure to sunlight. The Australian Apple and Pear Industry is of the opinion that most of the *in vitro* simulation of leaf environments upon which the 2005 DIRA view is premised, is of very limited use. The leaf offers many sites where bacteria are not exposed to direct sunlight and radiation (Lindow and Brandl 2003). Furthermore, the location of leaves on the tree with regard to angle and position within the tree is a variable affecting exposure and environmental impacts. Studies with epiphytic *E. amylovora* show that there was no difference in detecting bacteria as between upper or lower leaf surfaces (Thomson and Gouk 1999), indicating in fact a far more subtle relationship than that implied in 2005 DIRA between leaf surface/ environment and the survival of exposed *E. amylovora*. An alternative conclusion is that direct sunlight may not be a critical factor in the survival of *E. amylovora*, contrary to the conclusion of Mass Geesteranus and de Vries (1984) and Gottwald *et al.* (2002).

The 2005 DIRA states that at the time of harvest epiphytic populations of bacterial numbers are likely to be very small. This statement is not entirely accurate. Rapid decline was observed in reports with poor harvesting techniques (Ceroni 2004) or in short inoculation studies (Norelli 2004). **When the results of more sensitive techniques used by Thomson and Gouk (1999) were examined, it was found that towards the end of the season as much as 90% of leaves were infested with *E. amylovora*.** Once the bacteria is present in the tree, very quick distribution of the inoculum around the tree can be achieved by rainfall. Even if the populations are considered transient, they would be enough to serve as a pool for quick re-colonisation in the presence of readily available water.

One of the reasons for either very low counts or nil counts of *E. amylovora* from plant surfaces and from the calyx sinus reported in the

literature is the method employed for the recovery or harvesting of the bacteria from these surfaces. As discussed in detail under Section 5.3.6, most of the publications cited in the 2005 DIRA document use a form of Crosse's isolation/harvesting method. The classical technique for harvesting epiphytic bacteria, by washing the plant tissue, was developed by Crosse (1959). In their study of *E. amylovora* populations on leaves Thompson and Gouk (1999) compared the sensitivity of their leaf imprint method (a direct method) with Crosse's classical technique and the PCR technique. The leaf imprint method (direct method) was found to be markedly more effective than Crosse's classical technique by a factor of 5.4, and the PCR technique by a factor of 3.2.

In recent years the scientific understanding of the relationship between bacteria and plant surfaces has developed. The importance of attachment is a central development in the understanding of epiphytic survival (Sapers *et al* 2000; Barak 2004; Yap *et al.* 2005; Mandrel *et al.* 2006). A population of epiphytic bacteria is likely to be composed of two forms of bacteria; bacteria which are attached and non-attached or planktonic bacteria. Bacterial colonization is associated with bacterial attachment to surfaces. Most bacteria found on plant surfaces (from symbiotic to plant and human pathogens) have been observed to attach to surfaces. Ramey *et al.* (2004) documented that the majority of pathogens in general and in particular plant pathogens form attachment to surfaces. *E. amylovora* is a microorganism capable of such attachment. (see detailed explanation under Section 5.3.6). Attachment is a precursor to biofilm formation (Morris and Monnier 2003; Harrison *et al.* 2005); attachment and biofilms are discussed below under Section 5.3.6. the RAP's response, through the 2005 DIRA, to the biofilm issue is tactical and does not address the survival implication of biofilm formation.

Attachment delivers survival advantages including resistance to desiccation, resistance to plant defence responses, an increased ability to effectively deliver enzymes to break plant cell walls and to draw nutrients (Morris and Monier 2003). Planktonic populations arise from surface migration and division and breaking off from attached bacteria in favorable weather conditions. These planktonic populations are highly fluctuating due to exposure to natural elements. Planktonic bacteria play a particular role in colonizing new surfaces and spreading the inoculum (Hirano and Upper 2000).

5.3.4 *Erwinia amylovora* strains resistant to streptomycin:

Quite apart from the risk of introducing Fire Blight into Australia there is another risk that is as important as introducing Fire Blight. This is the likelihood of importation of strains of *E. amylovora*, with infested/infected apples, that are resistant to streptomycin. Streptomycin resistance in these bacteria is becoming more and more widespread in countries having Fire

Blight where this antibiotic is routinely used for control. Streptomycin is widely used in New Zealand in the management of Fire Blight and resistance to this antibiotic has been found in that country.

Streptomycin resistance are of two type's viz. chromosomal based resistance and plasmid based resistance. **Although plasmid based resistance is less common than the chromosomal type it is more dangerous than the chromosomal type as the resistance genes could be easily transferred to other bacteria, some of which may be important human and animal pathogens.** Once such bacteria acquire resistance to streptomycin it will not be possible to treat diseases caused by these bacteria with streptomycin based drugs. However, the resistant type occurring in New Zealand on *E. amylovora* is reported to be of the chromosomal type which is generally transferred during cell division and does not cross the species barrier (Vanneste and Voyle 2001). In the latter paper these authors report that *E. amylovora* bacteria carrying the chromosomal type are resistant to **very high levels of streptomycin, exceeding 1000 µg/ml.** Thus, if Fire Blight is introduced into Australia with New Zealand apples, the control of the disease, let alone its eradication would become extremely difficult if the chromosomal type streptomycin resistant strains of the bacterium flourish here. **This is because currently streptomycin is the only effective plant safe pesticide available for the control of Fire Blight.** However, Psallidas and Tsiantos (2000) state that “Although streptomycin is considered the most effective bactericide against Fire Blight, with no real phytotoxic problems at the recommended rates, its use in agriculture has been prohibited in many countries. The main reason for this is the development of resistance to streptomycin not only by *E. amylovora* but also by other microorganisms on the plant surface or in the soil or water, including possible human or veterinary pathogens”... (Jones and Schnabel 2000). Several references on streptomycin resistance in *E. amylovora*, including a summary of conclusions from these references are listed in APPENDIX 5.1(B).

5.3.5 Trash:

The RAP has identified the importation of trash (Part B, page 48) as a potential pathway for the introduction of *E. amylovora* into the country. This supports what New Zealand stated in their application to AQIS in 1995 seeking access for their apples to Australia; their letter stated “...mature apple free of trash are not a vector for Fire Blight”. The statement was made in connection with concerns by AQIS about Fire Blight being introduced into Australia with apple imports from New Zealand. Nevertheless, the statement clearly implies that trash would pose a risk in introducing Fire Blight. An important point to bear in mind is that the trash may not necessarily come only from the export orchard/block. Trash from other sources could get into the export fruit

during handling, transport, in the packinghouse etc. Although both leaves and small twigs pose significant risks, that posed by small twigs and pieces of stem would be greater than leaves. Twigs and pieces of stems may harbour the pathogen either in small cankers or exist epiphytically in buds. Thus, according to Brooks (1926), and Ritchie and Klos (1975) bacteria are often present in cankers that are formed in twigs as small as 4 mm in diameter. Furthermore, the size of cankers where *E. amylovora* overwinters varied considerably, with some twigs as small as 2-5 mm in diameter, but the majority averaging 6 mm (Brooks, 1926; Miller, 1929).

As for the occurrence of epiphytic *E. amylovora* on organs other than fruit, Baldwin and Goodman (1963) isolated the pathogen from apple buds in Missouri. Similarly, Keil and van der Zwet (1972) isolated *E. amylovora* from symptomless stems and shoots of Jonathan apple trees. Dueck and Morand (1975) too have isolated the bacteria from apparently healthy apple and pear buds. McManus and Jones (1995) detected *E. amylovora* in 0 %, 62% and 73% of buds, sampled from a scion orchard of apples free of Fire Blight symptoms, using first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. Although some researchers have reported that *E. amylovora* populations on leaves are either rare or are very transient, Sholberg *et al* (1988) recovered the bacterium from 100% of the leaves **sampled at harvest** from apple trees free of Fire Blight symptoms. Furthermore, they found that this high level of **leaf contamination (100%) continued for a further one month after harvest**. McManus and Jones (1995) detected *E. amylovora* in 39 %, 81% and 100% of leaves, sampled from a scion orchard of apples free of fire blight symptoms, using first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. There are two points in relation to this paper (McManus and Jones, 1995) that are particularly important from the point of view of 2005 DIRA. The authors state that the shoots collected for the tests were from an orchard that did not have any symptoms of fire blight at the time of collection. **However, symptoms have been found in previous years, but they have been pruned out in those years.** This point itself questions the validity of orchard inspections for areas free from disease symptoms referred to earlier in this response and in the 2005 DIRA. There has been some speculation that the high incidence of epiphytic *E. amylovora* detected by McManus and Jones (1995) in the scion orchard was a result of hail damage to this orchard. If this was true the **main point is that the orchards were symptomless, yet had a very high level of epiphytic bacteria**. The same thing could happen with an export orchard in New Zealand; the orchard could be hit by hail and may not show any symptoms but will have a heavy epiphytic population, and, consequently, will be used to source apples for export to Australia. The above evidence from the literature demonstrate that trash in the form of small stem pieces, twigs and leaves may be infected or infested with *E.*

amylovora and would pose a real risk in introducing Fire Blight into countries free of the disease.

5.3.6 Effectiveness of *E. amylovora* harvesting (recovery) methods:

2005 DIRA relies on the reported detection of *E. amylovora* on mature apples. The detection methods used in the literature cited by 2005 DIRA assume, and with one exception, do not test the efficacy of the harvesting methods used. Ineffective harvesting has implications for detection. No detection does not mean no infestation but the reliability of a detection result will be qualified by the accuracy and/or relevance of the harvesting technique. The classical technique for harvesting epiphytic bacteria was developed by Crosse (1959). Most of the publications cited in the 2005 DIRA document use a form of the Crosse isolation/harvesting method. Of the reports quoted in that section only Roberts *et al* (1989) tested the efficacy of bacteria harvesting. The harvesting technique developed by Crosse (1959), or modifications of this technique, reported in the literature, are capable of harvesting planktonic (unattached) bacteria but is unlikely to harvest the attached bacteria. Bacterial attachment prevents the removal of bacteria by washing. Roberts *et al* (1989) determined the efficacy of the harvesting technique by leaving the inoculum on the apple for relatively a short period of time < 5min. This test period is inadequate since it does not reflect the length of bacterial exposure to plant surfaces and is likely to result in significant underestimation of bacterial numbers. Naturally occurring infection would be expected to be on the fruit for longer than 5 min and for periods of time sufficient for bacteria to attach to surfaces.

The effectiveness of the Crosse method of harvesting attached bacteria, as distinct from planktonic bacteria, has not been validated in any of the quoted studies with the consequence that the method will most likely not account for attached bacteria and underestimates bacterial populations. A comparison of isolation techniques on *E. amylovora* performed on leaf samples showed that harvesting bacteria by washing from the leaf surface is about 4 times less likely to account for the bacteria than direct imprint into agar (Thompson and Gouk 1999). When the efficacy of the conventional isolation technique was tested on leaves, Wilson and Lindow (1992) concluded that only 25 % of bacterial populations were harvested. Estimates of bacterial populations could be in error by about a factor of 4 (Wilson and Lindow 1992). The significance of attachment by pathogenic bacteria in relation to the effectiveness and reliability of the harvesting method is demonstrated in the work of Sapers *et al.* (2000). Thirty minutes after inoculation, 90% of *E. coli* inoculum was recoverable, leaving a bacterial population in the vicinity of 3.5 log CFU/g. However if the inoculum remained on apples for longer than 24 h, the harvesting by washing procedure failed to remove any significant bacterial populations. It would be expected that the mature apples tested would have bacterial

populations well established and therefore most of the harvesting techniques based on washing would not be sensitive enough to harvest attached bacteria but only planktonic bacteria.

Attachment plainly has implications for the relevance and accuracy of harvesting techniques. There is an urgent need to evaluate the effectiveness of currently used harvesting techniques in relation to the possibility that the technique is insensitive /ineffective in harvesting any attached *E. amylovora*. **In the absence of validation of the efficacy of the harvesting techniques which incorporates the current state of knowledge with respect to bacterial behaviour, the absence of bacterial detection can tell very little. There is an urgent need to evaluate the harvesting techniques to establish the reliability of previously published results and the relevance of those results as a foundation for the conclusions drawn by 2005 DIRA.**

5.3.7 Endophytic *E. amylovora* in fruit:

A pathogen is said to exist as an endophyte when it resides within its host tissue without necessarily causing symptoms of the disease. Apples carrying endophytic infections cannot be distinguished externally from healthy fruit. However, they may begin to show symptoms of fruit blight several weeks after harvest under conditions favourable for disease development and may act as potent sources of inoculum as it happens in Missouri (Goodman 1954). **As it is with calyx infestations there are no treatments available for eliminating these endophytic infections.** As endophytic infections could be present on trees without any apparent symptoms (Bogs *et al* 1998; Vanneste and Eden-Green 2000; Lewis and Goodman 1965; Eden-Green and Billing 1974) the risk mitigation measure “areas free from disease symptoms” will only marginally reduce the likelihood of Importation Step 2. In this respect the risk of introduction of the disease is considerably greater than with calyx infestations as the rotting of the fruit (fruit blight) in the field, following importation, caused by the internal *E. amylovora* provides copious amounts of nutrients for the exponential growth of the bacterium. Thus, endophytic infections cannot be detected at Importation Step 2; nor can they be detected at on-arrival inspections done in Australia.

Several researchers have reported the occurrence of endophytic *E. amylovora* in apple fruit. While some of these endophytic infections have occurred naturally in the field others have occurred as a result of inoculation carried out in experiments. 2005 DIRA has listed some of these papers (McLarty 1924, 1925 and 1926; van der Zwet *et al* 1990, Goodman 1954) but proceeds to conclude “...the lack of evidence of endophytic infection in mature fruit suggests that if endophytic infection

does take place it must be a rare event.” Likewise, 2005 DIRA (pages 55-56) acknowledges the presence of *E. amylovora* in the vascular tissues in symptomless trees and cites several papers reporting such presence, but does not acknowledge that the bacteria could move into the fruit. The Australian Apple and Pear Industry in its response to the previous IRA cited work done with a related human pathogen, *Escherichia coli* O157:H7, showing the path taken by this organism in invading the core tissue of the apple fruit (Burnett *et al.* 2000; Beuchat 2001). These authors studied in detail the path followed by *E. coli* in contaminating the apple core using confocal scanning laser microscopy (CSLM). In their studies inoculation of Red Delicious apples was effected by taking advantage of infiltration of inoculum suspension resulting from temperature differentials (inoculum at 2°C and fruit at 25°C). Bacterial cells attach to intact apple skin at discontinuities in the waxy cuticle; lenticels and russet areas also attracted cells but in lower numbers. Cells enter through the calyx end and after passing through the floral tube infiltrate into the core of the fruit. Infiltration was found to occur through the blossom end of the calyx and progress up the floral tube into the core region. Although the wall of the floral tube did not harbour high numbers of cells the bacterium attached readily in high numbers to the apple flower remnants and internal trichomes just within the floral tube. Within the core, *E. coli* cells were found in the ventral cavity and seed locules. Discolouration of the parenchymatous cortex (flesh of the fruit) surrounding the core was also observed, suggesting infiltration into these tissues. Seeman (2002) and Seeman *et al* (2002) studied the movement of *E. coli* in 3 varieties of mature apple fruit in an outdoor setting. The apples were placed in an area where a culture of *E. coli* was applied to the topsoil. Examination of the apple cores after 1, 3, 8 and 10 days revealed that the *E. coli* bacterium had entered through the calyx and migrated into the inner core and flesh samples of all varieties of apples tested. It is concluded that contamination is likely to occur during the fruit growing and harvesting phases. The work of Burnett *et al.* 2000, Beuchat 2001, and Seeman *et al* (2002) with *E. coli* demonstrate the likely path that even the fire blight pathogen *E. amylovora* may take when they invade the fruit from the outside.

More recently, Azegami *et al* (2006) experimentally demonstrated the systemic movement of Fire Blight bacteria from the stem into the fruit. These authors inoculated fruit-bearing twigs of apple trees in the greenhouse with *E. amylovora* bacteria at ca. 10^5 cfu tagged with bioluminescence genes. One month later 176 apples were harvested and cut horizontally in half. The upper halves were checked for *E. amylovora* while the lower were tested for maturity. All fruits were symptomless and fully mature. The pathogen was recovered from 10.8% of the apples. **These results show that bacteria can pass through the abscission layer into the fruit, even though the mature fruit lack symptoms.** The above examples, especially the research by Azegami (2006), show that

endophytic infection of fruit is not exactly a rare event. Even if it is to be considered a rare event, as 2005 DIRA asserts, it could be significant with apple imports from New Zealand amounting to around 200 million pieces of fruit per year. In large consignments like this a significant number of fruit may carry such infections although in terms of percentage of fruit having these infections would be small. In APPENDIX 5.1(A), Industry has listed these as well as other papers on endophytic infections, with very brief summaries for each of these papers.

5.3.8 Viable but non-culturable (VBNC) *E. amylovora*; problems encountered in detecting the bacterium:

Identification of plant pathogenic bacteria is based on several characteristics of the bacterium. These include morphology (colony and cell morphology), biochemical and physiological properties, molecular characteristics and pathogenicity. Isolation and growth of the suspect bacterium on or in a culture medium is a basic prerequisite for the study of the characteristics leading to identification, as inoculum for these studies are obtained from such cultures. With infections, where disease symptoms are apparent, bacterial numbers in tissues affected are relatively high and are thus easily isolated. However, with infestations where bacterial numbers are generally low isolation from infested sites on culture media may not always be as successful. An example in this respect is *E. amylovora* infestation of calyces of apple fruit. As nutrient supply for the growth of these bacteria may be relatively low in such sites the bacteria may go into a viable but non-culturable (VBNC) state. The occurrence of the VBNC state with virulent *E. amylovora* under low nutrient conditions has been demonstrated by Biosca *et al* (2004 and 2006). Also, the number of bacteria in planktonic form, which go into suspension in calyx washings used as inoculum for culturing, will be very low; this combined with the bacteria being in the VBNC state will lead to either a very small number of colonies showing up on the culture medium or a complete lack of growth on the medium. Thus, under such conditions attempts to detect the presence *E. amylovora* in the calyces are very likely to underestimate its presence.

The significance of the occurrence of the VBNC state of *E. amylovora* on the surface of the mature apple fruit or in the calyx of the fruit is primarily with respect to the detection of the pathogen using solid media. As the organism is non-culturable it will not be detected on culture media. Furthermore, those DNA detection techniques that test mixed populations of organisms growing on the apple surface or in the calyx (Clark *et al*, 1993; Hale *et al*, 1996) would also fail to detect the pathogen as the VBNC bacteria would not grow on any culture media. In the 2005 DIRA, papers of Dueck (1974), Hale *et al*. (1987), Roberts *et al*. (1989), Roberts (2002), van der Zwet (1990), Clark *et al*. (1993) and Hale *et al* (1996) are cited to justify that apples derived from symptomless orchards will not

carry *E. amylovora*. In assessing the incidence of *E. amylovora* in apple tissue Dueck (1974), Hale *et al.* (1987), Sholberg *et al.* (1988), Roberts *et al.* (1989) and van der Zwet (1990) relied upon *E. amylovora* being able to actively grow on artificial media. **Thus, detection limits were assessed using viable culturable cells.** Prior to using DNA hybridisation Clark *et al.* (1993) and Hale *et al.* (1996) also relied upon growth of *E. amylovora* on nylon membranes; samples of apple suspensions were first streaked onto nylon membranes supported on artificial medium. Membranes were incubated for 3 days at 27°C. DNA was liberated from the resulting bacterial colonies and hybridised with the ³²P-labelled probe to assess the incidence of *E. amylovora*. Although a detection limit of 10¹ to 10² colonies per calyx was claimed using the ³²P-labelled probe (Hale and Clark 1990), this was measured using culturable cells, capable of multiplying on the membrane on which the apple-suspension was streaked. Thus, each of these studies relied upon growth of *E. amylovora* on artificial media to detect the presence of this bacterium. Where *E. amylovora* was not recorded in apple tissue, the authors concluded that *E. amylovora* was not present. However, this may not be the case.

Biosca *et al.* (2004; 2006) have demonstrated that *E. amylovora* cells in irrigation water, drinking water and deionized water enter the VBNC state under nutrient starvation; the length of time taken for cells in each water microcosm to enter the VBNC state was conditioned by the nutrient content in the microcosm. In irrigation water the cells remained culturable for a longer period than in deionized water. Biosca *et al.* (2006) conclude that the existence of such viable but non-culturable (VBNC) cells of *E. amylovora* could lead to an underestimation of the pathogen population from environmental sources when using only cultural methods.

Ordax *et al.* (2004; 2006a; 2006b) investigated the ability of *E. amylovora* cells to enter into the VBNC state in the presence of free-copper ions; this was followed by a study of the pathogenicity of the VBNC cells. Also, they studied the possible reversion or resuscitation from the non-culturable state, and whether the resuscitated cells retained their virulence. Copper compounds are commonly used in the control of many bacterial diseases of plants, and, along with antibiotics, they are used in the control of Fire Blight (van der Zwet and Keil, 1979; van der Zwet and Beer, 1995; Psallidas and Tsiantos, 2000). **In New Zealand copper based fungicides are applied on apple trees around 10 days before flowering for the control of black spot.** Recent studies on plant pathogenic bacteria have shown that copper induces the VBNC state in *Agrobacterium tumefaciens* and *Rhizobium meliloti* (Alexander *et al.*, 1999), *Xanthomonas campestris* pv. *campestris* (Ghezzi and Steck, 1999) and *Ralstonia solanacearum* (Grey and Steck, 2001; Caruso *et al.*, 2005). This state, in which cells progressively lose their culturability on non-selective solid media, is considered as a survival strategy under adverse environmental conditions

(Oliver, 1993). **The effectiveness of biocides is often measured by assaying the absence of bacterial growth on a solid medium but the failure of a bacterial cell to produce a colony may not necessarily mean that the cell is dead (Nyström, 2001).** Consequently, the ability of plant pathogenic bacteria to enter into the VBNC state by copper should be kept in mind to prevent the underestimation of viable cells, which may still be pathogenic. In their study Ordax *et al* (2006a; 2006b) performed counts of the number of (a) total cells, (b) viable cells and (c) culturable cells throughout a period of 4 months. They found that *E. amylovora* enters into the VBNC state induced by copper. Total and viable cell counts remained relatively constant at the initial levels (10^8 - 10^9 cells/ml) in all the cases, independently of the copper concentration assayed. However, the culturability of the bacterium decreased in different ways depending on the copper concentration. In the presence of copper ions, the culturability of *E. amylovora* went down quickly below the detection limit (<1 cfu/ml) and cells became nonculturable in spite of the high numbers of viable cells. Most of the bacterial population (87.5-94.4%) enter into VBNC state in the presence of the three copper concentrations assayed, with the time of entry much faster as concentration of this metal was increasing (days 36, 1 and 0 for 0.005, 0.01 and 0.05 mM Cu^{2+} , respectively). **Ordax *et al* (2006a; 2006b) found that the removal of copper ions with copper complexing agents was effective in all cases of restoring the culturability of copper-induced VBNC cells,** but their ability to recover such cells varied depending on the time after the entry of *E. amylovora* into the VBNC state. With further experiments it was shown that culturability achieved was a true resuscitation and not a regrowth. In comparison to controls where the *E. amylovora* cells always remained virulent VBNC cells held their pathogenicity only for the first five days. The recovery of the ability to cause symptoms was only reached when culturability was regained. Nevertheless, the investigations conducted by Ordax *et al* (2006a; 2006b) demonstrate the induction of the VBNC state in *E. amylovora* by copper and its ability to recover culturability and pathogenicity in the presence of copper complexing agents.

Using an attenuated non-pathogenic strain of *E. amylovora* Sly *et al* (2005) were able to induce the VBNC state of this strain in the presence of very low concentrations of copper (0.005mM and 0.05mM). However, unlike Ordax *et al* (2006), Sly *et al* (2005) have not been able to reactivate the VBNC to the culturable state. Sly *et al* (2005) used heat shock in attempting to recover culturability whereas Ordax *et al* (2006) used copper complexes to fix the free copper ions.

Thus, results obtained by Biosca *et al* (2004; 2006) and Ordax *et al* (2005; 2006) clearly indicate the possibility of *E. amylovora* infestations in the apple calyces not being detected by plating cells either directly on solid

media, which is the method commonly used in all bacteriological laboratories, or on nylon membranes placed on solid culture media for detection by DNA hybridization (Clark *et al*, 1993; Hale *et al*, 1996).

E. amylovora cells in apple calyces exist under adverse conditions especially with respect to nutrients. Under such conditions *E. amylovora* cells are very likely to enter the VBNC state as a mechanism for survival. Use of copper based bactericides in late autumn, winter and **particularly in spring about 10 days prior to flowering**, as practised in New Zealand, in the management of fire blight, would also contribute to *E. amylovora* cells entering the VBNC state. Consequently, they may not be detectable by culture plating methods. The following statements taken from the papers published by Biosca *et al* (2006) and Ordax *et al* (2006a) support this view: “..... The existence of such viable but nonculturable (VBNC) cells of *E. amylovora* could lead to an underestimation of the pathogen population from environmental sources when using only cultural methods” (Biosca *et al* (2006). “..... the VBNC state could be a part of the life cycle of *E. amylovora* under adverse environmental conditions unknown up to date. **Thus, this physiological cell state could be involved in the recurrent infections of Fire Blight, and therefore, be responsible of its difficult control. In fact, the occurrence of phytopathogenic bacterial cells in the VBNC state could have serious implications in plant pathology, since epidemiological studies are usually based on plate counts of culturable cells (Wilson and Lindow, 2000)”** (Ordax *et al* (2005; 2006a; 2006b).

5.3.9 Protocols proposed in 2005 DIRA; timing of orchard inspections:

The protocol proposed by the RAP (2005 DIRA), with a single inspection carried out 4-7 weeks after full bloom, is considered by the Industry as inadequate. Thus, in the case of the apple cv Pink Lady™, the period between 4-7 weeks after full bloom and harvest is 6 months; this is an excessively long period during which the disease could attack a Pink Lady™ orchard/block at least once if not more. Although on the average optimal weather conditions may occur at that time (in the south island of New Zealand), low levels of blossom blight and medium sized active cankers, let alone small cankers, would be very difficult to see at that stage (4-7 weeks after full bloom). Optimal weather conditions for Fire Blight infection, in terms of degree hours or degree days, may occur in early to mid-spring, thus favouring blossom blight. In a country where Fire Blight is endemic, and area freedom from the disease cannot be provided (see APPENDIX 5.1C) for details of relevant papers and their summaries), the measure that would reduce the risk to the importing country **at least to some degree** would be stringent orchard inspections to ensure freedom from all obvious symptoms (blossom blight, shoot blight, strikes, cankers etc). **This is an enormous task that is difficult to achieve though essential to reduce the risk to the importing country; the practical**

difficulty here would be, in the first place, to detect from ground level small (3-5 mm in diameter) but active cankers found on twigs and branches at the top of the tree (see APPENDIX 5.1(D) for details of relevant papers). Also, there should be an adequate buffer zone between the designated export orchards and other orchards and known Fire Blight hosts.

For inspections to have any effect at least three inspections must be carried out during the growing season outlined as follows: **The first inspection would be in spring just before bud break.** The purpose of this inspection is to exclude from the export program those orchards having any obvious overwintering cankers on the trees. **The second inspection would be at full flowering.** The purpose of this inspection is to exclude those orchards with any primary blossom blight symptoms and also any overwintering cankers that may have escaped attention in the first inspection. **The third inspection would be at time of harvest.** The purpose of this inspection is to exclude those orchards with any secondary blossom blight symptoms, shoot blight symptoms on suckers or water shoots and any cankers that may have escaped attention during the first and second inspections. There are at least 3 possible means by which mature apple fruit could get infected/infested prior to harvest.

They are as follows:

- (i) As described below under Section 5.4.2 fruit in orchards apparently free from Fire Blight symptoms could get infected/infested from pome fruit or alternative hosts in close proximity that carry Fire Blight symptoms.
- (ii) Secondary infections could occur in an orchard close to harvest resulting in shoot blight or infection of secondary blossoms. Bacteria from these infections could result in surface as well as calyx infections/infestations; calyx infections/infestations could occur as a result of water carrying the bacteria moving down the surface of fruit and eventually getting retracted into the calyx sinus.
- (iii) Hail and rainstorm damage occurring close to harvest is known to cause trauma blight. When this happens bacteria may get into the calyx sinus; often the fruit itself may get infected directly and exhibit symptoms. For these reasons it is very important that an extra orchard/block inspection be carried if hail is experienced in the orchard/block area. (For a discussion on the occurrence of fire blight outbreaks after the primary blossom periods see APPENDIX 5.1(E).

Coupled with orchard inspections statistically representative samples of immature and mature fruit must be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004) cited above. In regard to detection it is important to bear in mind that in those tests, including DNA techniques, **that depend initially on the isolation of organisms from test material on culture media**, a negative test result, implying an absence of Fire Blight bacteria, is not always totally reliable or accurate because of (a) the occurrence of viable but non-culturable (VBNC) states of the bacterium, and (b) if only planktonic bacteria are captured by the bacteria recovery technique employed.

A chlorine dip of the fruit is recommended to minimize the risk from any surface contaminations that may have occurred following harvest. Although it is known that chlorine dips are only partially effective in eliminating surface bacteria this treatment could be adopted as an added precaution.

The present scientific evidence, based on plating techniques that capture planktonic bacteria, is that the Fire Blight bacterium lasts only for a few hours on the surface of the fruit. There is no reference to attached bacteria (biofilms/aggregates). Also, no bactericidal dip such as chlorine, or any other presently known cost-effective treatment would be effective in eliminating any bacterial infestations/infections of the calyx. Cold storage is not recommended as a risk mitigation measure as all the evidence, except that coming from New Zealand, indicates that cold storage only prolongs the viability of the Fire Blight pathogen. One paper (Jock *et al* 2005) reports a 10-fold increase in the bacterial population within the fruit tissue following storage at **room temperature**.

CONCLUSION:

It is evident from the discussions above (Section 5.3) that epiphytic bacteria in the calyx sinus and endophytic bacteria pose the greatest risk with respect to importation of fruit from New Zealand. As the scientific evidence presented above clearly indicates calyx infestations and endophytic infections are present in mature fruit even in the absence of any apparent disease symptoms in orchards; this is because there are no areas in New Zealand that are free of Fire Blight. Thus, although it is not possible to harvest fruit that are totally free of such infestations/infections, a protocol comprising a minimum of 3 orchard inspections as detailed above (Section 5. 3.9) is required.

5.4 OTHER INDUSTRY CONCERNS

The industry concerns on the following topics related to the section on Risk Management in the 2005 DIRA are briefly discussed below:

5.4.1 ISPM 22 (April 2005): *Requirements for the establishment of areas of low pest prevalence (ALPP)*:

At the meeting APAL had with representatives of Biosecurity Australia on 05 January 2006, Dr W.P. Roberts advised that ISPM 10 referred to on page 96 in the 2005 DIRA has now been replaced with ISPM 22. ALPP is different from a pest free area (PFA). Thus, with respect to Fire Blight the pest/pathogen *E. amylovora* is absent in the PFA; in the case of ALPP the pest/ pathogen *E. amylovora* may be present **below a specified population level**.

According to ISPM 22 an ALPP may be established by a National Plant Protection Organization (NPPO) for the purpose of production where products are intended for export. In this case apart from the ALPP meeting the specific requirements the products from this area are subject to additional phytosanitary measures.

The specific requirements in establishing an ALPP are:

- (1) Determination of specified pest levels.
- (2) Geographic description by NPPO of the boundaries of the ALPP.
- (3) Documentation and verification by NPPO that all procedures are implemented.
- (4) Phytosanitary measures; these include: surveillance activities; reducing pest levels and maintaining low prevalence; reducing the risk of entry of specified pests; corrective action plan.
- (5) Verification of the ALPP status.

Some of the problems likely to be encountered in using ISPM 22 with respect to the export of New Zealand apples to Australia are as follows:

- (a) The definition of the term “area” used in the context of ALPP in ISPM 22 appears to be much broader and covers a larger area than just an orchard or a block in an orchard.
- (b) How would MAFNZ determine the levels of *E. amylovora* populations (pest population) in a given area in order to designate it as an ALPP?

- (c) Below what specific *E. amylovora* population level would MAFNZ consider a given area would qualify to be declared an ALPP?
- (d) If MAFNZ is to consider low disease prevalence as equivalent to low pathogen/pest prevalence what specific Fire Blight symptoms level would qualify a given area to be declared as an ALPP?
- (e) To consider low disease prevalence as equivalent to low pathogen/pest prevalence is strictly not correct as there have been instances in Canada, NZ and USA where *E. amylovora* has been detected in apple fruit calyces and leaves in the absence of any apparent Fire Blight symptoms (Sholberg *et al* (1988); Clark *et al* (1993); van der Zwet *et al* (1990)). How would MAFNZ circumvent this problem?
- (f) Under the primary specific requirement “phytosanitary measures” for establishing ALPP is the secondary requirement “reducing pest levels and maintaining low prevalence”. This would entail regular inspection of export orchards/blocks (ALPP) and removal of any diseased material found. Such action is in conflict with any protocol the RAP would agree to with respect to risk mitigation measures (2005 DIRA), because the purpose of the protocol inspections are to eliminate orchards/blocks that show disease symptoms.

5.4.2 Export orchards/blocks in close proximity to infected trees with symptoms;

The occurrence of *E. amylovora* in apple fruit calyces or internal fruit tissue has been reported by Sholberg *et al* (1988), van der Zwet *et al* (1990) and Clark *et al* (1993) from **trees free of Fire Blight symptoms but they were in close proximity to trees with symptoms.**

Sholberg *et al* (1988) sampled apple fruit at harvest from trees in 4 orchards in British Columbia, Canada. All the apple trees (Red Delicious, Golden Delicious, Spartan and Red Rome) were **free of Fire Blight symptoms** but were adjacent to **blighted** Bartlett pear trees. Apple fruit were assayed by taking a cylinder 1.0 cm in diameter and about 1.0 cm long from both the stem and calyx ends of the fruit. All fruit samples assayed were found to be contaminated by *E. amylovora*. **This is endophytic infection.**

In West Virginia, USA, van der Zwet *et al* (1990) isolated *E. amylovora* from **calyces** of Delicious mature apple fruit from **symptomless** trees in an area where Fire Blight was present.

In New Zealand Clark *et al* (1993) detected *E. amylovora* in calyces of immature apple fruit in 8.7% and 6.7% of fruit tested in two symptomless orchards in the year 1987; **in both cases the authors have attributed the presence of *E. amylovora* in calyces of immature fruit to the presence of Fire Blight symptoms on alternative hosts found in close proximity to these two orchards.**

The examples cited above clearly demonstrate that the presence of Fire Blight symptoms on pome fruit or other alternative hosts in close proximity to symptom free apple trees could result in **both endophytic infections and epiphytic calyx infestations/infections** in immature as well as mature fruit.

Thus, in selecting orchards/blocks for sourcing apples for export, it will be essential not to include orchards/blocks that are in close proximity to host plants or orchards showing disease symptoms.

5.4.3 Previous Fire Blight history of the export orchard/block:

In countries having Fire Blight the disease may occur in an orchard that did not show any apparent symptoms in the previous year or years; similarly, an orchard may not exhibit any apparent symptoms in the current year although symptoms have appeared in the preceding year or years. This is quite a common phenomenon and Fire Blight researchers are still perplexed by this as it cannot be explained simply by the present knowledge of the epidemiology of the disease (van der Zwet and Keil, 1979). **Van der Zwet *et al* (1988) attributed it to the lack fundamental knowledge of the causal bacterium and its mode of infection.**

A striking example of an orchard that showed severe Fire Blight in the previous years but did not show any symptoms in the current year was reported by McManus and Jones (1995). These authors detected *E. amylovora* in 39 %, 81% and 100% of leaves, sampled from a scion orchard of apples free of Fire Blight symptoms, using first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. Also, they detected *E. amylovora* in 0 %, 62% and 73% of buds, sampled from this scion orchard in first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. Calyces of symptomless mature fruit collected from an orchard, affected by Fire Blight, at Michigan State University were also tested; *E. amylovora* was detected in 4 %, 27% and 75% of the calyces sampled from this orchard in first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. A further point from the study by McManus and Jones (1995) that is relevant to the present discussion on the 2005 DIRA is that although the symptoms that appeared in the previous year had been pruned out, yet in the year of testing the orchard showed relatively high levels of *E. amylovora* in the leaves, but without any apparent symptoms.

Thus, in selecting orchards/blocks for the export program those showing symptoms must be strictly excluded from the program at least for a period of two years.

5.4.4 Disinfection and its efficacy:

The Australian Apple and Pear Industry fully agrees with the concerns expressed by 2005 DIRA as to the difficulty which aggregates/biofilms pose to the efficacy of washing apples. The Industry also agrees with the 2005 DIRA statement (on page 63) that “*epiphytic bacteria, especially those in the protected calyx cavity, would not be removed in dump tanks, at least in close calyx cultivars*”.

Chlorine based systems depend on a reaction which produces the unstable hypochlorous acid (HOCl) which dissociates into $H^+ + OCl^-$; the latter eventually liberates chlorine (referred to as available chlorine). The reaction is affected by pH (Beuchat 1992). To ensure that a constant level of free chlorine was available for sanitation, a number of factors must consistently be maintained. Most importantly, temperature and pH have to be held constant. This imperative is difficult to maintain in present washing systems, as acknowledged on page 63 of 2005 DIRA.

The limitation of chlorine treatment in relation to post harvest handling of fruit and vegetables is well recognized. Traditionally, chlorine based solutions have been used for surface sanitation. Van der Zwet (1990) found that apples naturally contaminated with *E. amylovora*, when washed in 650 ppm chlorine and cold stored for 1 month, showed more contamination (15%) than apples that were not disinfected (3%). Sholberg *et al* (1988) found that chlorinated wash of particularly contaminated apples for up to 30 min had limited efficacy and was no more effective than 20 min exposure to water as a control.

As far as fruit is concerned chlorine treatment (100 ppm for 1 min) is likely to be effective only against the planktonic *E. amylovora* present on the fruit surface, on the stem end and those epiphytic on the fruit stalk. Even here it will not be 100% effective (Sholberg *et al*, 1988). Its effect will be negligible or nil in reducing or eliminating the bacteria in the calyx sinus, because of air pockets preventing access into that space. Also, it will not be effective against endophytic infections present in the flesh of the fruit or in the lenticels.

As for the concentration of chlorine, in the light of findings by Janisiewicz and van der Zwet (1988) a higher concentration may have to be used. Sholberg *et al* (1988) found chlorine to be ineffective in eliminating *E. amylovora* present on apple fruit surfaces or in the calyxes. The biggest challenge for washing apples would be to maintain the quality of the sanitizing water in the tanks. When batches of apples are processed in dump tanks, the level of available chlorine would be expected to quickly

deteriorate as organic matter would react with the chlorine in dump tanks. Non automatic systems cannot guarantee maintenance of the required chlorine level. With respect to automated systems it is necessary that the contact time is sufficient to achieve the expected disinfection rate.

The Industry does not have enough information to be satisfied that even those 53% of packing houses that use the chlorine based system or alternative are able to maintain the crucial parameters that contribute to some level of sanitation. Even if chlorination levels were scrupulously maintained at 5-50 ppm, the expected efficacy of sanitation is likely to be marginal.

In terms of importation steps, chlorine may affect low levels of reduction in bacterial numbers in Importation Steps 4 and 5, but will not reduce Importation Step 3 (contamination during picking and transport) even with a 100 ppm level as the RAP assumes.

5.4.5 **Pre-cooling:**

The evidence presented in the 2005 DIRA on the effect of pre-cooling on *E. amylovora* is compelling **only** if the natural surface of apple equates with a glass surface and if bacterial survival on plant surfaces is considered as equating with survival on glass surfaces. The natural surface of plants and in particular the surface of apple is a far more complex surface than glass. The conclusions of Mass Geesteranus and de Vries (1984) must be qualified by these significant surface differences.

Furthermore, rapid cooling of warm produce may have an effect on epiphytic bacterial internalization due to the contraction of gases in the porous apple as a result of temperature differences between the outside and pulp tissue of fruit. This effect was used by Burnett *et al* (2000) and Seeman (2002) to inoculate the apple core by internalization of *Escherichia coli* 0157:H7; they found the cells easily entered the fruit through the calyx. **Thus, such internalization may offer the bacteria additional protection from sanitation during subsequent processing and have the opposite effect with respect to risk mitigation.**

5.4.6 **Cold storage:**

It is an established norm in basic bacteriology that low temperatures in the range of 0-4⁰ C do not kill bacteria (Salle 1967). These temperatures affect certain physical properties within the bacterial cell, which in turn decrease the rate of metabolic reactions leading to increased longevity of the cells. Also, these low temperatures reduce the requirements for nutrients by bacteria (Salle 1967). As with precooling cold storage too may offer any epiphytic *E. amylovora* on the fruit additional protection from disinfection treatments and also its survival; moisture from

condensation during cooling may assist the internalisation of surface bacteria.

Anderson (1952), Dueck (1974) and Nachtigall *et al* (1985) found *E. amylovora* on mature apple and pear to be unaffected following cold storage. Ceroni *et al* (2004) studying the survival of *E. amylovora* on pears in cold storage were able to reisolate the bacteria from calyces of pears even after 101 days of cold storage.

5.4.7 Conclusion:

As discussed above (Section 5.4) there is sufficient scientific evidence to prove that

- (a) fruit harvested from orchards or trees free of Fire Blight symptoms in close proximity to host plants showing disease symptoms carry fruit infestations/infections;
- (b) orchards free of symptoms in the current season but had symptoms in previous years carry fruit infestations/infections.

Thus, in selecting export orchards a protocol which excludes

- (i) orchards in close proximity to Fire Blight hosts showing symptoms
- (ii) orchards that have exhibited symptoms in the two previous years

would at least to some extent reduce the proportion of these infestations/infections.

Coupled with these steps and the 3 orchard inspections recommended earlier statistically representative samples of immature and mature fruit at harvest should be tested for *E. amylovora* using a highly sensitive technique to ensure that the orchard is free from detectable infection. Appropriate tests are described in detail in the EPPO publication titled EPPO Standards, PM 7/20 (2004).

5.5 RELEVANT IMPORTANT AREAS OF NEW SCIENCE THAT NEED TO BE CONSIDERED BY THE RAP

Following a review of the more recent literature on pest survival the Australian Apple and Pear Industry is convinced that the RAP should carefully consider the following areas of new science with respect to the import risk analysis on the importation of apples from New Zealand: **multicellular behavior, biofilms/aggregates, sigma factor and quorum sensing.**

The relevance and importance of these areas of new science with respect to the survival of *E. amylovora* are discussed below.

The literature on epiphytic forms of survival and growth on leaves and twigs, and on epiphytic infestation of apples is discussed in APPENDIX 5.1(A); the significance of epiphytic *E. amylovora* with respect to Importation Steps 2, 3 and

5 was discussed in Section 5.3.3 (Epiphytic populations). Further, recent experimental data also support the possible spread of *E. amylovora* due to survival and growth of bacterium on plant surfaces and mature apple (Jock *et al.* 2005; Tsukamoto 2005). Bacterial populations upon or within surface injury sites would be expected to survive and multiply by the factor of 10 and not show signs of infection (Jock *et al.* 2005).

There is increasing evidence that *E. amylovora* engages in **multicellular behaviour**. Bacterial multicellular behaviour begins when free living planktonic bacteria engage in **quorum sensing**. An outcome of multicellular behaviour in planktonic bacteria attachment to surfaces, is often facilitated by flagella. Following attachment surface colonisation in the form of aggregation develops, facilitated by pilli and other adhesions leading to biofilm formation (Stoodley *et al.* 2002). More complex adhesive structures called pellicle may follow (Yap *et al.* 2005).

Most recent publications confirm the reported ability of *Erwinias* to form biofilms; in particular *E. chrysanthemi* (Barak 2004) and *E. carotovora* (Marques *et al.* 2004). Biofilm producing bacteria have the following characteristics:

- Bacterial attachment to surfaces is initiated by pilli or flagella (Stoodley *et al.* 2002). *E. amylovora* has flagella (Raymundo and Ries 1980)
- EPS production plays an important role in the biofilm formation (Stoodley *et al.* 2002, Costerton *et al.* 1995, Harrison *et al.* 2005). *E. amylovora* is known to produce EPS (extrapolymer saccharide) which is an important virulence factor (Wei *et al.* 2000). Biofilms bind cells and organic and inorganic materials to each other, and to a variety of substrata. A dense EPS matrix triggered by a stress response and formed through EPS production maximizes bacterial survival by increasing nutrient concentration (Costerton *et al.* 1995). Biofilm or aggregate formations provide protection from UV, bacteriophages, desiccation (Geider, 2000), environment conditions, plant defences and antimicrobial agents (Sapers 2001; Ryu and Beuchat 2004).
- Multicellular behaviours are essential first steps in enterobacterial biofilm formation. *E. amylovora* has recently been reported to engage in multicellular behaviour such as quorum sensing (Venturi *et al.* 2004; Molina *et al.* 2005). Quorum sensing is a bacterial communication mechanism to coordinate expression of specific genes in a cell density-dependent manner. Quorum sensing is a bacterial defence mechanism known to be present in association with biofilm formation (Harrison *et al.* 2005) and involves the release of a signalling molecule (Acyl-Homoserine Lactone) which in turn interacts with specific receptors in each bacteria to turn on quorum sensing genes. Such genes often happen to be the virulence genes. There is evidence suggesting that quorum-sensing pathways converge with starvation-sensing pathways to regulate cell entry into a stationary phase (Lazazzera 2000).

- Quorum sensing may also be involved in the defence against antibiotics. In such circumstances the mechanism increases the production of molecular pumps that expel compounds from the cell (Harrison *et al.* 2005). These so-called multidrug efflux pumps reduce the accumulation of the toxin within the bacterium. A multidrug efflux system has been observed in relation to *E. amylovora* and was shown to be responsible for antibiotic resistance and to be resistant against some phytoalexins and antibiotics produced by epiphytic microorganisms such as *P. agglomerans*.
- The efflux system contributes substantially to the epiphytic fitness of *E. amylovora* (Burse *et al.* 2004). This multidrug efflux system could be responsible for the lack of penetration by other substances when the bacterium undertakes multicellular engagement.
- Type III secretion system (TTSS) is a molecular syringe which is required for virulence and aggregation (Yap *et al.* 2005). In *E. amylovora* Harp X, Harp Y and Harp S activates expression of *hrp L*. Harp L is a σ factor (sigma factor) homolog which in turn activates the expression of genes that encode TTSS as well as proteins that are secreted through the TTSS. The TTSS can be expressed in the absence of host cells using minimal medium (Wei *et al.* 2000).
- The presence of RpoS (Sigma S), the general stress response regulator, was found in *E. amylovora* as well as in many other enterobacteria including *Salmonella enterica* or *E. coli* (Mukherjee *et al.* 1998; Barak *et al.* 2005). This RpoS sigma regulates the mechanism for initial attachment and therefore plays an important role in biofilm formation (Prigent-Combaret 2001). The sigma factor is involved in the expression of a number of genes that are activated during growth when there is nutrient limitation (Zambrano and Kolter 1996) or exposure to toxins resulting in resistance of same (Badger and Miller 1995). Finally RpoS plays an important role as a regulator required for virulence (Barak *et al.* 2005).

Although it is not yet documented that *E. amylovora* is capable of developing a particular multicellular structure like biofilm, *E. amylovora* utilizes mechanisms associated with multicellular behaviours such as quorum sensing and the multidrug efflux system and has demonstrated characteristics which are common to biofilm producing bacteria *viz* the presence of flagella, the production of EPS as well as presence of particular genes that participate in TTSS and expression of sigma factors. These demonstrated precursors to biofilm production are not apparently qualified or neutralized by any demonstrated attribute or function of *E. amylovora* identified by 2005 DIRA and no positive reason for an incapacity to produce biofilm has been advanced by 2005 DIRA in relation to *E. amylovora*. In the short time since the relatively recent discovery of bacterial biofilm on plant surfaces, the capacity of *E. amylovora* to produce identified biofilm precursors

has been demonstrated. It is in this context that the incomplete but developing understanding of this new science invites caution, so as to not be misled by the present absence of observed biofilm associated with *E. amylovora*.

5.6 INDUSTRY'S ASSESSMENT OF UNRESTRICTED AND RESTRICTED RISK

5.6.1 Probability of Importation

As mentioned earlier the Australian Apple and Pear Industry was pleased to find that a good proportion of the literature cited by the Industry in its response to the 2004 RDIRA has been adopted by the RAP in the 2005 DIRA, even though the interpretation of the papers may not have been the same in some cases. This has certainly made Industry's task in responding to the 2005 DIRA much easier.

Importation Step 1: Likelihood that *E. amylovora* is present in the source orchards in New Zealand.

The Australian Apple and Pear Industry agrees with the assessment of likelihood for this importation given in the 2005 DIRA (likelihood – 1).

The Australian Apple and Pear Industry is concerned that some of the Orchard Management practices in New Zealand listed in the 2005 DIRA (page 50) if carried out routinely in source orchards would lead to erroneous results on Restricted Risk. The practices in question are:

- (1) pruning out infected shoots; this would lead to wrong conclusions by inspectors in regard to the disease status of the orchard.
- (2) frequent inspections of the orchard (*and pruning and burning infected material*). If these are done under assessment of unrestricted risk then it should not be considered again under assessment of restricted risk; it amounts to double counting.

According to 2005 DIRA, MAFNZ has stated that 61-75% of growers in any one year did not consider that production would be sufficiently affected by Fire Blight to warrant control measures. The danger of not using control measures is that there would be a progressive build up of inoculum in the form of epiphytic bacteria in the orchard over a period of time and at some stage cause disease development. If it is in close proximity to a designated source orchard it will cause the levels of epiphytic bacteria in the source orchard to considerably increase even though it may not exhibit any symptoms. This would adversely affect the subsequent importation steps, particularly steps 2 and 3.

Importation Step 2: Likelihood that picked fruit is infested/infected with *E. amylovora*

2005 DIRA has assigned a most likely value of 3×10^{-2} (minimum value of 1×10^{-3} and a maximum value of 5×10^{-2}). The Australian Apple and Pear Industry consider these values are far too low in the light of evidence presented in the literature cited in the 2005 DIRA.

Reports in the literature by Hale *et al* (1987), Sholberg *et al* (1988), van der Zwet *et al* (1990), Goodman (1954) and McManus and Jones (1995) indicate the possibility of fruit from trees with and without symptoms could be infested/infected with *E. amylovora*. A more recent piece of research by Azegami *et al* (2006) supports the possibility for occurrence of **endophytic** *E. amylovora* infections in fruit. These reports are cited and a brief discussion for each paper is given in APPENDIX 5.1(A).

The Australian Apple and Pear Industry disagrees with the RAP that a reliable rate of bacterial population decrease can be extrapolated from the finding by Hale (1987). A single finding is not sufficient to establish the measure contended for. Bacterial populations on plant surfaces are characterized by huge fluctuations in population numbers (Hirano and Upper 2000). Experimental data have shown that populations of *Erwinias* were fluctuating after leaf infiltration over a period of time and varied considerably in samples of wood from apple trees with fire blight (Jock *et al.* 2005). The 2005 DIRA quotes a study of seasonal changes in epiphytic populations on apples and pears (Dueck and Morand 1975). The highest populations of *E. amylovora* were observed during the season of highest rainfall. This finding is consistent with the general observations of population fluctuation of other epiphytic bacteria (Hirano and Upper 2000).

Observations of seasonal population change support a conclusion of fluctuating patterns of epiphytic populations, rather than consistent decline of those populations up to harvest time. Industry does not agree that the literature supports a conclusion that epiphytic populations tend to be low at the time of harvest. The observations made by Dueck and Morand (1975) suggest that on 20 September 1974 there was 38% of positive samples harvested from multicultivar pear. In NZ, the infestation of mature apples around harvest time increased markedly from 0.06% on 12/02/85 to 3% on 28/02/85 (Hale *et al.* 1987).

The Australian Apple and Pear Industry concludes that epiphytic populations of *E. amylovora* are highly fluctuating and that fluctuations are driven by a variety of environmental and other factors, including weather and the size of transient populations and the survival advantage conferred by common surface variabilities and trauma. Industry's

concern is that surface variability is a fact impacting the long term survival of inoculum. Low levels of inoculum are capable of rapid population re-growth when the skin surface is broken (Jock *et al.* 2005). No general rule of population decrease at harvest time can be postulated and therefore the risk associated has to be rated accordingly, as highly variable.

2005 DIRA has made reference to the following areas of new science which were discussed in considerable detail in the APAL's response to 2004 RDIRA:

- (a) Viable but non-culturable bacteria (VBNC),
- (b) biofilms/aggregates,
- (c) sigma factor.

2005 DIRA does not seem to consider these areas of new science as relevant to the assessment of risk with respect to the importation of apples from countries having fire blight. In this response the Australian Apple and Pear Industry has discussed in considerable detail the subject of VBNC and its relevance to conclusions drawn on the basis of results obtained by culturing the pathogen on or in culture media. Extensive studies on VBNC have been carried out recently by Biosca *et al* (2004; 2006) and Ordax *et al* (2004; 2006 a; 2006 b); a summary of their findings and a detailed discussion of the subject of VBNC in general were presented above under **Section 5.3.8**. The importance and relevance of the other areas of new science, including **multicellular behaviour, biofilms/aggregates, sigma factor and quorum sensing**, in risk assessment, with special reference to **the survival of *E. amylovora*** were discussed above in some detail in **Section 5.5**.

Referring to culture techniques 2005 DIRA has stated (page 53, para 2) that *“there is no justification or evidence to show that the bacterial numbers reported in the scientific papers cited above were systematically underestimated because of lack of sensitivity”*. What the Australian Apple and Pear Industry has hitherto maintained is its serious concern about the effectiveness of the methods that are used to harvest or recover epiphytic pathogenic bacteria from plant surfaces. Indirect methods such as washing plant tissue with sterile water or buffer solutions only capture the planktonic bacteria on plant surfaces. The harvesting technique developed by Crosse (1959), or modifications of this technique, reported in the literature, are capable of harvesting planktonic (unattached) bacteria but is unlikely to harvest the attached bacteria (biofilms/aggregates). Then there are the VBNC bacteria that are not culturable, induced by metal ions, such as copper, or as a result of stress caused by low nutrient levels. In New Zealand copper based fungicides are applied on apple trees around 10 days before flowering for the control of black spot. These subjects are discussed in considerable detail in **Section 5.3.6** under **“Effectiveness of *E. amylovora* harvesting methods”**, and in **Section 5.3.8** under **VBNC**.

On the basis of material referred to above the Australian Apple and Pear Industry is assigning a most likely value of 2×10^{-1} , a minimum value of 2×10^{-2} and a maximum value of 5×10^{-1} .

Importation Step 3: Likelihood that clean fruit is contaminated by *E. amylovora* during picking and transport to the packing house.

2005 DIRA has assigned a most likely value of 1×10^{-2} (minimum value of 1×10^{-3} and a maximum value of 3×10^{-2}). The Australian Apple and Pear Industry consider these values are inadequate in the light evidence presented in the 2005 DIRA by citing some papers from the literature. As stated above in **Section 5.3.3**, apart from the exponential epiphytic growth of *E. amylovora* on the stigmas of host and non-host flowers the pathogen is known to exist in an epiphytic form on leaves, buds, twigs and stems; van der Zwet and Keil (1979) has reviewed the early literature on the subject. More recently McManus and Jones (1995) detected *E. amylovora* in 39 to 100% of leaves sampled from a scion orchard of apples free of any Fire Blight symptoms. The subject of the occurrence and significance of epiphytic populations of *E. amylovora* in orchards was discussed in considerable detail above under **Section 5.3.3**. In relation to the assessment of risks associated with fruits the presence of epiphytic bacteria on leaves, buds, twigs and stems is of considerable importance in that these bacteria would contaminate relatively clean fruit during picking and transport to the packinghouse. Some of the relevant literature is cited in APPENDIX 5.1(A) with very brief discussions on the findings in each paper. **The following assessment of the likelihood for Importation Step3 is largely based on material presented in Section 5.3.3 and APPENDIX 5.1(A).**

The most likely value assigned by the Australian Apple and Pear Industry for Imp 3 is 1.75×10^{-1} ; the minimum value assigned is 2×10^{-2} and the maximum value 5×10^{-1} .

Importation Step 4: Likelihood that *E. amylovora* survives routine processing procedures in the packing house.

2005 DIRA has assigned a most likely value of 6.5×10^{-1} (minimum value of 3×10^{-1} and a maximum value of 7×10^{-1}). The Australian Apple and Pear Industry agree with most of the material presented in support of this assessment in the 2005 DIRA document, but considers the likelihood be somewhat higher than that assessed by the RAP.

Industry considers that pre-cooling would favour internalization of bacteria present on the outside of the fruit, thus providing protection for some bacteria that would have been vulnerable to disinfection.

Effectively, rapid cooling of warm produce may have an effect on epiphytic bacterial internalization due to the contraction of gases in the porous apple as a result of temperature differences between the outside and pulp tissue of fruit. This subject was discussed in some detail earlier under Section 5.4.5.

Disinfection with either chlorine or other products, even at concentrations that are inadequate, should not be considered under unrestricted risk assessments as it is a risk mitigation measure. Any lowering of the likelihood values as a result of such treatment at this stage and again in assessing restricted risk would amount to “double counting”. However, the Industry made some allowance for this in lowering the likelihood value for this importation step from 1 to 0.8.

There is abundant evidence in the literature of contamination of vegetable produce occurring in the wash or dump tank. Where effective disinfectants have not been added to the wash tank, or if they have been added but the concentrations of the disinfectants not continuously monitored, the result had been 100% contamination or very close to 100%. The Australian Apple and Pear Industry does not consider 5 - 50 ppm of available chlorine adequate to eliminate even a small proportion of the bacteria especially if the concentrations are not continuously monitored.

2005 DIRA cites a paper by Toivonen *et al* (2001) on the use of peroxyacetic acid on apples and the ability of this chemical to eliminate microbes from the calyx sinus. It is difficult to visualize how this could occur unless the fruits tested had a very open sinus.

The subject of cold storage was discussed earlier under Section 5.4.6. Except for reports from New Zealand, the Australian Apple and Pear Industry is not aware of any other work where cold storage has been found to control bacterial infestations or are reduced as a direct result of cold storage. However, decline in bacterial numbers may occur with time during cold storage if the storage periods are long. Besides the papers by Anderson (1952), Dueck (1974) and Nachtigall *et al* (1985), where the survival of *E. amylovora* on mature apple and pear has been found to remain unaffected following cold storage, it is an established norm in basic bacteriology that low temperatures in the range of 0-4⁰ C do not kill bacteria (Salle 1967). Temperatures in the range of 0-4⁰ C affect certain physical properties within the bacterial cell, which in turn decrease the rate of metabolic reactions leading to increased longevity of the cells. Also, these low temperatures reduce the requirements for nutrients by bacteria (Salle 1967).

Under Importation Step 4 there is no mention in the 2005 DIRA of the sanitation of equipment in packing houses that export apples would come

into contact with during packing house operations. Unless measures are taken regularly to ensure sanitation of this equipment there is a very high possibility that export apples will get cross contaminated from non-export apples *via* such equipment. APPENDIX 5.1(F) discusses this subject and lists some measures that could be undertaken in this regard.

The Australian Apple and Pear Industry recommends that sanitation of packing house equipment should be included in any protocol drawn up in connection with export of apples to Australia.

The subject of “Disinfection and its Efficacy” was discussed earlier in detail under Section 5.4.4.

On the basis of material referred to above and under Section 5.4.4, the Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 4.

Importation Step 5: Likelihood that clean fruit is contaminated by *E. amylovora* during processing in the packing house.

The 2005 DIRA has assigned a most likely value of 2.5×10^{-2} , a minimum value of 1×10^{-3} and a maximum value of 5×10^{-2} . Although the Australian Apple and Pear Industry agree with some of the material presented in support of this assessment it does not agree at all with the assessment itself; the assessments are considered far too low.

Almost all the material that the Australian Apple and Pear Industry presented above with respect to Importation Step 4 applies to Importation Step 5, although the latter is about contamination of clean fruit. In Industry’s opinion one of the reasons why the RAP has assigned a very low most likely value for this importation step is because of the wrong perception that the water in the dump tank would lower the bacterial numbers rather than increase them. This perception appears to have come from the report by Crosse *et al* (1972) about bacteria not surviving for long periods in either sterile or tap water. This point is discussed in greater detail below. The water in the dump tank contains a lot of organic matter coming with all the material being dumped into it along with the apples. This would support multiplication of facultative organisms including *E. amylovora*. As the 2005 DIRA document points out, “any bacteria present on fruit, leaves, twigs, harvesting bins and soil adhering to bottom of bins may get into the dump tank and contaminate clean fruit”. Thus, these contaminant bacteria would progressively multiply, unless controlled with disinfectants, and contaminate all of the fruit in the dump tank.

The washing procedures as described on page 69 in the 2005 DIRA state that water in dump tanks is changed after processing 600 bins of apples or at the end of the week. It is stated on page 64 2005 DIRA that 47% of pack houses do not use any means of surface sanitation. This contributes to the likelihood that accumulation of *E. amylovora* inoculum would occur. In the remaining 37% of pack houses using sanitation, it is uncertain whether the required level of free chlorine, can be maintained considering the volume of fruit processed. The alternative sanitation systems (16% of the remaining pack houses) do not specify the level of the sanitizing agent used or other system parameters. It can only be concluded that 84 % of packing houses are unlikely to be able to maintain a constant level of sanitation. The failure to maintain a high level of chlorine results in cross contamination of produce (Nguyen-the and Carlin 1994).

The Australian Apple and Pear Industry would like to point out that the washing operations of export apples and non export blocks are not separated, therefore the sources of cross-contaminations are multiple. The Ecowise Environmental Report (2005) provides an independent review of the literature and supports Industry's previously stated opinion with regard to:

- apples from fire blight free blocks coming into contact with Fire Blight infected blocks;
- the possibility of non sanitation of bacteria in dump tanks;
- cross contamination issues after sanitation;
- high level of chlorination (1,000 ppm) still resulted in 18% cross contamination of tomatoes with *E. carotovora* citing (Bartz 1988) after Ogawa (1988);
- the possibility of contamination of produce between sanitation procedures (Michaels *et al.* 2003).

At the time of harvest sources of fresh inoculum can be found if there is active Fire Blight in the orchard (Thomson and Gouk 1999). Inoculum may be present on 100% of leaves at some stage in an orchard in the absence of disease symptoms (McManus and Jones 1995). Bacterial inoculum will be introduced to dump tank water from apples, leaves, soil, bins and twigs. In the absence of a reliable sanitation system, at some point the dump tank waters would work as inoculation water. The follow up system used in 73% of packing houses (high pressure and high volume washing with a jet of "clean" waters to rinse apples after washing) would have some effect in removing cross-contamination, but equally the high pressure jets are likely to force some bacteria into the calyx or stem end. The bacteria free status of the water source of the high pressure treatment must be verified and monitored.

The Australian Apple and Pear Industry's assessment is that trash or soil as well as apples will introduce *E. amylovora* to the wash waters. The contamination of water has a cumulative effect. In the unrestricted scenario where the pest is present in the source orchard, it is fair to assume that *E. amylovora* would accumulate in the wash waters and that they would become a source of inoculum.

It is difficult to estimate the level of infection found in dump tanks. The quoted work of Sholberg et al. (1988), Özakman and Maiden (1999) give some indication of the level of infection that can be washed from shoots or leaves. On occasion some twigs with cankers could be washed or some soil particles from bins could be dropped off. Fire Blight can be active at the end of the season, giving rise to sources of inoculum for epiphytic infestation (Thompson and Gouk 1999). If one considers the volume of fruit washed in the dump tanks even a small percentage of contaminated material would build up inoculum to unexpected levels.

The 2005 DIRA document states on page 69 that *E. amylovora* has difficulty in surviving in water. The literature qualifies the relevance and usefulness of this statement as indicated by the following:

- Biosca *et al.* (2004) reports that *E. amylovora* survived for at least 6 months in irrigation waters.
- Researchers use water to harvest bacteria from fruit (Roberts 1989; Dueck 1974; Manceau *et al.* 1990; Miller and Schroth 1972).
- Water is claimed to have an antimicrobial property with respect to *E. amylovora* (Mass Geesteranus and de Vries 1984; Crosse et al. 1972).
- Water has been accepted as a vector for spreading the disease (Miller 1929; Thomson and Gouk 1999; Pusey, 2000).

The Australian Apple and Pear Industry accepts that distilled water may have an impact on the viability of *E. amylovora* but the literature supports the view that rain water plays a part in spreading the disease and is capable of supporting *E. amylovora* (Pusey 1999; Thomson and Gouk 1999; Norman *et al.* 2003).

The 2005 DIRA states that no comparison should be made between *E. coli* and *E. amylovora* with respect to bacterial adherence and internalization to fruit surface and suggests three reasons for this proposition:

- (i) Surface adherence was not demonstrated for *E. amylovora*, citing Ceroni et al (2004).
- (ii) Internalization ought result in symptom development, and
- (iii) *E. coli* was not washed off into dump tanks from inoculated apples quoting Sapers (1999), a publication which is not readily available.

Taking each reason in turn; the Ceroni et al. (2004) results arise from a method sensitive only to detect planktonic bacteria but not validated to detect attached bacteria. Burnet et al. (2000), Kenney et al. (2001) and Seeman et al. (2002) use methods which are more sensitive than the method used by Ceroni et al. (2004) (including confocal microscopy) and the results of each are reflective only of the methods used. With regard to (ii), the reported internalization of *E. amylovora* in apple core does not result in disease symptoms despite the detection of viable inoculum (van der Zwet et al. 1990; Jock et al. 2005). With regard to (iii), in the absence of knowing the experimental settings of that trial, how many apples were washed, what was the level of infection, the size of the tank, whether sanitizers were used, or the manner of sanitation (whether automatic, non automatic, or how the sanitation was dispensed), it is difficult to draw any conclusion from the reported non contamination of wash waters.

The ability of *E. coli* to internalize within the apple core reflects the property of an apple rather than of the bacterium. Bacterial penetration of fruit immersed in water depends on negative air pressure that is created while fruit is immersed in water.

On the basis of material referred to above the Australian Apple and Pear Industry is assigning a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1) for Importation Step 5.

Importation Step 6: Likelihood that *E. amylovora* survives palletisation, quality inspection, containerization and transportation to Australia.

The Australian Apple and Pear Industry agrees with the values assigned in the 2005 DIRA for Importation Step6 viz a most likely value of 8×10^{-1} , a minimum value of 5×10^{-1} and a maximum value of 1×10^0 (1).

Importation Step 7: Likelihood that clean fruit is contaminated by *E. amylovora* during palletisation, quality inspection, containerization and transportation.

The Australian Apple and Pear Industry agrees with the values assigned in the RDIRA –2005 for Importation Step7 viz a most likely value of 5×10^{-7} , a minimum value of 0 and a maximum value of 5×10^{-7} .

Importation Step 8: Likelihood that *E. amylovora* survives and remains with the fruit after on-arrival minimum border procedures.

The Australian Apple and Pear Industry agrees with the value of 1 assigned in the 2005 DIRA for Importation Step8.

**5.6.2 Probability of entry, establishment and spread
Proportion of utility points near host plants susceptible to *E. amylovora* in each exposure group:**

The Australian Apple and Pear Industry highlighted in PART B of this submission concerns with many aspects of the 2005 DIRA relating to utility points. Industry is of view that an increase in the following proximity values would present a more realistic picture:

Page 74, section *Commercial fruit crops near utility points*

The proportion of **consumers near commercial fruit crops** is considered to be in the range of 10^{-5} to 10^{-3} .

Page 74, section *Nursery plants near utility points:*

The proportion of **orchard wholesalers near nursery plants** is considered to be in the range 5×10^{-2} to 10^{-1} .

Page 74, section *Nursery plants near utility points:*

The proportion of **consumers near nursery plants** is considered to be in the range of 10^{-4} to 10^{-3} .

Page 75-76, section *Wild and amenity plants near utility points*

The proportion of **consumers near wild and amenity plants** is considered to be in the range of 10^{-3} to 10^{-2} .

**5.6.3 Exposure:
Survival and transfer mechanism:**

Discarded apple cores or whole fruit carrying *E. amylovora* in the calyces will soon begin to decay releasing kairomones which would attract several species of crawling and flying insects. Release of nutrients during the decay process will enhance rapid growth of *E. amylovora* present in the calyx. This rapid growth is unlikely to last for a long period as saprophytic microorganisms will soon invade the decaying material and quickly over run the *E. amylovora*. **However, the insects visiting the decaying fruit prior to this happening would pick up substantial**

quantities of Fire Blight bacteria that could be transferred either to host blossoms or to succulent shoots to initiate an infection.

Host receptivity:

Epiphytic growth of *E. amylovora* on flower stigmas of non-host plants reported by Johnson (2004) is an important epidemiological factor that had hitherto remained unrecognised. Non-host plants could blossom at various times of the year depending on the species involved. Thus, crawling and flying insects visiting decaying infested/infected discarded apples/apple cores may transfer Fire Blight bacteria to such non-host stigmas where exponential growth could occur. High levels of inoculum from these blossoms could be transferred by these crawling and flying insects to blossoms or succulent shoots of susceptible hosts of *E. amylovora*. This could occur at any time during spring and summer or even early autumn provided such tissue (eg secondary blossoms) is available and the weather conditions are favourable for infection (see page 81, para 7 of RDIRA). Thus, epiphytic *E. amylovora* on flower stigmas of non-host plants could act as reservoirs of inoculum.

Conclusion – Exposure

For reasons mentioned under “*survival and transfer mechanisms*” and “*host receptivity*”, the exposure value for an individual apple for the 5 utility points by 4 exposure group combinations is considered to be in the range of 10^{-7} to 10^{-4} .

5.6.4 Probability of establishment

Reproductive strategy of *E. amylovora*, minimum populations needed for establishment and mode of infection

The rate of growth and generation time of bacteria depends on the culture medium used and the incubation temperature (Thimann, 1963). In nutrient broth at 30°C the generation time (doubling time) is around 82 minutes for virulent strains of *E. amylovora* and around 74 minutes for avirulent strains (Hildebrand 1938; Billing *et al* 1961). Under favourable conditions a single bacterium is considered to take about 17 hours to multiply to 100,000 bacteria. *Escherichia coli* has a generation time of 17 minutes at 37°C in broth; theoretically a single *E. coli* cell would produce around 16 billion cells in 17 hours. It is likely that the number of cells produced by *E. amylovora* in 10 hours stated in 2005 DIRA as one million cells is for *E. coli*, rather than for *E. amylovora*.

Hildebrand (1937) transferred single cells to nectaries of dwarf apple tress in 2 trials. Infection resulted only in one of these trials. In another experiment he carried out 15 different single cell inoculations, 5 different

2-cell inoculations, 5 different 5-cell inoculations and several different 10-cell inoculations on excised apple flowers; infections resulted in 60%, 60%, 80% and 100% of the inoculations respectively. The point to note is that infection occurred in 60% of the inoculations using single cells. van der Zwet (1989) tested in the field 3 different levels of inoculum using 3 different isolates of *E. amylovora* on blossoms of Bartlett pear and Jonathan apple. The degree of blossom blight obtained with each of the inoculum levels varied with isolates used; 12.5% of the apple blossoms developed blight with 10^2 (100) cfu/ml, 20.0% with 10^5 cfu/ml and 61.5% with 10^8 cfu/ml. With another isolate 26.0% of pear blossoms developed blight with 10^2 (100) cfu/ml, 51.5% with 10^5 cfu/ml and 79.0% with 10^8 cfu/ml. The point to note is that infection occurred in 12.5% of the apple blossom inoculations and 26.0% pear blossom inoculations using 10^2 (100) cfu/ml. Crosse *et al* (1972) inoculated apple shoots using 9 μ l aliquots of *E. amylovora* inoculum ranging from 10^2 to 10^5 cells/ml. They were able to induce symptoms with just **38 cells**. Thus, with respect to the lower range of cells required to initiate infection of hosts by *Erwinia amylovora*, leading to establishment of disease, it could occur with a range of cell numbers from 1 to 100.

Theoretically *E. amylovora* should be able to enter its hosts through any surface either through natural openings like stomata or lenticels or through wounds caused by wind damage, hailstorms etc. Infection of blossoms occurs through natural openings, including stigmas, anthers, stomata on the styles, fruit surfaces and sepals, hydathodes, nectarhodes (Thomson, 2000). In shoots invasion of the host tissue following entry occurs largely in actively growing young leaves. Entry into mature tissue is predominantly through wounds. However, infections occurring in apple or pear orchards in late summer following hailstorms are known to cause severe symptoms and inflict serious damage to the trees.

The exact mode of infection of the host by *E. amylovora* is still not properly understood. This was the reason for van der Zwet *et al* (1988) to comment as follows in their review article titled “Controlling Fire Blight of pear and apple by accurate prediction of the blossom blight phase”: *“Fire Blight is one of the most erratic and unpredictable diseases of pear and apple. Our perplexity is due mainly to our lack of fundamental knowledge of the bacterium and its mode of infection, especially just before and during bloom”*. Prior to that Schroth *et al* (1974) stated *“Fire Blight continues to be one of the most intensively studied bacterial diseases of plants. In spite of this effort, the disease is still not satisfactorily controlled; it continues to spread throughout continental Europe and remains a major concern in most countries where pome fruits are grown”*. Commenting on this statement Johnson and Stockwell (1998) stated *“twenty four-years later, this summation by Schroth et al (1974) of the status of Fire Blight is unchanged”* (Johnson and Stockwell, 1998).

The movement of *E.amylovora* within the tree seems to depend on the plant tissue that is infected. Most studies indicate movement in the xylem, while some other studies indicate movement in the phloem. Also, there is evidence for the movement of the bacterium in the cortical parenchyma (Lewis and Goodman 1965; Lewis and Goodman 1966; Thomson 2000).

5.6.5 The method of pest survival

Method of survival of *E.amylovora* was discussed earlier in detail under **Section 5.3.8, Section 5.5 and under Importation Step 2.**

Potential Movement of pest with commodities and conveyances

According to the latest statistics on the worldwide distribution of Fire Blight, the disease is now known to occur in 47 countries, with the first introduction being to Canada in 1840, and last introduction being to Liechtenstein in 2004 (Dr Tom van der Zwet, personal communications with Satish Wimalajeewa). **According to van der Zwet, apart from the USA, which is regarded as the centre of origin of the disease, the exact means by which the disease has been introduced and subsequently established is known with certainty for only one country, namely Egypt.** It was established that LeConte pear trees imported from Florida in 1964 introduced fire blight to Egypt. In the case of the other 45 countries, records only speculate as to how the disease was introduced. The speculative means of introduction range from means like air currents in 29 countries (65%), nursery stock in 9 countries (20%), migratory birds in 6 countries (13%) and contaminated fruit boxes in one country (2%). Table 1 gives the list of countries and the means by which fire blight is **suspected** to have been introduced into the countries shown.

Table 5.1. Suspected means by which fire blight has been introduced to the countries where it is now known to occur; centre of origin is the USA

Country (in chronological order in which disease was introduced)	<u>Suspected</u> means of introduction	Percentage (%) countries in each category of introduction
Canada, Luxemburg, Cyprus, Greece, Israel, Turkey, Sweden, Norway, Macedonia, Austria, Lebanon, Bulgaria, Switzerland, Jordan, Syria, Armenia, Italy (Apulia and Sicily), Iran, Serbia-Montenegro, Bosnia-Herzegovina, Romania, Moldavia, Croatia, Ukraine, Hungary, Albania, Slovenia, Slovakia and Liechtenstein	Air Currents	65%
Japan, New Zealand, Bermuda, Mexico, Guatemala, Ireland, Italy, Spain	Nursery stock	20%
The Netherlands, Poland, Denmark, Germany, France and Belgium	Migratory birds	13%
United Kingdom	Contaminated fruit boxes	2%

From the above it is apparent that the means by which Fire Blight has been introduced to over 95% of the countries where it is currently known to occur is based on **pure speculation**. Apple and pear fruit may have been exported to numerous pome fruit growing countries from the time the disease was first reported in the USA in 1793. **However, it is a mystery as to why among these suspected means of introductions fruit has not been to date implicated, especially when it is known that fruit could be both infected (without exhibiting external symptoms) and infested (calyx).**

5.6.6 Partial probability of establishment and spread

Household and garden plants

The reasons given by the RAP for the partial probability of establishment in household and garden plants are very subjective and the probability allocated is considered inadequate. The Australian Apple and Pear Industry is of view that the chances of spread of the pathogen once established are greater than that deemed by the RAP. One of the principal reasons for this would be that in household and garden situations the disease may remain without being noticed for a long time. This would provide ample time for the pathogen to spread and establish itself in neighbouring properties until it attacks a commercial orchard or nurseries which are inspected for maintenance on a regular schedule. **Thus, Industry would consider the probability of establishment to be in the range of 0.7 to 1, and the probability of spread also in the range of 0.7 to 1.**

Conclusion – Entry, establishment and spread

The distribution values given by @RISK model, based on the two scenarios for utilisation of apple fruit are shown in Table 5.2.

Table 5.2. Unrestricted probability of entry, establishment and spread

Percentile	Probability of entry establishment and spread: P1 = Uniform (0.7, 1)	Probability of entry establishment and spread: P1 = Uniform (10^{-3} , 5×10^{-2})	Qualitative description
5th percentile	1.0	1.0	Certain
Median	1.0	1.0	Certain
95th percentile	1.0	1.0	Certain

5.6.7 Assessment of Consequences

The Australian Apple and Pear Industry agrees with the impact scores given in the 2005 DIRA, for most of the criteria except for that given for “Control and eradication”. Industry considers the costs given for the control of Fire Blight in the USA are too low. The reason for this may be because the figures have been based on costs worked out in 1997 by Oliver *et al* (1997). One of the members of the Industry Technical Team obtained costs shown below in Table 2 for control of Fire Blight on pears

in the Sacramento Valley, California (Satish Wimalajeewa – personal communications with Dr Broc G. Zoller, Pear Doctor Inc, Kelseyville, California – October 2005).

The cost of control given here includes the cost of chemicals used and their application (Table 5.3). The cost of removal of holdover cankers and pruning of early season infections in spring is around US \$ 250/acre (Australian\$ 750/ha. The costs shown in Table 5.3 have been converted from US\$ to Australian \$, and wt/area converted from lb/acre to kg/ha.

Table 5.3. Cost of chemicals and spray applications for control of Fire Blight in the Sacramento Valley in California

Treatment (chemical used)	Amount per treatment	Cost of chemical/kg	Number of treatments	Cost of chemical used	Total cost of chemicals	Grand Total – Chemicals +Applications
Terramycin 17WP	0.25 kg	\$ 69.50/kg	16	\$278.00	\$278.00	
Terramycin 17WP	0.50 kg	\$ 69.50/kg	2	\$69.50	\$69.50	
Streptomycin 17WP	0.30 kg	\$ 56.60/kg	1	\$17.00	\$17.00	
Copper 50WP	0.5 kg	\$ 8.75/kg	2	\$8.75	\$8.75	Total cost of chemicals for 21 treatments = \$373.25
Applications cost		\$59.70 per treatment	21		Total cost of 21 applications = \$1253.70	Grand Total for Chemicals +Applications = \$1626.95/ha per season

Thus the average cost of control for the application of chemicals (bactericides) only is \$1627 per ha. When the cost of removal of cankers and pruning of strikes is added the total cost would be \$ 2377/ha. The average size of an apple or pear orchard in Victoria is about 15.4 ha while the average size for the whole of Australia is around 15.5 ha. On this basis the cost of Fire Blight control on an average size orchard in Australia would be approximately \$36,843 per year.

Conclusion – Consequences

In view of the higher costs for the control of Fire Blight worked out by the Australian Apple and Pear Industry in comparison to that given in the 2005 DIRA, Industry considers it more appropriate to assess the

Consequences as “**Certain**” (1) rather than “**High**” as given by the RAP. However, as the range for “**High**” according to Table 12 in the 2005 DIRA is from 0.7 to 1, the rating of “**High**” allocated for Consequences is acceptable for convenience of comparison with the 2005 DIRA estimation of Unrestricted risk.

5.6.8 Unrestricted risk

The unrestricted annual risk estimated by the Australian Apple and Pear Industry for *E. amylovora*, based on the RAP’s model, is presented in Table 3.

Table 5.4. Unrestricted risk estimation for *E. amylovora*

	P1 Uniform (0.7, 1)	P1 Uniform (10^{-3} , 5×10^{-2})
Overall probability of entry, establishment and spread (median value)	1 (Certain)	1 (Certain)
Consequences	High	High
Unrestricted annual risk	Greater than Moderate Risk	Greater than Moderate Risk

5.7 Risk management for Fire Blight

5.7.1 Areas free from disease symptoms

The 2005 DIRA states that areas free from disease symptoms could be established and maintained following the guidelines described in ISPM 4 and ISPM 22. However, there are several difficulties and problems that are likely to prop up in trying to adhere to ISPM 22. These were discussed in detail above under **Section 5.4.1**.

The 2005 DIRA states that in the Integrated Fruit Production Program Manual (Fact Sheet 7) a combination of 10 measures is recommended to New Zealand apple growers for the management of Fire Blight.

One of the measures recommended is “frequently inspecting the orchard; especially from blossoming to mid-summer for signs of infected blooms or shoots, pruning and burning any infected material upon detection”. This recommended practice covers to a considerable degree the risk mitigation measure proposed (areas free from disease symptoms). Thus, if orchardists implement this measure as a routine practice then the likelihood for Imp 2 under Unrestricted Risk is already lowered to an appreciable degree. To further lower the Restricted Likelihood, without making any allowance for this, would amount to double counting.

Another measure recommended in the Integrated Fruit Production Program is pruning out infected shoots. This would lead to wrong conclusions by inspectors in regard to the disease status of the orchard. If frequent inspections of the orchard (*and pruning and burning infected material*) are done under assessment of unrestricted risk then it should not be considered again under assessment of restricted risk; it amounts to double counting. Also, if removal of infected material is allowed from blossoming onwards, how would orchard inspectors, inspecting the areas 4-7 weeks after flowering, know that the area actually had disease symptoms prior to that?

When inspections of orchards/blocks are done 4-7 weeks after flowering how would inspectors be able to see active 3-5 mm cankers (symptom) high up on tree canopies?

The 2005 DIRA states that when the likelihood of Imp 2 is reduced it will flow on to Imp 3 and Imp 5. While the likelihood for Imp 3 may be very marginally reduced as a result of some reduction in the likelihood for Imp 2 it will not affect the likelihood for Imp 5. At Imp 5 there will be uniform spread of bacteria and contamination of the apples in the dump tank unless an effective concentration of chlorine or other suitable bactericide has been added to the water to kill almost all the bacteria.

As pointed out earlier, under Sections 5.3.1, 5.3.7 and APPENDIX 5.1(A), fruit from orchards apparently free of Fire Blight symptoms have been shown to have calyx infestations and endophytic infections. For this reason and for reasons stated above, Industry considers the restricted likelihoods given by the RAP in Table 24 of the 2005 DIRA, implying a 10 to 10⁵ fold reduction of the unrestricted likelihoods for Imp 2, 3 and 5, is excessive with this mitigation measure.

Although the Australian Apple and Pear Industry acknowledges that some reduction in the likelihoods for Imp 2 and Imp 3 would occur the magnitude of the reductions for the two Imps in the 2005 DIRA is considered excessive (Table 24 in the 2005 DIRA document).

Industry's median values for unrestricted risk are 0.2, 0.175 and 0.5 respectively for Imp 2, Imp 3 and Imp 5. It may be noticed that these values are marginally lower than those allocated by APAL in 2004 (in its response to 2004 RDIRA) as a result of allowance being made for inspections done from spring to mid-summer even in the case of unrestricted risk. Similarly, Industry would assess the restricted likelihoods as 0.16, 0.125 and 0.5 respectively for Imp 2, Imp 3 and Imp 5 (Table 5.5). It is apparent that the effect of "areas free from disease symptoms" has been overstated in 2005 DIRA.

Table 5.5. Effect of orchards free from fire blight symptoms

Step	Unrestricted likelihood	Restricted likelihood
Imp2	0.2	0.16
Imp3	0.175	0.125
Imp3b	0.002	0.002
Imp5	0.5	0.5
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

Thus, based on results of analysis presented in Table 5.5 “areas free from disease symptoms” do not lower the risk below “Moderate”.

5.8 Disinfection treatment

The limitation of chlorine treatment in relation to post harvest handling of fruit and vegetables is well recognized. Traditionally, chlorine based solutions have been used for surface sanitation. van der Zwet (1990) found that apples naturally contaminated with *E. amylovora*, when washed in 650 ppm chlorine and cold stored for 1 month, showed more contamination (15%) than apples that were not disinfected (3%). Sholberg *et al* (1988) found that chlorinated wash of particularly contaminated apples for up to 30 min had limited efficacy and was no more effective than 20 min exposure to water as a control.

As far as fruit is concerned chlorine treatment (100 ppm for 1 min) is likely to be effective only against the planktonic *E. amylovora* present on the fruit surface, on the stem end and those epiphytic on the fruit stalk. Even here it will not be 100% effective (Sholberg *et al*, 1988). Its effect will be negligible or nil in reducing or eliminating the bacteria in the calyx sinus, because of air pockets preventing access into that space. Also, it will not be effective against endophytic infections present in the flesh of the fruit or in the lenticels.

As for the concentration of chlorine, in the light of findings by Janisiewicz and van der Zwet (1988) a higher concentration may have to be used. Sholberg *et al* (1988) found chlorine to be ineffective in eliminating *E. amylovora* present on apple fruit surfaces or in the calyxes. The biggest challenge for washing apples would be to maintain the quality of the sanitizing water in the tanks. When batches of apples are processed in dump tanks, the level of available chlorine would be expected to quickly deteriorate as organic matter would react with the chlorine in dump tanks. Non automatic systems cannot guarantee maintenance of the required chlorine level. With respect to automated systems it is necessary that the contact time is sufficient to achieve the expected disinfection rate.

The Australian Apple and Pear Industry does not have enough information to be satisfied that even those 53% of packing houses that use the chlorine based system or alternative are able to maintain the crucial parameters that contribute to some level of sanitation. Even if chlorination levels were scrupulously maintained at 5-50 ppm, the expected efficacy of sanitation is likely to be marginal.

As pointed out earlier, under Sections 5.3.1, 5.3.7 and APPENDIX 5.1(A), fruit from orchards apparently free of Fire Blight symptoms have been shown to have calyx infestations and endophytic infections. Chlorine will have **no affect whatsoever** on these infestations and infections

In terms of importation steps, chlorine may affect low levels of reduction in bacterial numbers in Importation Steps 4 and 5, but will not reduce Importation Step 3 (contamination during picking and transport) even with a 100 ppm level as the RAP assumes.

As mentioned in the 2005 DIRA, a total of 53% of the packinghouses already use either chlorine or other bactericide in the dump tank to reduce the bacterial numbers therein, albeit at concentrations insufficient to achieve a satisfactory kill. This was considered under Unrestricted Risk. Therefore, if the effect of chlorine at 100 ppm for one minute (with concentration monitored at regular intervals) is to be considered again under Restricted Risk, proper allowance must be made for having already used it to reduce **the unrestricted risk (in 53% of the cases)** even at a lower efficacy level (approx. 35%). Therefore, the Australian Apple and Pear Industry suggest the **normally expected effect estimated by the RAP be reduced by a factor of $(1 \times 0.53 \times 0.35 = 0.19)$** . As acknowledged in the 2005 DIRA, bacteria in the calyx remain inaccessible by chlorine solutions (or by any other bactericidal solutions/suspensions); the reduction of calyx infestations (Imp 4) is therefore 0. Thus, reduction of surface contamination at Imp 4 would be by a factor of $0.66 \times (1 - 0.19) = 0.53$; reduction in calyx infestation at Imp 4 would be by a factor of 0; reduction of contamination at Imp 5 would be by a factor of $0.95 \times (1 - 0.19) = 0.77$. Industry did not consider further reduction of Imp 3 was necessary as a result of further contamination of these apples at Imp 4, because Industry did not take into account such added contamination.

If as mentioned in the 2005 DIRA soil is likely to get into the dump tank along with apples, even in very small amounts, continuous monitoring of the chlorine levels, rather than at regular intervals, will be necessary, particularly in summer and early autumn if satisfactory results are to be achieved. Chlorine readily combines with organic matter and thus becomes unavailable to attack bacteria.

For reasons stated in the preceding paragraphs the values for unrestricted and restricted likelihoods in Table 25 of the 2005 DIRA document are considered by the Australian Apple and Pear Industry as too low.

Industry's values for unrestricted and restricted likelihoods for Imps 3, 4 and 5 are given in Table 5. The risk estimate is greater than moderate.

Table 5.6 Effect of Chlorine Treatment on *E. amylovora*

Step	Unrestricted likelihood	Restricted likelihood
Imp3	0.175	0.175
Imp3b	0.002	0.002
Imp4	0.8	0.65
Imp5	0.5	0.175
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

5.9 Storage

It is an established norm in basic bacteriology that low temperatures in the range of 0-4°C do not kill bacteria (Salle 1967). These temperatures affect certain physical properties within the bacterial cell, which in turn decrease the rate of metabolic reactions leading to increased longevity of the cells. Anderson (1952), Dueck (1974) and Nachtigall *et al* (1985) found *E. amylovora* on mature apple and pear to be unaffected following cold storage. Ceroni *et al* (2004) studying the survival of *E. amylovora* on pears in cold storage were able to reisolate the bacteria from calyces of pears even after 101 days of cold storage. Sholberg *et al* (1988) did not detect a reduction in bacterial numbers in the fruit after 2 months; a significant decline was observed only after 6 months.

The 2005 DIRA states that the analysis of the effect of storage was based on application of the storage measure at the pre-export and transport step (Imp 6). The Australian Apple and Pear Industry maintains that the effect of cold storage would be almost zero regardless of the stage in the export chain at which the cold storage measure is applied. Any negligible reductions in numbers observed following cold storage would be **predominantly** due to normal declines that may occur with time with storage at **room temperature**; even this reduction would be arrested or impeded if the apples are stored at temperatures of 0-4°C.

As pointed out earlier, under Sections 5.3.1, 5.3.7 and APPENDIX 5.1(A), fruit from orchards apparently free of fire blight symptoms have been shown to have calyx infestations and endophytic infections. Storage will only marginally reduce the calyx infestations.

2005 DIRA has assigned a 2-fold (50%) reduction in the likelihood for Imp 6, lowering the Unrestricted Risk from a median value of 0.8 to 0.4 for Restricted

Risk as a result of cold storage. The Australian Apple and Pear Industry would reduce the likelihood from 0.8 for Unrestricted Risk to 0.65 for restricted risk, **attributing the reduction to time only**.

Industry's values for unrestricted and restricted likelihoods for Imp 6 are given in Table 5.7. The risk estimate is greater than moderate.

Table 5.7. Effect of Storage on *E. amylovora*

Step	Unrestricted likelihood	Restricted likelihood
Imp6	0.8	0.65
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

5.10 Systems Approaches

5.10.1 Areas free from Disease Symptoms and Chlorine Treatment

In the view of the Australian Apple and Pear Industry and with the appropriate modifications to the risk management protocols this is the only combination of risk mitigation measures that might go some way to having some appreciable effect in lowering overall risk, though not low enough to be within the ALOP range, whether considered from a qualitative or quantitative point of view.

The comments by the Australian Apple and Pear Industry separately under “Areas free from Disease Symptoms” and “Chlorine Treatment” apply here.

Industry's values for unrestricted and restricted likelihoods for Imps 2, 3, 3b, 4 and 5 are given in Table 5.8. The risk estimate is greater than **‘moderate’**.

Table 5.8. Effect of Areas free from Disease Symptoms and Chlorine Treatment on *E. amylovora*

Step	Unrestricted likelihood	Restricted likelihood
Imp2	0.2	0.16
Imp3	0.175	0.1
Imp3b	0.002	0.002
Imp4	0.8	0.65
Imp5	0.5	0.175
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

5.10.2 Areas free from Disease Symptoms and Storage

The Australian Apple and Pear Industry does not consider that combining Storage with Areas free from Disease Symptoms adds any appreciable risk reduction to the latter. The only effect storage will have would be a very marginal reduction of any bacterial populations in the calyx, stem-end sinus and on the surface purely as result of a very small decline in numbers with time. Endophytic infections will not be affected.

Industry's comments made above, separately, with respect to "Areas free from Disease Symptoms" and "Storage", will apply for the combined risk mitigation too. Industry did not consider further reduction of Imp 3 was necessary as a result of further contamination of these apples at Imp 4, because Industry did not take into account such added contamination.

Industry's values for unrestricted and restricted likelihoods for Imps 2, 3, 5 and 6 are given in Table 5.9. The risk estimate is greater than moderate and, as such, exceeds Australia's ALOP.

Table 5.9. Effect of Areas free from Disease Symptoms and Storage on E. amylovora

Step	Unrestricted likelihood	Restricted likelihood
Imp2	0.2	0.16
Imp3	0.175	0.125
Imp3b	0.002	0.002
Imp5	0.5	0.5
Imp6	0.8	0.65
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

5.10.3 Areas free from Disease Symptoms and Chlorine Treatment and Storage

This combination is only marginally better than the combination of “Areas free from Disease Symptoms and Chlorine Treatment”. The comments made above separately for each of the components in this combination (systems approach) apply here too.

Industry’s values for unrestricted and restricted likelihoods for Imps 2, 3, 4, 5 and 6 are given in Table 5.10. The risk estimate is greater than moderate and, as such, exceeds Australia’s ALOP. **However, from a purely qualitative angle, taking into consideration all the relevant epidemiological factors, the Australian Apple and Pear Industry is inclined to give this combined risk mitigation measure a risk estimate that is between “Low” and “Moderate”.** Although the latter is lower than the outcome obtained by using the @RISK model it would still exceed Australia’s ALOP.

Table 5.10. Effect of Areas free of Disease Symptoms and Chlorine Treatment and Storage

Step	Unrestricted likelihood	Restricted likelihood
Imp2	0.2	0.16
Imp3	0.175	0.125
Imp3b	0.002	0.002
Imp4	0.8	0.43
Imp5	0.5	0.175
Imp6	0.8	0.65
PEES (median)	1.0	1.0
Consequences	High	High
Risk estimate	Greater than Moderate Risk	Greater than Moderate Risk

APPENDIX 5.1 (A)

Examples of scientific papers where the Fire Blight pathogen <i>Erwinia amylovora</i> has been confirmed <u>on the surface</u> of mature fruit:

- (a) Papers reporting presence of *Erwinia amylovora* bacteria on surface of mature fruit from orchards with Fire Blight symptoms:

Hale, C.N., McRae, E.M. and Thomson, S.V. (1987). Occurrence of *Erwinia amylovora* on apple fruit in New Zealand. *Acta Horticulturae*, Number 217, 33-40.

These authors report that *E. amylovora* is only very rarely isolated from surfaces of mature fruit even in orchards showing severe fire blight symptoms.

Sholberg, P.L., Gaunce, A.P. and Owen, G.R. (1988). Occurrence of *Erwinia amylovora* of pome fruit in British Columbia in 1985 and its elimination from the apple surface. *Canadian Journal of Plant Pathology*, **10**, 178-182.

In heavily blighted orchards these authors found *E. amylovora* bacteria surviving on apple fruit surface at harvest time in British Columbia, Canada. They comment that unlike in Ontario the relative humidity in British Columbia is low and thus supports the survival of the pathogen on mature apples well into harvest time.

van der Zwet, T., Thomson, S.V., Covey, R.P. and Bonn, W.G. (1990). Population of *Erwinia amylovora* on external and internal apple fruit tissues. *Plant Disease* 74, 711-716.

These authors have reported the occurrence of *E. amylovora* bacteria on surface of mature apple fruit collected from West Virginia, and Utah (see Table 4 of paper). In West Virginia the pathogen was found on surfaces of fruit collected from both blighted as well as apparently healthy orchards. In Utah they were found only on apples from blighted orchards.

Examples of scientific papers where the Fire Blight pathogen <i>Erwinia amylovora</i> has been confirmed in <u>immature fruit</u>:

Hale, C.N., McRae, E.M. and Thomson, S.V. (1987). Occurrence of *Erwinia amylovora* on apple fruit in New Zealand. *Acta Horticulturae*, Number 217, 33-40.

These authors report the occurrence of *E. amylovora* in calyxes of 50% of immature fruit in orchards showing fire blight symptoms.

Miller, T. D. and Schroth, M. N. (1972). Monitoring the epiphytic population of *Erwinia amylovora* on pears with selective medium. *Phytopathology* 62: 1175-1182.

In a Bartlett pear orchard in the Butte County in California these authors detected epiphytic *E. amylovora* cells in 92% of the immature fruit tested.

Clark, R. G., Hale C. N. and Harte, D. (1993) A DNA approach to *Erwinia amylovora* detection in large scale apples testing and in epidemiological studies. *Acta Hort* 338: 59-66.

In an experiment conducted over 4 seasons in New Zealand, these authors detected *E. amylovora* in the calyxes of immature fruit in 3 out of 9 apple orchards that were free of any fire blight symptoms. The levels of calyx infestations were 6.6%, 8.7% and 14.7%. In orchards with Fire Blight the levels of calyx infestations ranged from 0.5% to 12.7% % with < 1 strike/tree, and 21.8% with 1-2 strikes/tree.

Examples of scientific papers where the Fire Blight pathogen <i>Erwinia amylovora</i> has been confirmed in <u>mature fruit</u> as endophytic infections or calyx infestations:

- (a) Papers reporting presence of *Erwinia amylovora* bacteria in mature fruit from orchards with Fire Blight symptoms:

Goodman, R.N. (1954). Apple fruits a source of overwintering fireblight inoculum. *Plant Disease Reporter*, 38, 414. *E. amylovora* was isolated from mummified apple fruit remaining attached to the tree in winter.

The author concludes that in the absence of overwintering cankers in orchards in Missouri these apples are a source of inoculum for infections in the following spring.

Hale, C.N., McRae, E.M. and Thomson, S.V. (1987). Occurrence of *Erwinia amylovora* on apple fruit in New Zealand. *Acta Horticulturae*, Number 217, 33-40.

These authors detected *E. amylovora* in calyxes of 3% of mature fruit harvested from an orchard showing severe Fire Blight symptoms.

van der Zwet, T., Thomson, S.V., Covey, R.P. and Bonn, W.G. (1990). Population of *Erwinia amylovora* on external and internal apple fruit tissues. *Plant Disease* 74, 711-716.

These authors found Fire Blight symptoms in 1% of 4 month cool stored fruit collected from a tree free of Fire Blight symptoms, in an orchard affected by Fire Blight. Also, they detected endophytic *E. amylovora* bacteria in the core tissues of 21% of apple fruit collected within 30 cm from shoot infections. Note that the latter statement and the findings reported by Goodman (1954) is contrary to what the New Zealand Ministry of Foreign Affairs and Trade has stated on page 9 of the document titled “**Third Party Submission of New Zealand to the Compliance Panel – Japan – Measures Affecting the Importation of Apples (WT/DS245) – Recourse by the United States to Article 21.5 of the DSU. 19 October 2004**” - reference:

<http://www.mfat.govt.nz/support/legal/disputes/japanapples.html>.

The latter submission states that endophytic populations of *E. amylovora* have never been demonstrated to occur.

Note: Although the NZ Government response to the 2004 RDIRA states that van der Zwet has written to the WTO Committee stating that he used or considered only immature fruit in his work the paper states that the authors used mature fruit for the cold storage experiment. In this experiment the authors state that “*after 1 month of storage, as much as 15% of the disinfested fruit blighted (presumably from endophytic bacteria), and only 4% of the non-disinfested fruit developed symptoms.*” The Abstract of the paper states “**Endophytic** populations were recovered from apples located within 30 cm of from blighted shoots but not from those 60 cm and 200 cm away.” Table 2 of the paper provides further proof that the fruit used were mature fruit. Results of the experiment on correlation between fruit location and blight source, shown in Table 3 of the paper, indicate that the fruit collected in August could not have been strictly immature. Results of the geographic survey, shown in Table 4 of the paper, indicate that the fruit collected in September 1985 and September 1986 could not have been immature (see footnotes to the table). NZ Government response to the 2004 RDIRA also states that endophytic infections do not occur in mature fruit; the two papers cited above show that this is not strictly correct.

McManus, P.S. and Jones, A.L. (1995). Detection of *Erwinia amylovora* by nested PCR and PCR-dot-blot and reverse-blot hybridizations. *Phytopathology* 85, 618-623.

In Michigan, USA, these authors were able to detect *E. amylovora* in 75% of the calyxes of symptomless **mature** apples tested, collected from an orchard **with** Fire Blight symptoms, using a sensitive nested PCR technique.

Hale, C.N. and Taylor, R.K. (1999). Effect of cool storage on the survival of *Erwinia amylovora* in apple calyxes. Conference Handbook of the 12th Biennial Conference of the Australasian Plant Pathology Society, Canberra, 1999, p 206.

In this paper the authors report the detection of *E. amylovora* in calyxes of 2% of fruit harvested from an orchard showing Fire Blight symptoms.

Azegami, K., Tsukamoto, T., Matsuura, T., Inoue, Y., Uematsu, H., Ohara, T., Akifumi, M., Yoshida, K., Bessho, H., Sato, S., Kimura, S and Goto, M. (2006). *Erwinia amylovora* can pass through the abscission layer of fruit-bearing twigs and invade apple fruit during fruit maturation. *Journal of General Plant Pathology* 72, 43-45.

In this paper the authors report that *E. amylovora* bacteria at ca. 10⁵ cfu tagged with bioluminescence genes were deposited in artificial wounds on fruit-bearing twigs of apple trees in the greenhouse. One month later 176 apples were harvested and cut horizontally in half. The upper halves were checked for *E. amylovora* while the lower were tested for maturity. **All fruits were symptomless and fully mature. The pathogen was recovered from 10.8% of the apples. These results show that bacteria can pass through the abscission layer into the fruit, even though the mature fruit lack symptoms**

- (b) Papers reporting presence of **Fire Blight symptoms and/or *E. amylovora*** bacteria on mature fruit from orchards with Fire Blight symptoms:

Borden, A.D. and Thomas, E. (1943). Fire blight and oil sprays. *Pacific Rural Press*, 146, 68.

These authors have reported that in California 17% of the Bartlett pear fruit from trees sprayed with summer oil were infected with *E. amylovora*, compared to 0.5% fruit from unsprayed trees.

Goodman, R.N. (1954). *Plant Disease Reporter*, 38, 414. Apple fruits a source of overwintering fire blight inoculum.

This author obtained virulent *E. amylovora* bacteria from beneath the skin of soft apple fruit picked from trees that were affected by fire blight.

University of California (1966). Do summer oil sprays favour fire blight development in pear fruit? *California Agr. Ext. Serv. Fruit Nut Grape Disease Newsletter (Jan)*. 2.

This article reports that in 1965, 30-50% of apparently healthy Bartlett pear fruits, from blighted orchards, shipped from California developed Fire Blight symptoms on arrival in Hawaii.

Wilcox, W. (1994). Fire Blight. NYS, IPM Tree Fruit Crops, Fact Sheet Series (Revised). New York State Agr. Exp. Station, Geneva, New York.

This fact sheet reports the occurrence of fruit blight in apple orchards affected by the disease.

Examples of scientific papers where the Fire Blight pathogen *Erwinia amylovora* has been confirmed in immature fruit from orchards without any Fire Blight symptoms:

Clark, R. G., Hale C. N. and Harte, D. (1993) A DNA approach to *Erwinia amylovora* detection in large scale apples testing and in epidemiological studies. *Acta Hort* 338: 59-66.

In an experiment conducted over 4 seasons in New Zealand, these authors detected *E. amylovora* in the calyxes of **immature fruit** in 3 out of 9 apple orchards that were free of any Fire Blight symptoms. The levels of calyx infestations were 6.6%, 8.7% and 14.7%.

It is claimed by some countries exporting apples that mature fruit do not carry Fire Blight bacteria, and that such apples, free from trash, should be considered equivalent to exporting apples from an area free from *E. amylovora*. In this regard it is important to consider that Fire Blight symptoms appear on mature apples whether the initial infection occurred in the immature stage or later (see references by Goodman (1954), van der Zwet and Keil (1979) and van der Zwet and Beer (1995). It is known that in regard to any kind of infection, if after infection conditions suddenly become unfavourable for disease development and manifestation of symptoms, then the infection remains within the tissue in a latent form. Material infected in this manner, whether it is propagating material, fruit or seed, would act as a source of inoculum to cause new infections. Thus, in the case of apple, it is possible for the fruit to be infected but not exhibit external symptoms.

Steiner, P. W. (2001) Problems in managing fire blight in high density orchards on M-9 and M-26 rootstocks. *College of Agriculture and Natural Resources, University of West Virginia* <http://www.caf.wvu.edu/kearneysville/articles/SteinerHort1.html>.

Examples of scientific papers where the Fire Blight pathogen *Erwinia amylovora* has been confirmed on leaves and shoots of apples and pears.

The occurrence of Fire Blight symptoms like blossom blight, leaf blight, shoot blight (twig blight) and stem cankers is quite common on apples, pears and all other fire blight hosts. The pathogen usually attacks leaves and shoots in the

immature stage. Sometimes mature tissues are also attacked especially when they are injured as a result of hailstorm damage or some other injury. A few of the scientific papers on the occurrence of leaf and shoot symptoms are listed below:

Lewis, S.M. and Goodman, R.N. (1965). Mode of penetration and movement of fire blight bacteria in apple leaf and stem tissue. *Phytopathology* 55, 719-723.

Lewis, S.M. and Goodman, R.N. (1966). The glandular trichomes, hydathodes and lenticels of Jonathan apple and their relation to infection by *Erwinia amylovora*. *Phytopathologische Zeitschrift* 55, 352-358.

Crosse, J.E., Goodman, R.N. and Shaffer, W.H. (1972). Leaf damage as a predisposing factor in the infection of apple shoots by *Erwinia amylovora*. *Phytopathology* 62, 176-182.

Miller, T. D. and Schroth, M. N. (1972). Monitoring the epiphytic population of *Erwinia amylovora* on pears with selective medium. *Phytopathology* 62: 1175-1182.

In a Bartlett pear orchard in the Butte County in California these authors detected epiphytic *E. amylovora* cells in 100%, 92%, 76% and 26% of flowers, fruit, leaves and young shoots respectively.

McManus, P.S. and Jones, A.L. (1995). Detection of *Erwinia amylovora* by nested PCR and PCR-dot-blot and reverse-blot hybridizations. *Phytopathology* 85, 618-623.

These authors detected *E. amylovora* in 39 %, 81% and 100% of leaves, sampled from a scion orchard of apples free of Fire Blight symptoms, using first round PCR, PCR-dot-blot hybridization, and nested PCR respectively. Similarly, using the same 3 PCR methods, they detected *E. amylovora* respectively in 0 %, 62% and 73% of buds, sampled from the same scion orchard.

Hickey, K.D., Orolaza-Halbrendt, N. and van der Zwet, T. (1999). The presence of endophytic *Erwinia amylovora* bacteria in symptomless apple tissue on orchard trees. *Acta Horticulturae*, Number 489, 453-458.

These authors reported isolating the pathogen from shoot tips located 100-300 cm away from active cankers during summer. In fact, according to these authors shoot blighting in eastern fruit growing regions of the USA is due to endophytic *E. amylovora* in the tree, which they call “latent canker blight”.

Vanneste, J.L. and Eden-Green, S. (2000). Migration of *Erwinia amylovora* in host plant tissues. In J.L. Vanneste edited, Fire Blight, The Disease and Its Causative Agent, *Erwinia amylovora*. CABI Publishing, Oxon. UK. 370 pp.

Finelli, F, Contessi, A., Calzolari, A., Saccardi, A., Zecchin and Vettorazzo (2004). Fireblight in the Po Valley (Italy): the monitoring programmes of Emilia-Romagna and Veneto regions. *Bulletin OEPP/EPPO* 34, 331-334.

The most common type of Fire Blight symptoms in the Emilia-Romagna region were not primary blossom infections but shoot infections and secondary blossom infections.

APPENDIX 5.1 (B)

Occurrence of Streptomycin Resistance in *Erwinia amylovora*

Vanneste, J.L. and Voyle, M.D. (1999). Genetic basis of streptomycin resistance in pathogenic and epiphytic bacteria isolated in apple orchards in New Zealand. *Acta Horticulturae* 489, 671-672.

Jones, A.L. and Schnabel, E.L. (1999). Streptomycin and oxytetracycline resistance determinants detected among bacteria from Michigan apple orchards and their potential importance. *Acta Horticulturae* 489, 673.

Jones, A.L. and Schnabel, E.L. (2000). The development of streptomycin-resistant strains of *Erwinia amylovora*. In J.L. Vanneste edited, Fire Blight, The Disease and Its Causative Agent, *Erwinia amylovora*. CABI Publishing, Oxon. UK. 370 pp.

Psallidas, P.G. and Tsiantos, J. (2000). Chemical Control of Fire Blight. In J.L. Vanneste edited, Fire Blight, The Disease and Its Causative Agent, *Erwinia amylovora*. CABI Publishing, Oxon. UK. 117-140 pp.

Vanneste, J.L. and Voyle, M.D. (2002). Characterisation of Transposon, Genes and Mutations which Confer Resistance in Bacterial Strains Isolated from New Zealand Orchards. *Acta Horticulturae* 590, 493-495.

Norelli, J.L., Jones, A.L. and Aldwinckle, H.S. (2003). Fire Blight Management in the Twenty-first Century; Using New Technologies that Enhance Host Resistance in Apple. *Plant Disease* 87, 756-765.

Reference is made in the six papers cited above to the widespread occurrence of streptomycin resistance in *E. amylovora* in the western states of the USA, in Michigan, USA and in the Hawkes's Bay region of New Zealand. Psallidas and Tsiantos (2000) state that "*although streptomycin is considered the most effective bactericide against Fire Blight, with no real phytotoxic problems at the recommended rates, its use in agriculture has been prohibited in many countries. The main reason for this is the development of resistance to streptomycin not only by E. amylovora but also by other microorganisms on the plant surface or in the soil or water, including possible human or veterinary pathogens (Jones and Schnabel, Chapter 12)*". The Chapter 12 referred here is the reference cited above by Jones and Schnabel (2000).

Thus, quite apart from the risk of introducing Fire Blight into Australia with the New Zealand apples there is also the risk of importation of strains of *E. amylovora*, with infested/infected apples, that are resistant to streptomycin. Besides the USA and New Zealand streptomycin resistance

in *E. amylovora* is likely to become more and more widespread in countries having Fire Blight where this antibiotic is routinely used for control. Streptomycin is widely used in New Zealand in the management of Fire Blight and as mentioned above resistance to this antibiotic has been found in that country. Streptomycin resistance are of two type's viz. chromosomal based resistance and plasmid based resistance. **Although plasmid based resistance is less common than the chromosomal type it is more dangerous than the chromosomal type as the resistance genes could be transferred to other bacteria, some of which may be important human and animal pathogens.** Once such bacteria acquire resistance to streptomycin it will not be possible to treat diseases caused by these bacteria with streptomycin based drugs. The control of Fire Blight, if introduced into Australia, would also become difficult if streptomycin resistant strains of the bacteria flourish here **because streptomycin is the only effective plant safe pesticide available for the control of Fire Blight.** New Zealand is known to have the chromosome based resistance.

APPENDIX 5.1 (C)

Fire Blight is endemic in New Zealand (Area Freedom cannot be provided); details of the last serious outbreak of Fire Blight in New Zealand

According to the New Zealand Apple and Pear Marketing Board Technical Bulletin on Fire Blight, published in November 1988, following its first appearance in Auckland in 1919, Fire Blight spread to South Island and to all the major pipfruit (pome fruit) growing areas in New Zealand. The disease is thus endemic in New Zealand.

The following article that was published as a supplement to AQIS Bulletin Vol. 1 No. 2 October 1989, titled “Draft Agreement Between MAFQual, on Behalf of the New Zealand Ministry of Agriculture and Fisheries and The Australian Quarantine and Inspection Service (AQIS) on Behalf of the Australian Department of Primary Industries and Energy Concerning the Access of Apples (*Malus sylvestris*) Into Australia from New Zealand”. Attachment 1 to this publication states that there are no pip fruit growing areas in New Zealand that are totally free of Fire Blight bacteria.

The AQIS publication in 1998 titled “Final Import Risk Analysis of the New Zealand Request for the Access of Apples (*Malus pumila* Miller var. *domestica* Schneider), December 1998” states the following in section 5.2 (“Analysis of the Pathway for Fire Blight Establishment via Trade in Apples”) under the sub title “Fire Blight being active in the district sourcing apples during the growing season.”
“Fire Blight established in New Zealand in 1919. Except for a brief period soon after disease establishment there have been no restrictions on the movement of infected host material. Therefore the distribution of Fire Blight bacteria in New Zealand reflects environmental limitations and the presence of host material. No commercial apple producing areas are known to be free of the disease organism.

The significance and the intensity of the disease in New Zealand varies from season to season and therefore the chance of apples becoming contaminated with bacteria also varies significantly. However, even in years or districts where the level of disease in apple orchards is low there could be other sources of active Fire Blight. For example, many orchard areas are located near towns and settlements and it is known that the other hosts such as cotoneaster and pears can have active Fire Blight in seasons where there is little Fire Blight evident in apple orchards This is confirmed by the significant number of registered orchards that failed to meet the conditions for export to Japan because of the presence of Fire

Blight symptoms on plants in the buffer areas surrounding the apple orchards (see Appendix 2, Question 9)".

Vanneste, J.L. (2000). What is Fire Blight? Who is *Erwinia amylovora*? How to Control it? In J.L. Vanneste edited, Fire Blight, The Disease and Its Causative Agent, *Erwinia amylovora*. CABI Publishing, Oxon. UK. 370 pp (2000).

This author refers to the last serious outbreak of Fire Blight in New Zealand that occurred in 1998 in the Hawkes Bay area. Losses as a result of this outbreak were estimated to be around NZ\$ 10 million.

APPENDIX 5.1 (D)

Difficulty in identifying cankers by visual inspection

Brooks, A.N. (1926). Studies on the epidemiology and control of fire blight of apple. *Phytopathology* 16, 665-696.

Miller, P.W. (1929). Studies of fire blight of apple in Wisconsin. *Journal of Agricultural Research* 39, 579-621.

Ritchie, D.F. and Klos, E.S. (1975). Overwintering survival of *Erwinia amylovora* in apple and pear cankers. *American Phytopathological Society Proceedings* 2, 67-68.

Johnson, K.B. and Stockwell, V.O. (1998). Management of fire blight: A case study in microbial ecology. *Annual Review of Phytopathology* 36, 227-248.

The following section on the difficulty in identifying cankers by visual inspection is based on the above 3 research papers (Brooks, 1926; Miller, 1929; Ritchie and Klos, 1975) and the review article (Johnson and Stockwell), and also by Satish Wimalajeewa's own practical experience in the Sacramento Valley, California in 1990 and 2004.

Ensuring that apple orchards are free of symptoms is an enormous task and it is impracticable to determine whether a given orchard is totally free of symptoms. The most difficult and almost impossible part of the exercise is detecting the small cankers on twigs and small branches at the top of the tree. It is generally known that about 30% of the tree biomass is invisible to the examiner from the ground level.

Although some of the larger holdover (indeterminate) cankers on the trunks and lower branches are easily detected and may be active, the smaller cankers developing on twigs which are difficult to detect are also known to be active. Thus, according to Brooks (1926), and Ritchie and Klos (1975) bacteria are often present in cankers that are formed in twigs as small as 4 mm in diameter. Furthermore, the size of cankers where *E. amylovora* overwinters varied considerably, with some twigs as small as 2-5 mm in diameter, but the majority averaging 6 mm (Brooks, 1926; Miller, 1929).

In preparing orchards for registration to export apples, registered growers, in accordance with good orchard practice, would be expected to remove all visible cankers and cut out any strikes in the previous season. However, Johnson and Stockwell (1998) maintain that once disease has become established in an orchard it is not feasible to locate and remove every holdover canker.

APPENDIX 5.1 (E)

Incidence of Fire Blight outbreaks occurring after the primary blossom periods

Crosse, J.E., Bennett, M. and Garrett, C.M.E. (1960). Investigation of fire-blight of pear in England. *Annals of Applied Biology* 48, 541-558.

These authors report that in England the pear cultivar Laxton's Superb is particularly susceptible to Fire Blight; they attribute this partly to the abundant production of secondary blossoms by this cultivar.

Billing, E. (2004). Weather affecting the incidence and severity of fire blight in England. 10th International Workshop on Fire Blight, Bologna, Italy, 5th to 9th July 2004. (Workshop Abstracts).

Based on her studies this author states that primary blossom blight on pear and apple in England is rare because of low spring temperatures. The highest incidence of pear blossom blight in England is through secondary blossoms in June, July or later. However, primary blossom does occur on hawthorn, cotoneaster and pyracantha, as these come into flowering from May to July.

van der Zwet, T. and Keil, H.L. (1979). Fire Blight – A Bacterial Disease of Rosaceous Plants. USDA Agriculture Handbook Number 310, USDA Washington D.C., 200 pp.

In their Monograph on Fire Blight, these authors report that in Beltsville, Maryland, USA, which is a severe blight area, about **50% of the blight observed is twig blight**. They state that during some seasons **twig blight may be the only blight seen**.

Longstroth, M. (2000). The fire blight epidemic in southwest Michigan. *Michigan State University Extension; website:*
<http://www.canr.msu.edu/vanburen/fb2000.htm>.

The author reports that this epidemic in 2000 in the southwest Michigan area started as a mild blossom blight infection but later developed into a severe shoot blight resulting in the death of over 220,000 trees and the removal of more than 340 ha of apple orchards. The total economic loss as result of this epidemic had been estimated at US\$ 42 million.

van der Zwet, T. and Beer, S.V. (1995). Fire Blight – Its Nature, Prevention and Control. A Practical Guide to Integrated Disease Management. *Agriculture Information Bulletin Number 631*, United States Department of Agriculture, Washington DC. 91pp.

The authors state that after blossoms, succulent shoots and water sprouts or suckers are the most susceptible to Fire Blight infection. They further state that during some seasons shoot blight may be the only symptom observed.

Finelli, F, Contessi, A., Calzolari, A., Saccardi, A., Zecchin and Vettorazzo (2004). Fireblight in the Po Valley (Italy): the monitoring programmes of Emilia-Romagna and Veneto regions. *Bulletin OEPP/EPPO* 34, 331-334.

The authors report that in the Emilia-Romagna region the most common symptoms of Fire Blight on pears were the shoot blight and secondary blossom blight infection.

APPENDIX 5.1 (F)

Sanitation of equipment, dump tank water etc in packing houses where export apples are handled

There is a distinct possibility of *E. amylovora* cross contamination occurring from non-export apples in the packing house operations if the equipment used have not been sanitized prior to use with export apples.

1. Steam cleaning equipment in sorting sheds with which apples come into contact (dump tanks, sorting lines, graders, conveyer belts). This ought to occur before export apples are processed to avoid cross-contamination from non-export blocks where the level of *E. amylovora* infection can be much higher.
2. Testing dump tank water and validation of the “clean” status of wash waters by reference to an enforceable standard, ie. HACCP. A similar recommendation was made to BA by Ecowise Environmental (2005) p. 30 with regard to chlorine systems.
3. Proposing a check measure, that apples meet a particular health standard. In the absence of such a measure it is difficult to verify whether the proposed mitigation measure delivers expected outcomes. This may be proposed as quarantine measure.
4. That the use of automated washing systems which follow defined/specified and verifiable throughput, volume/disinfectant concentration and temperature parameters, be mandated as a precondition to export.

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SECTION 6: EUROPEAN CANKER

EUROPEAN CANKER

Summary:

Exports would be only accepted from orchards that have been subject to active surveillance and demonstrated that any export block was free of cankers.

The risk of importation of apple fruit carrying latent infections of *Nectria galligena* can be reduced by:

- a. Banning importation of fruit from Auckland and Waikato areas where European canker is endemic and severe.
- b. Permitting export from the Nelson area where European canker is reported to be sporadic, subject to twice yearly inspections (winter pre-pruning and summer pre-harvest). The exact timing of those inspections will need to be determined.
- c. Insisting on active surveillance of export orchards for European canker. Detection of any cankers would disqualify the orchard from export for that season.

6.1 Introduction

This document consists of two sections:

Section A considers some general information relating to European canker.

Section B addresses specific issues from the 2005 DIRA requiring further attention by the RAP.

Reading of the available literature and the information provided in the 2005 DIRA indicates that:

1. The information contained in the 2005 DIRA is generally accurate and covers the relevant facts.
2. In general, the most important parts of the import process from a point of view of the risk of importation of European canker into Australia on infected fruits, are;
 - a. Importation step 1 (Likelihood that *Nectria galligena* is present in source orchards) and;
 - b. Importation step 2 (Likelihood that picked fruit is infected/infected with *Nectria galligena*).
 - c. Packing and post-importation steps are less controllable but of such negligible risk in the case of EC that the first two steps are considered to be paramount.

Generally, with respect to European canker, the 2005 DIRA has been well researched and thoughtfully written. Notwithstanding this, the Australian Apple and Pear Industry is in variance with the of 2005 D IRA with respect to interpretation of the data and suggestions for risk mitigation measures. Unless otherwise stated, the references cited in this response are those documented in the bibliography of the 2005 DIRA document.

6.2 SECTION A: – General Information.

6.2.1 Infection of Fruit.

There are significant scientific papers that identify internal infection [assuming this means internal infection of fruit]

Fruit is known to be infected by spores from cankers and to remain systemically infected and symptomless for some time after harvest.

Relevant references (see bibliography in 2005 DIRA) are

Dillon-Weston (1926, 1927);
Baudys (1930);
Osterwalder (1931);
Richter (1936);
Taylor & Byrde (1954);
Bondoux & Bulit (1959);
Viennot-Bourgin (1960);
Swinburne (1964, 1970a,b, 1975);
Kavanagh & Glynn (1966);
McCartney (1967);
Agarwala & Sharma (1968);
McDonnell (1970, 1971);
Burchill & Edney (1972);
Swinburne & Cartwright (1974);
Brown & Swinburne (1974);
Blank et al. (1975);
Blank (1976, 1982);
Swinburne et al. (1977);
Mappes (1983);
Brown (1984);
van Mourik (1985);
Berrie (1997);
Colgan (1997);
Cremers (1998);
Maxin et al. (2005).

However, (as pointed out in the 2005 DIRA) there is a difference in the persistence of the symptomless state between dessert apples and cooking apples.

Latency is affected by levels of benzoic acid which is toxic to the fungus and inhibits its development resulting in periods of latency proportional to the amount of benzoic acid in the fruit. Benzoic acid is usually present in unripe fruit, but diminishes as the fruit matures.

Dessert apples usually metabolise all the benzoic acid before maturity and in most cases develop rot symptoms while still on the tree.

Cooking apples such as Granny Smith, on the other hand, have high levels of benzoic acid which persist after harvest, so that rots often don't develop until fruit has been stored for lengthy periods of time.

Consequently dessert apples could carry lower amounts of latent infections into storage and transport.

Infection could occur immediately prior to harvest resulting in infection to going undetected through grading. This could easily happen if there was heavy and persistent rainfall in the month prior to harvest.

Infection of fruit occurs predominantly through the calyx, and heavy, persistent rainfall is required to ensure pooling of inoculum (mostly conidia) around the calyx.

McCartney (1967) reported a high incidence of rot (up to 10% of the crop) in a variety of dessert apples in California, following unseasonably high summer rainfall. The rot developed on the tree prior to harvest, and the author did not report any further rots developing in storage.

Blank (1982) recorded storage rots of 13.4% in apples from an orchard in Germany which had not been sprayed as normal, and had been exposed to unusually high and frequent rainfall in the autumn, resulting in unusually high levels of wood infection, and hence high levels of inoculum. The trial was conducted with Cox's Orange Pippin, a dessert apple.

6.2.2. Incidence in trash.

There appears to be no published data on the incidence of *N. galligena* in trash which makes any consideration of the importance of trash difficult.

Spores of *N. galligena* on trash are most likely to be infective if present as fruiting lesions on cankers. Well-developed cankers typically cause breakage of twigs, and it is thus possible that cankered twigs could be harvested during harvest of fruit.

Proper packing-house practice might ensure that twigs are unlikely to be retained in graded export fruit but this has not been detailed as part of the 2005 DIRA.

The main risk of spread in the packing house would be release of spores (conidia) from sporulating twig cankers into water during dipping/washing. While adequate levels of chlorine in the dip water might kill the spores there is no scientific data to confirm this.

It is not known if it is possible for the fungus to act as a saprophyte on leaves in cold storage and to sporulate on dead tissue.

6.2.3 Time that infection can remain dormant

The time that infection can remain dormant in fruit cannot be generalized as it depends on environmental/storage conditions and in particular the amount of benzoic acid (see above) present in the fruit.

In general, dessert apples, with low levels of benzoic acid can be expected to develop rots (i.e. the infection loses dormancy) by the time the fruit is harvested. However infections that take place immediately before harvest may not develop soon enough to be detectable during harvest and grading, and may enter a dormant state due to cold storage and therefore not develop a detectable rot until released from storage at the point of sale.

Rots usually develop in dessert apples by the time the fruit is harvested. However, in some varieties of cooking apples, rots may take 3-7 months to develop in storage. While it could be expected that rots in dessert apples infected immediately prior to harvest would develop relatively quickly in storage there is lack of scientific information and data to offer clarity to this point.

The length of the latent period in dessert varieties in storage will depend on how green the fruit is when picked, and how recently it has been infected.

However CO₂ storage can hasten the development of rots due to *N. galligena* (Swinburne & Carwright, 1973). Concentrations of CO₂ greater than 5% in storage inhibit the production of benzoic acid by the fruit and encourage the development of rots (Swinburne, 1974, Swinburne & Brown, 1975).

This needs to be taken into consideration when storing apples.

6.2.4 Theoretical mode of infection – point of entry into fruit & time –

Entry into fruit is almost invariably via the calyx, although it has been reported to occur through scab lesions, lenticels and insect feeding sites. Infection can occur any time there is sufficient rainfall to carry and hold spores in the calyx area.

6.2.5 Difficulty in identifying infection in host plant

There is little data on detection of infection in asymptomatic trees or fruit.

In general, detection relies on the appearance of twig cankers, or fruit rots.

An article in the popular horticultural press (Lovelidge, 1995) quoted Swinburne (in a lecture) as saying that the fungus could be detected in symptomless wood by microscopic histology and isolation onto agar. Swinburne claimed that his data confirmed that the fungus could move systemically in wood, traveling upwards in the xylem with the transpiration flow. While this claim has not been formally published and

no further mention is made in subsequent papers relating to the same project, by McCracken (Swinburne's successor) the Industry believes that the RAP must investigate the information.

Indeed McCracken (quoted in another popular article – Lovelidge 2003) said "One of the things that we hoped might be developed within the project was a molecular technique for detecting low levels of *Nectria* in symptomless wood, but we don't have one".

In short, there is no validated rapid technique for detection of the fungus in infected wood or fruit, apart from the appearance of symptoms, and subsequent identification of the pathogen. Although it is theoretically possible to isolate the fungus from symptomless tissue of stems and fruit, translation of this possibility into a technique that could be used for rapid screening of orchards or harvested fruit is a long way off.

6.2.6. Known incidence of disease in NZ.

The disease has been recorded from a majority of NZ apple growing areas, but is only a significant problem in some, and is absent from some others (see below).

Fruit rot has been recorded in NZ by Brooks & Bailey (1965) and Braithwaite (1996). The MAFNZ correspondence reported in the 2005 DIRA suggests that the rate of fruit infection even in areas with a known high incidence of disease is quite low (0.21% in the sample reported). However this was as a percentage of rotted fruit sent for diagnosis, so it is possible that rots occurring in the orchard and discarded during grading may be more frequent. Because of the unreliable nature of the sampling, this data should not be regarded as a realistic estimate of the background level of fruit infection. It is probably considerably higher, but no reliable data is available.

There are cultures in PDD (New Zealand National Fungal Collection, Landcare Research, Auckland) of *N. galligena* from fruit rot of apple, cv. Granny Smith in Auckland (http://nzfungi.landcareresearch.co.nz/html/search_collections.asp).

6.2.7 NZ protocol regarding fruit movement when an outbreak occurs.

There appear to be no known Government or Industry protocols regarding the movement of fruit or any other host plants within New Zealand.

6.2.8 Other potential host plants and presence of these in Australia.

Internationally, the fungus has been recorded from a wide range of hosts including many genera and species of woody trees. This includes trees that are commonly used as windbreaks around orchards such as poplar,

willow and hawthorn and ornamentals such as oaks, birches, elms and maples.

Although there are no records of the fungus on Australian native plant genera, the broad host range on northern hemisphere plants strongly implies the probability that at least some genera of Australian plants will be susceptible.

The fungus has been recorded from stem cankers on three species of NZ native plants, *Coprosma areolata*, *C. lucida*, and *Sophora microphylla*. A search of the New Zealand fungal herbarium database (http://nzfungi.landcareresearch.co.nz/html/search_collections.asp) revealed records from the following hosts (in addition to apple):

- i. *Pyrus pyrifolius* – Nashi
- ii. *Pyrus communis* – Listair pear
- iii. *Eriobotrya japonica* – Loquat
- iv. *Coprosma areolata* – thin-leaved Coprosma
- v. *Coprosma lucida* – Karamu
- vi. *Sophora microphylla* – Kowhai

This indicates that the fungus is capable of producing inoculum on alternative hosts outside the orchard and therefore that inoculum can enter the orchard from surrounding vegetation. The two *Coprosma* records are from Coromandel, where there are no published records of the fungus on apple; this may indicate that it has spread more widely than apple growing areas, or that records of its occurrence on apple are not fully comprehensive.

This means that even if inspections of the orchard show it to be free of disease, there is no guarantee that it will remain so. Inspect of the export orchard surroundings for presence of the fungus on other hosts will be necessary as well as the annual inspection of the orchard.

While the literature suggests that the fungus is usually only dispersed over short distances, and that infection of fruit almost invariably comes from inoculum produced by cankers on the same tree, host plants in close proximity to the export blocks could be the source of inoculum.

Although a clean orchard may receive inoculum from surrounding susceptible hosts, this is only likely to result in a gradual re-infection of the orchard from the margins.

Occurrence on Nashi is also documented by [Hale, C.N. (1990). Diseases. In: *Nashi: asian pear in New Zealand* White, A.G.; Cranwell, D.; Drewitt, B.; Hale, C.; Lallu, N.; Marsh, K.; Walker, J. (eds.) 51-52 Wellington: DSIR Publishing.]

If Pears and/or Nashi are grown in the same orchard or in close proximity to export blocks, it will be necessary to inspect those trees to determine absence of cankers.

Recommendation:

1. Inspection of apple trees is essential to determine freedom but inspection must be carried out twice annually even if infected trees have not been found in the previous season.
2. Host plants in close proximity of export blocks must be inspected annually.
3. If pear or Nashi trees are present in the same orchard or in close proximity to export blocks they must also be inspected.

6.3 SECTION B: Minimising risk of importation

6.3.1 Importation step 1: Presence in source orchards

6.3.1.1 Pathogen/disease distribution:

European canker is reported to occur in significant amounts as an endemic disease in northern and western parts of the North Island – specifically Northland, Auckland and the Waikato, Bay of Plenty and Taranaki. These areas reportedly account for about 3% of apple exports from NZ.

However it is recorded from other areas of NZ including:

1. In Nelson it is regarded as established but occurring sporadically in wet seasons (Murdoch, 2002). Although the disease was found on only one tree in a survey in 1999 (MAFNZ, 2000c), a second survey in 2002 found the disease in orchards in the Motueka, Moutere and Walmea areas. These occurrences are apparently related to unusually wet seasons, and are believed to have originated from the movement of large amounts of planting material from the Auckland area.

However, a horticultural suppliers' website (Wilson & Kettle, Fruitfed Supplies –

<http://www.wilket.co.nz/merch/archive/hort0304.pdf>

reported a trial on the fungicide Euparen Multi in which use of the fungicide on a Motueka (Nelson area) orchard reduced canker from 79% of stems sampled to 4%. This would suggest that in at least some orchards in the Nelson area the disease is more than an occasional minor problem as 79% stem infection would threaten the viability of the orchard. (There is no indication that the trial has been formally published).

It follows that climate in Nelson is conducive to development of significant epidemics of the disease.

2. In Hawkes Bay the disease has been reported on trees imported from the Auckland area over 20 years ago, but there is no evidence to indicate spread from these trees to other trees in the area and the area is apparently now regarded as free of the disease (Wilton 2004).
3. In Gisborne there appears to be none or limited published records or herbarium records. If the disease occurs there then it is likely only to be sporadic in wet seasons.

4. European canker has not been recorded from Otago.

Recommendations:

1. The areas from which imports will be acceptable should be formally defined according to the WTO-SPS either as Pest Free Areas (PFAs) or as Areas of Low Pest Prevalence (ALPPs). An ALPP is an area ‘in which a specific pest (in this case European canker) occurs at low levels and which is subject to effective surveillance, control or eradication measures’.
2. In the case of European canker ALPPs should be defined as areas in which occurrence of the disease is sporadic and dependent on occasional favourable weather conditions, and in which disease is effectively controlled by a combination of fungicide use and eradication pruning. Effective surveillance would consist of winter inspections carried out prior to winter pruning and a pre-harvest inspection.. Any cankers detected would be pruned out immediately after the inspection.
3. MAFNZ must declare both PFAs and ALPPs for European canker. In accordance with ISPM 7, an ALPP should not be defined without provision of survey data for a number of years prior to declaration of the ALPP. It may be possible to define areas such as Otago as PFA’s, providing sufficient surveillance data can be demonstrated.
4. MAFNZ must also be asked to declare how they intend to maintain those areas as PFA & ALPP, in particular with respect to movement of propagating material from areas of high occurrence levels. ICPM 7 (2005) section 3.1.4.3 ‘Reducing the risk of entry of specified pests’ may be invoked here.
5. In light of the available evidence, and subject to adequate definition of ALPP’s, the above conditions would appear to allow for importation from all areas other than Auckland province and the Waikato, although there is considerable doubt about Nelson.
 - a) This is justified by the assumption that properly defined ALPP’s would have such low incidence of disease on trees and that occurrence of fruit rots would be extremely unlikely. Given that we expect to be dealing with dessert varieties, the likelihood of latent infection of fruit is even lower.
 - b) It seems unlikely that Auckland/Waikato could ever be defined as ALPPs, even under best practice management of the disease.

- c) More information from more reliable surveys is required for the Nelson area and should be obtained before imports are accepted from the Nelson area.
- 6. A weakness of the above conditions is that in years when environmental conditions are particularly favourable for development of European canker, winter inspections will not reflect the likely disease levels leading up to harvest. McCracken et al. (2003) reported a trial undertaken in heavily infected orchards where rainfall varied throughout the study from 653 – 791 mm.
The Industry would believe that it is essential that orchard inspection occur after specifically defined environmental events eg., high spring or summer rainfall.

Detection of active cankers in either the winter inspection or the summer/pre-harvest would lead to removal of export permission from that export block/orchard.

6.3.1.2 Environmental conditions:

European canker is a serious disease in wet conditions and its incidence varies widely from season to season depending on rainfall. Dubin & English (1974) reported that the disease was only serious in California in areas where mean annual rainfall exceeds 1000 mm. This figure correlates well with the distribution of endemic disease in NZ, where the disease is only serious in the higher rainfall areas, with mean annual rainfall in or around 1000 mm.

However the view that European canker is only severe where annual rainfall exceeds 1000mm is an over-simplification.

Other factors that need to be taken into account are the seasonal distribution of rainfall, and the frequency and duration of wetness periods, especially between fruit set and harvest. McCracken et al. (2003) reported a trial undertaken in heavily infected orchards where rainfall varied throughout the study from 653 – 791 mm. This occurrence is explained by the fact that rainfall was more frequent and temperatures were lower than in comparable areas in NZ and this would have resulted in longer wetness periods, increasing the incidence of infection, despite the lower rainfall.

Weather is a strong factor in the incidence and severity of European canker, from a point of view of controlling risk, it is

essential to concentrate on both the knowledge of the actual occurrence of the disease as defined by surveillance as well as defining areas of high disease risk on the basis of climate.

Recommendations:

1. Export orchards/blocks must be surveyed regularly for the presence of European canker, and freedom from disease should be determined by both mid-winter surveys and pre-harvest spring/summer surveys for the presence of cankers in orchard.
2. Export will not be allowed from orchards in which a single canker is found during surveillance.
3. In region like the Auckland province, Gisborne and Nelson areas the following should occur:
 - a) In Auckland (where the disease is endemic and damaging) export is not recommended,
 - b) In Nelson, where the disease is reported to be sporadic and rainfall dependent, but where it may be severe in some seasons, surveys are recommended after any rainfall event as well the normal mid-winter and pre-harvest surveys.

6.3.2 Importation step 2: Presence on/in picked fruit

Imported fruit is at risk of carrying European canker if the fruit has become infected but has remained symptomless. In dessert apples this is less common than in cooking apples, as the disease does not often remain latent in dessert apples and rots are usually visible at harvest. However, it is likely that a low proportion of harvested fruit of dessert varieties will carry latent infections, probably established very soon before harvest. Infected fruits generally occur on trees with active cankers on branches and twigs, so surveillance for canker symptoms is essential to ensure no fruit is harvested from infected trees.

Traditionally, inspections are carried out in mid-winter because cankers are easiest to detect when branches are bare of leaves.

Correspondence with Dr Alistair McCracken, Dept. of Agriculture and Rural Development, Belfast [alistair.mccracken@dardni.gov.uk] indicates that new cankers can appear at any time of the year, meaning that mid-winter inspections cannot be relied upon to guarantee that there won't be fresh, infective cankers at harvest. For this reason Dr McCracken recommended pre-harvest inspections for active cankers to ensure that no fruit infection would occur immediately prior to harvest.

This is supported by Wilson (1966) who showed that infections initiated through leaf scars in autumn may remain dormant in the suberised leaf scar tissue until bud burst in spring (180 days later) when bud expansion breaches the suberised layer and allows spread of the infection into wood.

These new cankers could then expand and begin to produce spores later in spring and summer, which would be well timed to infect fruit as soon as suitable rainfall for spore dispersal occurred.

Pre-harvest inspections will be difficult as the of detection of cankers on twigs high in the canopy when the tree is in full leaf will be much harder than when the tree is dormant. Such inspections must be more stringent and complete to achieve the appropriate result.

The 2005 DIRA concludes that under New Zealand conditions fruit is rarely infected, but no reliable data is supplied to support this statement. The statement is only supported by the observation that there are no published records of the incidence of fruit rot in New Zealand, and on the results of diagnostic samples of rotted fruit which only resulted in a fruit infection rate of 0.21%. This data is considered as relatively meaningless due to the sampling regime used and has been disregarded in this analysis. There is a single record of a fruit rot on Granny Smith apple in the PDD culture collection – the record is from the Auckland area. The NZ Pipfruit Disease Management fact sheet also states that fruit rot is not normally a problem in New Zealand.

The risk management protocols proposed in the 2005 DIRA for Apple leafcurling midge would appear to offer a reasonable chance of detecting rotted fruits in fruit consignments, but could not be expected to detect symptomless fruits with latent infections.

Fruit infection is generally only a problem in regions where there is high summer rainfall, such as Northern Ireland. In Europe, fruit infection is only a significant problem in years with excessive summer rain. In California and the Pacific northwest of USA, although there is sufficient rainfall fruit infection is rare, because rain mostly falls in winter. However, McCartney reported a case of severe fruit rot in California following unseasonable high summer rainfall in 1975. While New Zealand receives mainly winter rainfall they do in some years receive spring and/or summer rainfall so fruit infections can be expected in very wet summers.

Recommendations:

1. Apples should only be imported from areas south of Auckland and Waikato. In the Auckland and Waikato areas the disease is particularly prevalent, fruit infection is known to occur, and the climate appears to be more suited to fruit infection due to higher summer rainfall.
2. As Nelson appears to be the only other area in which European canker is established (although there is not sufficiently reliable

data to indicate to what level), it should also be considered an area at risk of fruit infection in wet summers, and subject to management and surveillance measures. Surveys will be required to maintain any status as an ALPP, involving surveillance in both winter and summer (pre-harvest) as well as inspections after heavy spring and/or summer rain events.

3. Export orchards/blocks need to be able to demonstrate a high level of active control of European canker through “*standard commercial agronomic practice*” including both eradicated pruning and regular fungicide programmes.

SECTION 7: **ARTHROPODS**

SUMMARY AND CONCLUSIONS

1. The Australian Apple and Pear Industry does not consider Biosecurity Australia should have excluded Wheat Bug from the analysis by reclassifying it as a contaminant. The evidence suggests that importation of fruit from New Zealand represents a high risk pathway for this pest, such that specific risk management strategies are required for fruit imports from New Zealand. Appropriate risk management options are suggested.
2. It is accepted that it is appropriate to consider New Zealand Flower Thrips as a contaminant species.
3. A review of the ten insect species that have existing PRAs, as a result of the 2005 Draft Extension of Existing Policy for Stone Fruit into Western Australia, indicates that two species, Codling Moth and Citrophilous Mealybug should not be approved under existing policy. This is because their pest status on apples and stone fruit is not comparable; both are negligible or minor pests on stone fruit, but are major pests on apples with much higher risks of entry, establishment and spread.
4. The Australian Apple and Pear Industry commends Biosecurity Australia for the quality of its reanalysis of Apple Leafcurling Midge, and the risk mitigation measures proposed, which are in line with the recommendations of the Industry in our response to the 2004 IRA.
5. The Australian Apple and Pear Industry considers that the 2005 DIRA has underestimated the probability of entry, establishment and spread for Garden Featherfoot, Leafrollers, Mealybugs and Oystershell Scale.
6. The Australian Apple and Pear Industry supports the proposed pre-clearance regime in New Zealand, but is concerned that it may be discontinued following a review after a trial period.
7. The Australian Apple and Pear Industry is concerned that the Apple Leafcurling Midge analysis shows that in some circumstances the standard AQIS on-arrival fruit sample of 600 is inadequate to reliably detect low levels of quarantine insects. The Industry considers the inadequacy of the standard 600 fruit sample is a major flaw in Australia's quarantine security. By comparison with the levels of sampling undertaken on fruit entering the USA, Canada, and Korea for example, the AQIS sampling rate is miniscule and leaves a major hole in Australia's quarantine net. As such, the Industry considers the AQIS 600 fruit sample is completely inadequate as a risk mitigation measure.

8. The AQIS standard 600 fruit sample is the only risk mitigation measure in the 2005 DIRA for Leafrollers, Mealybugs, Codling Moth and Wheat Bug. The Industry considers this is totally inadequate to reduce the risk of these species to within Australia's ALOP.
9. The Australian Apple and Pear Industry considers that risk management for pests on imported New Zealand apples should include mandatory post-entry monitoring for escaped pests at major distribution and repacking centres and compulsory treatment of waste fruit and packaging to destroy pests and diseases.

RECOMMENDATIONS

The Australian Apple and Pear Industry recommend that:

1. Wheat Bug be subjected to the full semi-quantitative analysis on account of the high risk pathway for this pest into Australia provided by fruit imports from New Zealand.
2. Codling Moth be subjected to the full semi-quantitative analysis because it is highly inappropriate to use the extension of existing policy for New Zealand stone fruit into Western Australia for this apple pest, which has negligible status in stone fruit, but is the key pest of apples worldwide.
3. Citrophilous Mealybug be subjected to the full semi-quantitative analysis because apples represent a much higher risk than stone fruit for this species and the use of existing policy is inappropriate.
4. Biosecurity Australia conducts a critical review of the standard AQIS 600 fruit on-arrival sample for its statistical adequacy in detecting low, but threatening levels of quarantine pests.
5. The Australian Apple and Pear Industry insist that any review of the pre-clearance regime in New Zealand be conducted with full industry consultation and that this be formally agreed.
6. Pre-clearance inspections of 3000 fruit in New Zealand should include dissection of the calyx of all fruit to obtain a true indication of the levels of cryptic pest species hidden in the calyx.
7. Wheat Bugs should be included as a targeted pest in pre-clearance and on-arrival inspections.
8. Biosecurity Australia initiates a review of the statistical adequacy of the standard AQIS 600 fruit sample, in view of evidence that it is inadequate for at least some pests and that many other countries have much more robust quarantine sampling regimes.

9. **In the absence of satisfactory risk mitigation measures for Grey-brown Cutworm, Leafrollers, Mealybugs, Codling Moth and Wheat Bug, the Australian Apple and Pear Industry considers that all New Zealand apples bound for Australia should be fumigated before leaving New Zealand.**
10. Biosecurity Australia and AQIS develop protocols for post-entry monitoring of moth pests at major distribution and repacking facilities, and for the treatment of waste fruit and packaging to destroy pests and diseases contained thereon.

7.1 INTRODUCTION

The treatment of insect pests in the 2005 Draft Import Risk Analysis Report (2005 DIRA) for Apples from New Zealand differs significantly from that in the 2004 Draft New Zealand Apple IRA. In the 2004 RDIRA all 12 individual pests or pest categories (e.g. leafrollers) that might be associated with shipments of New Zealand apples were subjected to the same 'semi-quantitative' analysis. The discovery of European Red Mite on apples in Western Australia in January 2005 has removed this pest from consideration. The 2005 DIRA has categorised the remaining 11 pests into three groups that are then subjected to quite different kinds of analysis:

1. Contaminant pests

- a) New Zealand Flower Thrips
- b) Wheat Bug

2. Pests that have been assessed previously

- a) Grey-brown Cutworm
- b) Leafrollers (including Native Leafroller, *Pyrgotis plagiatana*, that was considered separately in 2004)
- c) Codling Moth
- d) Mealybugs
- e) Oriental Fruitmoth
- f) Oystershell Scale

3. Pests for which no recent Pest Risk Analysis (PRA) has been completed by Biosecurity Australia

- a) Apple Leafcurling Midge
- b) Garden Featherfoot

By contrast to the 2004 IRA, the two newly classified contaminant pests are not formally analysed in the 2005 document. Instead it is simply stated that any found in New Zealand apple shipments would be treated in the same way as contaminants found in all other imported commodities. The six pests, or pest groups, actually five individual pests and five leafroller species, that have recently been analysed for the extension of New Zealand stonefruit into Western Australia,

have been subjected only to a qualitative analysis in the 2005 DIRA. This qualitative approach uses the 2005 Extension of Existing Policy for Stone Fruit from New Zealand into Western Australia as its basis with modifications for the situation in apples. The overall effect of this new pest classification policy is to reduce from 11 to 2, Apple Leafcurling Midge and Garden Featherfoot, the number of species that receive the detailed semi-quantitative analysis. The following sections examine the justification for these changes.

7.2 Contaminant pests

Biosecurity Australia has justified the reclassification of New Zealand Flower Thrips and Wheat Bug as contaminants in the 2005 DIRA in the following terms; ‘they are not pests of mature fruit’ and ‘there are no special risks associated with apples in regard to these contaminants’. Furthermore, these pests ‘are potentially an issue’ on ‘commodities already imported from New Zealand’ including ‘*Prunus* spp. and kiwi fruit’. These claims are considered in detail below.

7.2.1 Wheat Bug

Wheat Bug, *Nysius huttoni*, is not a pest of apples in New Zealand, but is a serious pest of brassicas (Ferguson, 1994) and wheat crops (Gurr, 1952, 1957; Swallow and Cressey, 1987; Every *et al.*, 1998 and many references cited therein). Wheat Bug has a wide host range including the cereal crops barley, ryecorn and oats in addition to wheat, and pasture grasses including bromes and ryegrass (Bejakovich *et al.*, 1998). It can be highly abundant in some seasons on crops and weeds. Ferguson (1984) reported densities of 1218/m² in a direct drilled swede crop. Of great relevance to the 2005 DIRA, is the observation that it can also occur ‘in profusion under weeds, particularly wireweed and twin cress, on the loading areas and yards around ... sheds’ (Sale, 2003).

Damage in New Zealand by Wheat Bug is significant. Ferguson (1994) recorded 92 percent of swede plants were damaged by Wheat Bug in untreated control plots in direct drilling trials. Feeding by Wheat Bug on developing wheat grains may result in a marked decline in the quality of harvested wheat. Damaged grain contains a bug salivary proteinase that results in bread with characteristically poor volume and texture (Every *et al.*, 1998). There have been six major outbreaks of Wheat Bug in New Zealand wheat since 1936 (Swallow and Cressey, 1987; Every, 1992). The United States Department of Agriculture has declared Wheat Bug a ‘primary pest of concern’ (USDA-MAF, 2005) owing to the potential threat it poses to the USA wheat industry if it were introduced on commodities from New Zealand.

Wheat Bug has been frequently detected as a hitchhiker species in New Zealand fruit consignments, particularly apples and kiwifruit, into the USA. Wheat Bug has been a concern on New Zealand kiwifruit since at

least 1971 when it was first detected (Sale 2003). Indeed, Wheat Bug is the major pest targeted by APHIS inspections of New Zealand kiwifruit at US ports of entry (USDA 2003). It is also commonly detected in apple consignments entering the USA from New Zealand (Birtles *et al.*, 1992; Lay-Yee *et al.*, 1997). Entry of fruit consignments infested with Wheat Bug is allowed only after fumigation (USDA 2003).

The most likely mode of entry by Wheat Bug to apple and kiwifruit packages is from weeds into bins of picked fruit, either in the orchard, or most likely, in holding areas around packing sheds, where pallets of packed cartons may also be invaded (Sale, 2003). A recommended mitigation measure is to keep the areas used for holding bins and pallets around packing houses free of weeds year round (Sale, 2003).

Clearly, the history of detections of Wheat Bug on fruit consignments from New Zealand to the USA indicates that fruit shipments represent a high risk pathway for potential introduction of this pest, even though it is not primarily a fruit pest. Given the important national consequences for the Australian wheat industry that may arise from the introduction of this pest, it is critical that specific measures are taken to minimise the chances of inadvertent introduction with fruit imports. The treatment of Wheat Bug as a contaminant in the 2005 DIRA ignores the importance of fruit shipments as a high risk pathway for this pest, and contrasts markedly with the approach taken by the USDA. By treating Wheat Bug as just a contaminant, Biosecurity Australia is missing a crucial opportunity to put specific measures in place to minimise the risk of introduction of this pest with fruit consignments.

The paragraph on contaminant pests on page 12 of the 2005 DIRA refers the reader to the section on risk management and draft operational procedures for information on risk mitigation measures for contaminants. There is no section in the draft operational procedures on the treatment of contaminants and the references to avoidance of contamination of fruit are few, non-specific and scattered. In relation to packing houses, the relevant sentence says, 'The packing house must maintain hygiene standards and weed control to reduce the potential contamination of picked fruit'. This does not adequately cover the possible modes of access by Wheat Bug to pallets and bins.

Specifically, the 2005 DIRA should have:

1. Conducted a semi-quantitative risk analysis on Wheat Bug
2. Determined that apple imports, and other fruit, from New Zealand represent an important potential pathway for entry of this pest into Australia.

3. Given the potential importance of this pest and the likely national consequences ensuing from its establishment, recommended specific risk mitigation measures in a separate section, as for Apple Leafcurling Midge, such as:
 - a) Weeds must be eliminated from all bin and pallet storage areas, outdoor holding areas and loading yards from at least 4 weeks prior to harvest until harvest is completed.
 - b) Consideration should also be given to preharvest orchard inspections and spraying of the orchard floor with an effective insecticide if Wheat Bug is found.
 - c) Wheat Bug must be specifically targeted during preclearance fruit inspections with thorough examination of packing materials, boxes and pallets.
 - d) Shipments found to be infested with Wheat Bug must be rejected or fumigated prior to acceptance.

It is of concern that Wheat Bug does not appear to have been considered, even as a contaminant, in previous IRAs for importation of New Zealand fruit into Australia, e.g. the *2005 Draft Extension of Existing Policy for Stone Fruit from New Zealand into Western Australia*. It is recommended that Biosecurity Australia and AQIS recognise the importance of all fruit imports from New Zealand as a high risk pathway for the introduction of Wheat Bug and review policy and procedures for this pest in all New Zealand fruit imports to Australia.

7.2.2 New Zealand Flower Thrips

By contrast to Wheat Bug, apple imports from New Zealand do not appear likely to represent a pathway for introduction of New Zealand Flower Thrips, for the following reasons:

1. New Zealand Flower Thrips is known to occur on apple blossom, but does not go on to feed on the fruit as it often does on various stone fruit species.
2. There do not appear to have been many, or any, interceptions of New Zealand Flower Thrips on New Zealand apples into markets such as the USA.
3. New Zealand Flower Thrips appears not to be an 'invasive species' (Mound, 2005). Despite many interceptions in Australia on New Zealand apricots, nectarines and peaches (Biosecurity Australia, 2005) and the high likelihood that it has been introduced to Australia many times, it has not established (Mclaren and Fraser, 1998; Mound 2005).

The reclassification of New Zealand Flower Thrips as a contaminant in the 2005 DIRA appears to be justified.

7.3 Pests that have been assessed previously

A total of ten insect pest species in the 2005 DIRA have been analysed qualitatively, rather than semi-quantitatively, because they have been subject to a previous analysis or policy determination. This is allowed under ISPM No.2: *Part 1 – Import regulations: Guidelines for pest risk analysis* (FAO, 1996a) which states:

‘Prior to proceeding with a new PRA, a check should be made as to whether the pathway or pest has already been subjected to the PRA process, either nationally or internationally. If a PRA exists, its validity should be checked as circumstances may have changed. The possibility of using a PRA from a similar pathway or pest, that may partly or entirely replace the need for this PRA, should be investigated.’

All ten pests were assessed in 2005 for the Draft Extension of Existing Policy for Stone Fruit into Western Australia. The validity of using the stone fruit PRA as a substitute for apples depends on the similarity or otherwise of:

- the import pathway
- the pest status and biology of the insect on the two crops

In the case of stone fruit and apples from New Zealand, the import pathways are very similar, although the details of packing house procedures may differ, with different outcomes on the likelihood of pests remaining on the fruit. However, these differences are considered to be relatively minor, so that no further consideration of the pathway is given here.

However, the status of the 10 insects on stone fruit may differ markedly from that on apples, such that it may be very inappropriate to treat apples and stone fruit interchangeably. The remainder of this section considers the status of each pest on the two crops to determine whether it is appropriate to use the stone fruit PRA in lieu of a full analysis for the pest on apples. The issue of differences between the status of the pests on apples and stone fruit is dealt with in the 2005 DIRA by adjusting the probabilities of entry, establishment and spread. While this approach may be appropriate where the differences in pest status between the two crops are relatively small, APAL does not accept that it should be used for pests that are of negligible significance in one crop, but are major pests in the other. The Industry considers that the above provision in ISPM No.2 must be used very judiciously to avoid any perception of misuse.

7.3.1 Grey-brown Cutworm

The limited literature on Grey-brown Cutworm suggests that it has very similar behaviour and biology on apples and stone fruit. The rates of quarantine interceptions of Grey-brown Cutworm appear to be very low on both crops.

7.3.2 Leafrollers

Five species of Leafrollers have been considered together in the 2005 DIRA as follows:

Brown-headed Leafrollers, *Ctenopseustis herana* and *C. obliqua*

Green-headed Leafrollers, *Planotortrix excessana* and *P. octo*

Native Leafroller, *Pyrgotis plagiata*

The Green-headed and Brown-headed Leafrollers were considered together in the 2004 IRA, while the Native Leafroller was assessed separately. The leafrollers have been lumped together for analysis because of the similarity of their life histories and the difficulty of distinguishing their eggs and larvae, from each other, and from the more abundant Light-brown Apple Moth. The difficulty in reliably identifying these species means there is little data on the contribution of each species to damage in New Zealand apples or stone fruit, and hence the likelihoods of each species entering Australia on New Zealand fruit cannot be determined individually. There is a particular lack of published information on infestation rates and damage levels of leafrollers in stone fruit, so it is difficult to compare the risks associated with stone fruit and apples for entry of leafrollers into Australia on New Zealand fruit. Estimation of the risks associated with the entry of stone fruit in the 2005 stone fruit extension IRA would have been no more than guesswork. However, the available information does not suggest stone fruit is any less susceptible to leafroller attack than apples, so it appears reasonable to equate apples and stone fruit for assessing leafrollers.

7.3.4 Codling Moth

By contrast to the likely situation in the previous species there is no comparability between the infestation potential of stone fruit and apples for Codling Moth. This will be demonstrated in the following discussion which shows irrefutably that Codling Moth should have been subjected to a full semi-quantitative analysis in the 2005 DIRA.

Stone fruit are listed as hosts for Codling Moth in many host lists. However, host lists need to be used with caution as they often fail to distinguish between the dominant hosts on which the species is dependent and atypical hosts that are only occasionally or rarely utilised. This is the case with most host lists for Codling Moth. The dominant hosts of Codling Moth worldwide are members of the families Malaceae and Juglandaceae,

pome fruit and walnuts, respectively, including apples, crabapples, pears, quinces and hawthorn; and Black and English Walnuts. There are few records of Codling Moth in members of the stone fruit family, the Amygdalaceae.

Appendix 7.1 summarises references to Codling Moth as a pest in 23 Orchard Spray Guides and Pest Management Handbooks from an internet search. All 19 references that deal with apples nominate Codling Moth as a serious pest, usually the dominant or key pest. Eighteen of these references also consider Codling Moth the key pest of pears. Four guides from areas where walnuts are grown indicate Codling Moth is a dominant walnut pest. Eighteen of the guides that cover stone fruit make no mention of Codling Moth as a pest, not even as a minor one.

Two of the references (Nos. 1 and 20) mention stone fruit as a host for Codling Moth; but only in host lists where stone fruits are included for the sake of completeness. The information in these lists will have been drawn from the literature. In this way, the idea that stone fruit is a host for codling moth is being perpetuated through the repetition in host lists of old, rare, atypical records. (Reference 23 in Appendix 1 from the Codling Moth Information Support System of the International Plant Protection Convention, which indicates Codling Moth may be a key pest of ‘apricot, plum, peach, nectarine and even *Prunus* species (like sweet cherry and almonds)’, is grossly inconsistent with the literature and is an unfortunate piece of misinformation from this important organisation.) The only area in the USA where Codling Moth is a pest of stone fruit appears to be California, where it can be a problem in prunes and plums (Reference 17, Appendix 7.1).

Riedl (1983) showed that Codling Moth populations from fruit of the three host families (Malaceae, Juglandaceae and Amygdalaceae) represent different host races within the species. Insects from walnuts and plums have different host preferences, development diapause, phenology and population dynamics than those from apples (Riedl, 1983). Host preference is genetically based, but also influenced by conditioning. This suggests that Codling Moth from stone fruit and apples are genetically different races with different biology.

Research in New Zealand specifically targeted at determining the host status of stone fruit for Codling Moth found no evidence that females will lay eggs on cherries or nectarines (Wearing and McLaren, 1996). Inspections of stone fruit in the Otago district by New Zealand MAF and packing house QC programs found no Codling Moth, even in orchards where there were known to be infestations in apples (Wearing and McLaren, 1996).

The great weight of evidence indicates that Codling Moth is not a pest of stone fruit, except for plums and prunes in California, where a different race of the insect is involved. This race does not appear to occur in New Zealand or Australia, where the only host is pome fruit. For these reasons, it is quite inappropriate to consider that the situation in New Zealand stone fruit is in any way equivalent to that for apples. Therefore, the PRA for Codling Moth in the 2005 Extension of New Zealand Stone Fruit into Western Australia should not be used for New Zealand apples into Western Australia. Rather, given the seriousness of Codling Moth as the key pest of apples, it should have been subjected to the full semi-quantitative analysis.

7.3.5 Mealybugs

Mealybugs are also pests whose incidence on stone and pome fruit differs significantly, such that they should have been subjected to a full semi-quantitative analysis in the 2005 DIRA.

The 2005 *Extension of Existing Policy for Stone Fruit into Western Australia* indicates that AQIS inspections have found Citrophilous Mealybug on imported peaches from New Zealand and it occurs on nectarines and plums in New Zealand (Charles, 1993; McLaren *et al.*, 1999). It also commonly occurs on apples, pears and quinces (Hortnet, accessed 4/01/06). There appears to be no published data on infestation levels in New Zealand stone fruit; the lack of data suggesting it is not a serious pest in these crops.

By contrast there is data, which appears to have been overlooked by Biosecurity Australia in the 2005 DIRA that indicates mealybugs, possibly of several species, are the commonest insect on New Zealand apples. Mealybugs were the most prevalent pests on harvested fruit in 13 Integrated Fruit Production orchards which exceeded the MAF Maximum Pest Limit of 0.5% in New Zealand in 1997 (Walker *et al.*, 1997). The mean incidence of mealybugs on fruit in these orchards was 2.07% with a maximum of 3.55%. Mealybugs were the second most prominent pest after leafrollers across all IFP orchards in 1998 (Walker *et al.*, 1998). In North Island crops district averages for mealybug infested fruit varied from 0.31 to 0.4%, while between 7 and 11% of orchards exceeded fruit infestation levels of 1%. Maximum recorded levels of mealybugs ranged from 4.2 to 4.75% and some North Island crops exceeded the MAF tolerance for this pest on export apples (Walker *et al.*, 1998).

These levels give considerable cause for concern for the following reasons;

- Mealybugs are small, may have multiple individuals per fruit and aggregate in the calyx area, where they are unlikely to be removed by

washing and brushing in the packing house, and are unlikely to be detected by fruit sorters on the grading line. Hence, they have a high probability of being introduced on fruit, especially apples, into Western Australia.

- Citrophilus Mealybug has been found in pre-clearance inspections in New Zealand on export apples for the USA, and in on-arrival inspections in the USA (2005 DIRA). This indicates that the insect survives packing house processes and is sufficiently common to be found regularly in fruit inspections.
- Citrophilus Mealybug is a native of eastern Australia, but now has an almost cosmopolitan distribution indicating it can readily establish once it has been transported to new countries. Fortunately, it has not yet established in Western Australia, but its capacity for colonisation of new environments suggests strongly that it will readily establish in Western Australia if introduced on fruit from New Zealand. These considerations indicate that this pest requires a higher level of risk management than for many other potential introductions on New Zealand fruit.
- Citrophilus Mealybug is a major pest of fruit in many parts of the world including citrus in South Australia (Altmann and Green, 1991) and is likely to be a significant problem in Western Australia.

The above considerations indicate that apples are a particularly high risk pathway for the introduction of Citrophilus Mealybug. This conclusion warrants analysis of this pest by the full semi-quantitative approach in the 2005 DIRA. Reference to the 2005 Stone Fruit Extension into Western Australia is inappropriate for this pest.

7.3.6 Oriental Fruit Moth

The comparative scenarios for Oriental Fruit Moth, *Grapholita molesta*, in apples and stone fruit are the reverse of those for Codling Moth. Oriental Fruit Moth is a key pest of stone fruit, but rarely a pest in apples. Therefore, the PRA for this pest in the 2005 Stone Fruit Extension into Western Australia is inappropriate for apples. However, in this case the likelihoods of entry will be much lower in apples than for stone fruit, so that apples represent a much smaller risk. In this situation it is more acceptable to use the earlier PRA as the basis for assessing the apple risk.

7.3.7 Oystershell Scale

Oystershell Scale has a very wide host range including over 100 species (Townsend, 2005), mainly deciduous trees and shrubs (Hortnet, 2004). It is common on both pome and stone fruit and while there is little data on relative infestation levels, the literature does not suggest there are great differences in susceptibility between them. Nor are there likely to be differences of quarantine significance in the numbers of scales surviving pack house procedures and escaping detection on the grading line. Therefore the PRA in the 2005 Stone Fruit Extension into Western Australia is probably appropriate for apples.

7.4 Pests that have not been assessed previously

The 2005 DIRA identifies only two insect pests that have not been assessed and approved previously; Apple Leafcurling Midge, *Dasineura mali*, and Garden Featherfoot, *Stathmopoda horticola*. These two pests have been subjected to the full semi-quantitative analysis that was used for all pests and diseases in the 2004 RDIRA. The following comments seek to provide additional information and clarification of some points. The 2005 DIRA analysis on Apple Leafcurling Midge is considerably expanded and improved on that presented in 2004. The conclusions reached in the 2005 DIRA generally accord with the recommendations made by the Australian Apple and Pear Industry in its submission on the 2004 RDIRA.

7.4.1 Apple Leafcurling Midge

Importation Step 3.

The 2005 DIRA is unclear about the availability of young leaf growth for egg laying by females of Apple Leafcurling Midge (see discussion, p. 144-145). Correctly, the 2005 DIRA indicates that the first flush of leaf growth in apples occurs adjacent to the flower clusters and commences as flowering finishes. These 'flag' leaves provide much of the nutrition for the growing fruitlets. Leaf growth in this area of the tree ceases in early summer. However, other flushes of leaf growth occur in association with branch and twig extension, and watershoots whose growth may be stimulated by earlier pruning. These later growth flushes tend to alternate with periods of high growth in the fruit and may be stimulated by irrigation. Generally speaking in one part of the tree or another there is likely to be a ready supply of unfolding young leaves suitable for Apple Leafcurling Midge egg laying. This accounts for the ability of the insect to go through 7 generations during the season and to have mature larvae that can infest the fruit at harvest time. Larvae on the fruit will have come from actively growing branches and watershoots above the fruit. These comments are also relevant to the discussion in the last paragraph on page 161, where there seems to be some difficulty on the part of the authors in

reconciling the number of midge generations with conflicting statements on availability of fresh leaf growth for egg laying.

Importation Step 5.

The sentence ‘However, once again it should be noted that there is no net increase in the numbers of apple leafcurling midge already present in the packing house.’ (lines 10 and 11, page 147) misses the point of this importation step. It is not about whether midge numbers go up or not, obviously they don’t; it is about whether there is an increase in the proportion of fruit infested. An increase in the proportion of fruit infested may occur if some midge larvae on heavily infested fruit, say with 4 or 5 midge larvae or pupae each, are washed off and manage to reattach themselves to uninfested fruit. The total number of midges has not changed, but the percentage of infested fruit has increased. Similarly, there could be redistribution of midges from any heavily infested leaves to uninfested fruit. Contrary to the MAF submission which asserts that old midge-free ‘flag’ leaves are the only ones removed with the fruit, which would likely be the main leaf contaminant, it is also possible that pickers moving about in the foliage could dislodge heavily infested branch, twig and watershoot leaves into the picking bag or bins. Such leaves may be prone to fall due to the midge damage they have sustained.

The summary paragraph for Imp 5 (p. 147) is clearly an incorrect interpretation of this step.

Importation Step 6.

The Australian Apple and Pear Industry has indicated previously that it does not consider there is any justification for assuming up to 30 percent mortality, or an average of 15 percent mortality, of apple leafcurling midge during the palletisation, quality inspection, containerisation and transportation steps. In the absence of any argument or data supporting significant mortality, it is prudent to assume the mortality is most likely to be quite small, say 1 to 5 percent.

This is why the Industry preferred the application of ‘certain’ at this step rather than ‘high’ in its submission on the 2004 IRA. We can see no reason to change our view on this point.

Importation Step 8.

See comments for Imp 6 above. Biosecurity Australia has offered no reasons why a median 10 percent mortality (and up to 30 percent) should be associated with this importation step. In the absence of any cause of mortality it should be assumed that survival would be very high, close to 100 percent. In effect, Biosecurity Australia is saying that between them,

importation steps 6 and 8 could in some circumstances cause up to 51 percent mortality $[0.3 + (0.7 \times 0.3)]$, yet no reason for this high death rate is offered.

Table 41.

The probabilities presented in Table 41 for proximity of Utility Points to Exposure Groups differ considerably from the single infested fruit scenario presented in the 2005 DIRA and are more realistic. The probabilities do not all agree with those proposed by the Australian Apple and Pear Industry in its response to the 2004 IRA, however, the reasoning of the RAP for the lower probabilities is accepted.

Unrestricted Risk

The overall probability of entry, establishment and spread of ‘**moderate**’ for apple leafcurling midge in the 2005 DIRA is the same as for the 2004 IRA and the unrestricted risk of ‘**low**’ is also the same in both cases. The Australian Apple and Pear Industry commented in its response to the 2005 DIRA that these probabilities did not relate well to the very high level of quarantine interceptions, 60 percent of lots, found in preclearance inspections of New Zealand fruit bound for the USA market. The Industry considered that the risk mitigation proposed in the 2005 DIRA was inadequate to deal with the very obvious threat posed by apple leafcurling midge on New Zealand apples. The Australian Apple and Pear Industry is pleased that, although the ‘risk’ remains the same, the risk management measures have been improved in line with APAL’s recommendations.

Risk Management.

It is not surprising to the Australian Apple and Pear Industry that the standard AQIS 600 fruit sample is statistically inadequate to reliably detect low, but threatening levels of apple leafcurling midge. The 95 percent confidence given by the 600 fruit sample that no more than 0.5% of fruit in a consignment is infested provides no reassurance to the Australian apple industry. The Industry considers this level of assurance is totally inadequate and provides too great an opportunity for new pests to enter undetected and become established.

Therefore, we welcome the Biosecurity Australia recommendation of AQIS supervised pre-clearance inspections in New Zealand and the 3000 fruit sample size for inspections. We consider a sample size of 3000 should also be the minimum for routine on-arrival inspections of all fruit in Australia. This issue is considered further in the discussion.

7.4.2 Garden Featherfoot

A small amount of information on Garden Featherfoot, *Stathmopoda horticola*, additional to that accessed by Biosecurity Australia in the 2005 DIRA, can be found in Stevens *et al.* (1995) and the Persimmon IPM System Manual (Green and Gold, undated). These papers indicate that Garden Featherfoot also feeds on avocado fruit (Stevens *et al.* (1995) and is a major pest of persimmons (Green and Gold, undated). Garden Featherfoot is also known to feed on dead and dying plant material, such as the dying flowers of willows (Green and Gold, undated).

On persimmons, Garden Featherfoot larvae produce webbing around, and feed on, the shrivelled petals that remain attached to the fruit (Green and Gold, undated). The petals are webbed to the fruit, on which the larvae also feed, causing scarring of the fruit surface. There are two generations per year with nearly all damage being caused by the first generation from flowering until early February. This suggests that most, if not all, larvae will have left the fruit by harvest.

These observations suggest Garden Featherfoot eggs may be laid mainly around flowers, with young larvae feeding on dying flower parts and the older larvae on other plant tissues, such as fruit. The increased number of known commercial fruit hosts, and observations that Garden Featherfoot feeds on dead and dying plant material suggests that it is polyphagous on a wide range of flowering plants. It is also recorded as being widespread in New Zealand (Green and Gold, undated)

A *Stathmopoda* species, possibly Garden Featherfoot, was recorded in low numbers in an organic apple orchard at Canterbury associated with dried necrotic leaf tissue around the calyx, or in old leafroller feeding sites (Burnip and Suckling, 2001). This information suggests Garden Featherfoot larvae may occur wherever there is decaying plant material.

Generally speaking, Garden Featherfoot is controlled by sprays applied against leafrollers in persimmons (Green and Gold, 1999) and this would also be the case in other crops.

The Australian Apple and Pear Industry does not agree with several aspects of the Biosecurity Australia analysis of Garden Featherfoot. However, since the altered probabilities that would result from the Industry amendments are unlikely to change the outcome of the analysis, they are not detailed here.

7.5 Comments on the qualitative analyses for pests with previous PRAs.

In this section the qualitative analyses for pests for which there is existing policy (approvals), due to the existence of previous Pest Risk Analyses, are discussed. The 2005 DIRA indicates the existing policy for these pests relates to the 2005 Extension of Existing Policy for Stone Fruit from New Zealand into Western Australia, which post-dates the 2004 New Zealand apple IRA. The assignment of probabilities in the qualitative assessment process is grossly subjective and nebulous by comparison with the semi-quantitative process, which is structured, logical and easier to 'come to grips with'. It is very easy to disagree with the probabilities assigned by Biosecurity Australia and the RAP in the qualitative analyses, both up and down, so that often the net result is no different. This will become apparent in the discussion below. However, in some cases there are significant differences that make a material difference to the overall probability of entry, establishment and spread. However, these seemingly significant differences are all nullified by the next steps in the analytical process, particularly the analysis of consequences, such that the Australian Apple and Pear Industry analysis returns the same 'annual unrestricted risk' as the Biosecurity Australia analysis for all pests.

7.5.1 Grey-brown Cutworm

Importation

The data presented in the 2005 DIRA contains questionable scientific data and/or a lack of data making the assessment more difficult. At best the Industry would accept the probability of importation of this species is '**moderate**', i.e. 'would occur with an even probability'.

Distribution

The likelihood of the eggs of this species being distributed close enough to a suitable host to allow newly hatched larvae to transfer to the host might be considered here to be between '**moderate**' and '**low**'. The eggs are laid in or near the fruit calyx (Burnip *et al.*, 1995). The most likely scenario for distribution is on waste fruit or discarded apple cores dumped amongst suitable host plants. Since Grey-brown Cutworm is highly polyphagous and the hosts include many herbaceous and grass species, there are likely to be suitable hosts near some waste fruit dumps and near many discarded apple cores.

Probability of entry

Combining the probabilities of importation and distribution returns a result of between ‘**low**’ and ‘**moderate**’ for the probability of entry.

Establishment and Spread

The probabilities of ‘**high**’ in the 2005 DIRA for both the establishment and spread of Grey-brown Cutworm are considered reasonable.

Overall probability of entry, establishment and spread

This probability becomes ‘**moderate**’ according to the matrix of rules for combining descriptive likelihoods.

Unrestricted risk

If the consequences of ‘**moderate**’ are considered reasonable, the unrestricted risk becomes ‘**low**’, which for this pest seems reasonable.

7.5.2 Leafrollers

Leafrollers are one of the dominant pests of apples in New Zealand, and as such represent a much greater risk of being imported to Australia than Grey-brown Cutworm. From this point of view it is very hard to understand how the qualitative analyses for Leafrollers and Grey-brown cutworm could have returned identical results in the 2005 DIRA up to the step of combined probability of entry, establishment and spread. That these results are the same lacks credibility.

Importation

Given that leafrollers are the major caterpillar pests in New Zealand IFP apple orchards (Walker *et al.* 1997, 1998) and that some larvae may burrow into the fruit to feed, it is highly likely that such individuals will survive packing house processes and grading, and enter Australia. This is verified by the relatively high number of interceptions of leafrollers on fruit in quarantine inspections.

Walker (1996) investigated the efficiency of removal by New Zealand packing houses of leafroller infested fruit. Removal efficiency of sorters varied between packing houses and lines of fruit, with most performing poorly in the removal of leafroller damaged fruit. For blocks in Hawke’s Bay, the numbers of live larvae was estimated between zero and one per 48.8 cartons. The numbers were lower in Nelson where there were between zero and one live larva per 148.4 cartons. Fruit submitted for USA import inspection had probabilities that leafroller larvae escaped

detection varying from $P=0.000076$ to $P=0.00099$, equivalent to one per 132 to 101 cartons, respectively. Fruit infestations at these levels are hard to eliminate, yet potentially allow a lot of live larvae to pass through the system. Infestations at these levels are also highly unlikely to be detected by the AQIS 600 fruit on-arrival sample.

It is considered that the probability of importation of these species is at least **‘moderate’** as in the 2005 DIRA and is likely to be **‘high’**. **The Australian Apple and Pear Industry considers that the analysis should be based on an importation likelihood of ‘high’.**

Distribution

The Australian Apple and Pear Industry consider the probability for this step is also at least **‘moderate’** and may also be **‘high’**. Given the high volumes of imported fruit and its aggregation at distribution and repacking centres, the chances of several individuals escaping at the same time and place appear relatively good, especially from bins of waste fruit. In addition, all species are highly polyphagous and suitable hosts are ubiquitous. Nevertheless, a number of crucial steps have to occur before entry is complete. Mature larvae would have to leave the fruit, find a safe place to pupate, mature into adults, emerge and escape to the outside. Males and females would then have to find each other and mate, before the female then finds a suitable host for egg laying. The last two steps would not be difficult due to sex pheromone communication between the sexes and the high availability of hosts. Such events are most likely to occur around repacking and distribution centres suggesting that there should be post-entry monitoring for these species focussed on these places. In addition it would be advisable to mandate that waste fruit and packaging from imports be treated before disposal to minimise the possibility of pests escaping.

Probability of entry

Combining the probabilities of importation and distribution, say **‘high’** x **‘moderate’** gives a probability of entry of **‘moderate’**.

Establishment and Spread

The Australian Apple and Pear Industry agree with the 2005 DIRA assessment that both the probabilities of establishment and spread are **‘high’** for leafrollers.

Overall probability of entry, establishment and spread

Combining the probabilities above, according to the rules, gives an overall probability of entry, establishment and spread of **‘moderate’** for leafrollers.

Unrestricted risk

The Australian Apple and Pear Industry agrees with the consequences of **‘moderate’** for leafroller entry into Australia from New Zealand. This accords with the consequences that have occurred with the establishment in New Zealand of the Australian Light Brown Apple Moth, and the recent incursion in the Auckland area of Painted Apple Moth, also from Australia. Light Brown Apple Moth has become a major quarantine concern for New Zealand horticultural exports and attempts to eradicate Painted Apple Moth have been very costly and controversial.

Combining the consequences of ‘moderate’ with the Australian Apple and Pear Industry probability of entry, establishment and spread of **‘moderate’** gives an unrestricted risk of **‘low’** which exceeds Australia’s ALOP.

While this conclusion agrees with the 2005 DIRA outcome, it was arrived at with higher input probabilities, which tends to raise questions about the process. In any event it is clear that leafrollers are a serious risk, not only to the Australian Apple and Pear Industry, but to Australian Horticulture in general.

Risk management

The Australian Apple and Pear Industry does not consider that a sample of 600 fruit per lot provides an adequate assurance that low, but threatening, levels leafrollers arriving in Australia will be detected. The Industry considers that the sample of 3000 adopted for pre-clearance of Apple Leafcurling Midge should be adopted across all horticultural imports as a minimum. Likewise, any requirement to cut samples of fruit by packing houses in the first season of imports (2005 DIRA, p. 216), should involve 3000 fruit, not 600. The Industry recommends that fruit cutting be required for the 3000 fruit pre-clearance sample that is to be conducted for Apple Leafcurling Midge, in lieu of the one-off requirement for packing houses. This would be more efficient than having multiple inspection regimes, as page 216 implies.

The Australian Apple and Pear Industry consider that two post-entry requirements should also be instituted as added precautions against leaf roller establishment as follows:

1. **Waste fruit and packaging from facilities repacking any New Zealand fruit, not just apples, should be compulsorily treated to destroy any pests before disposal.**
2. **Monitoring of distribution centres and repacking facilities with sex pheromone traps should be instituted to determine if any moths are escaping. This could be carried out in conjunction with monitoring programmes for fruit flies or other pests. Such a programme should be run for three years and could be suspended if no moths are caught. The suggested monitoring would provide a test of the efficacy of other proposed risk management measures.**

7.5.3 Codling Moth

It was argued earlier that Codling Moth should have been subjected to the full semi-quantitative analysis in the 2005D IRA. This section examines the qualitative analysis as it is presented in the 2005 DIRA.

Importation

While Codling Moth is the key pest of apples in New Zealand and most other parts of the world where apples are grown, it is the focus of concerted efforts by growers to control it, and as such, it is usually not abundant in commercial orchards (Wearing, 1995; Walker *et al.*, 1998), despite its high potential for damage, as indicated by references quoted in the 2005 IRA. Research IFP trials indicate Codling Moth damage to fruit occurs at lower frequencies than for leafrollers (Walker *et al.*, 1997, 1998).

In addition, most fruit containing larvae will be removed by sorters on the packing house grading line. However, there will always be a proportion of infested fruit that is undetectable by graders on the packing line, due to entries in the calyx area and small entries lacking frass on the skin of highly coloured fruit.

It is considered the probability of ‘**moderate**’ for entry of Codling Moth given in the 2005 DIRA is reasonable.

Distribution

Given the limited host range of the pome fruit race of Codling Moth; apples, crabapples, pears and quinces, individuals would have less opportunity than say, leafrollers, to find hosts. However, Codling Moths are good fliers and can detect hosts by their volatile chemical signature. Establishment is most likely to occur in places where large lots of fruit are stored, distributed or repacked. These areas provide the best opportunity

for multiple mature larvae to leave fruit, pupate and emerge as adults. Mating is likely to occur on or near host plants just prior to egg laying. The main constraint may be the relative scarcity of suitable hosts near areas where moths are likely to emerge.

However, there have been outbreaks of Codling Moth in Western Australia suggesting that it has been distributed to suitable hosts from likely small introductions with infested fruit from eastern Australia. The probability for distribution on balance is considered to be **‘moderate’** as in the 2005 DIRA.

Probability of entry

Combining the probabilities of entry and distribution gives a probability of entry of **‘low’** as per the 2005 DIRA.

Establishment and spread

The Australian Apple and Pear Industry agree with the probability in the 2005 DIRA of **‘high’** for both establishment and spread.

Consequences

Introduction of Codling Moth to Western Australia will certainly have significant regional impacts through the cost and disruption of eradication campaigns. The Australian Apple and Pear Industry agree with the consequence rating of **‘moderate’**.

Unrestricted risk

The unrestricted risk of **‘low’** would require specific risk management for Codling Moth

Risk Management

The Australian Apple and Pear Industry support the use of disinfestation treatments as a risk management strategy in preference to attempting to define, identify and manage areas of low pest prevalence. Codling Moth is a ubiquitous pest in New Zealand orchards and is always present, even if only at low levels.

Therefore area freedom will not be an option. Establishing areas of low pest prevalence is not an option with which the Industry is comfortable.

The cryptic nature of the pest inside the fruit will often mean that it escapes detection in the field and on the packing line. The use of sex pheromone traps is not likely to be sensitive enough to provide accurate

estimates of low population levels. Many studies have shown that pheromone traps may catch only a small proportion of the population in an orchard (e.g. Suckling *et al.*, 1994), such that for low populations there is a strong risk that the populations will not be detected. Packing house sorters will not remove all infested fruit, as exemplified by the leafroller research (Walker, 1996). If the low pest prevalence option is invoked, APAL considers there must be an independent verification of its efficiency by submitting lots through the pre-clearance program for Apple Leafcurling Midge and cutting 3000 fruit as also recommended for leafrollers.

7.5.4 Mealybugs

It was argued in the Introduction that Mealybugs should have been subjected to the full semi-quantitative analysis in the 2005 DIRA. This section examines the qualitative analysis as it is presented in the 2005 DIRA.

Importation

Mealybugs are one of the two most common groups of insects on harvested New Zealand apples under Integrated Fruit Production (IFP) programmes (Walker *et al.*, 1997, 1998). One of the most important of these is Citrophilous Mealybug, *Pseudococcus calceolariae* (Hortnet, accessed January 2006), which is not present in Western Australia. See the earlier section on mealybugs for details of infestation rates in IFP orchards in New Zealand.

Adults and larvae of mealybugs commonly shelter, feed and breed in the calyx of apple fruit. Mealybugs deep in the apple calyx are protected from packing house processes such as brushing and washing (Whiting *et al.*, 1998), and are unlikely to be detected by fruit sorters on the packing line. Hence, it is highly likely that mealybugs will be present on New Zealand apples imported into Australia. Therefore, the Australian Apple and Pear Industry agrees with the **‘high’** likelihood of importation given in the 2005 IRA.

Distribution

Factors to be considered in assessing the likelihood of distribution of mealybugs to an endangered area include:

1. Citrophilous Mealybug has a remarkable colonising ability. Originating in eastern Australia, it is now distributed through most of the world, suggesting that it is able to easily move from introduced host material onto local vegetation and establish. Its absence from Western Australia is unexpected, but most likely attributable to long standing quarantine barriers in that state.

2. Citrophilous Mealybug has a very wide range of potential hosts including common herbaceous species like clover (Clearwater, 2001, Hortnet, accessed January 2006) ryegrass, Chenopodiaceae and Brassicaceae (Hortnet, accessed January 2006). This suggests suitable hosts would often be in close proximity to an infested, discarded apple core.
3. All nymphal and adult stages of Citrophilous Mealybug, except the adult male, are flightless, but have legs and are quite mobile, especially the first stage nymphs which undergo most dispersal, often on the wind. First instar crawlers can walk 6m or more (Hortnet, accessed January 2006) indicating they would often be able to find hosts from, say, a discarded apple core.

The above considerations suggest distribution to a suitable host may not be as difficult as the analysis in the 2005 DIRA proposes. Accordingly, the probability of distribution is considered here to be **‘high’**.

Probability of entry

Combining the probabilities of importation (**‘high’**) and distribution (**‘high’**) results in a probability of entry of **‘high’**.

Establishment and spread

APAL agrees with the probability in the 2005 DIRA of **‘high’** for both establishment and spread.

Overall probability of entry, establishment and spread

Combining **‘high’** probabilities for all steps in the process returns an overall probability of **‘high’**.

Unrestricted risk

Accepting the consequences of the introduction of Citrophilous Mealybug to Western Australia as **‘low’** as in the 2005 DIRA, gives an unrestricted risk of **‘low’**. This is the same as for the 2005 DIRA, despite the higher probability of distribution in this analysis.

Risk management

The Australian Apple and Pear Industry does not consider the proposed risk measures for mealybugs to be adequate to reduce the risk below Australia’s ALOP. The Apple Leaf-curling Midge analysis has clearly demonstrated the inadequacy of the standard AQIS 600-unit sampling procedure for small, hidden insects on fruit that represent an unacceptable

risk, even at lower infestation frequencies. Mealybugs are certainly in this category, which would have been demonstrated if the full semi-quantitative analysis had been performed on these species.

The Industry considers that mealybugs must be subject to the 3000 fruit pre-clearance sample in New Zealand, or on-arrival in Australia, including dissection of the calyx and examination with a 10 times hand lens in good light. If these procedures are considered too onerous, then shipments of New Zealand apples should be subject to mandatory fumigation.

7.5.5 Oriental Fruit Moth

The Australian Apple and Pear Industry concur with the Biosecurity Australia analysis for this species.

7.5.6 Oystershell Scale

The Australian Apple and Pear Industry does not agree with the method of analysis for Oystershell Scale. Our objections were enunciated in the APAL response to the 2004 IRA and the concerns have not been addressed in the 2005 DIRA.

The fundamental problem with the analysis of Oystershell Scale in both the 2004 and 2005 DIRAs is the assumption that all lots of New Zealand export apples will carry the same low risk of being infested with Oystershell Scale. This is because Oystersell Scale is found only in the Canterbury and Otago apple production areas, which comprise only about 5 percent of New Zealand apple production. Yet the analysis is conducted as if the concentrations of scales on Canterbury and Otago fruit were distributed randomly among all New Zealand apples. A more realistic approach, more likely to produce a valid outcome, would be to assess the risks associated with Canterbury and Otago fruit separately from the main crop further north which carries a nil risk for this insect. The Australian Apple and Pear Industry considers it is invalid to say that the risk is low across the whole crop, when a large part of the crop carries no risk, but a clearly identifiable smaller part carries some risk. The analysis below considers the risks associated with the importation of lots of Canterbury and Otago fruit into Western Australia.

Importation

The limited published information indicates that harvested apples from the Canterbury and Otago regions may be infested with Oystershell Scale, sometimes at relatively high levels. In the first years of IFP apple production in New Zealand, Oystershell Scale levels on fruit at harvest were as high as 10 percent (Wearing, 1996). Scale infestations on fruit at harvest in Canterbury and Otago apple orchards in the IFP program averaged 0.44 and 0.56% in 1998 (Walker *et al.*, 1998). Overall, in the IFP program in 1998, 'scale insects were present in a significant proportion of

IFP orchards in each district and a few crops were unacceptable for export certification'. Oystershell Scale was the principal scale pest in Otago with 3% of blocks exceeding 1% scale infested fruit at harvest. In Canterbury 25% of blocks exceeded 1% of scale infested fruit, but the scale species is not stated. However, it is likely to have included a significant amount of Oystershell Scale. Overall, Walker *et al.* (1998) indicated that scale insects were difficult to control under IFP recommendations for some growers in all districts.

Infestations of Oystershell Scale on fruit are often concentrated in the calyx region, where many may survive packing house processes and be overlooked by graders on the packing line. Hence, it is likely that packed fruit will include some with scale infestations.

The above considerations indicate that there is a **'high'** probability of importation of Oystershell Scale on fruit from Otago and Canterbury into Western Australia.

Distribution

There are three main limitations to the ability of Oystershell Scale to move from imported apples to new hosts in Western Australia.

1. The main limitation on the movement of Oystershell Scale from fruit to a suitable host is the immobility of all life cycle stages except the tiny first instar 'crawlers' and the winged males. Males are unable to establish new colonies; it is the crawlers that move to new host plants, mostly on the wind.
2. Oystershell Scale has only one generation per year in New Zealand, such that adults do not have time to develop on fruit before harvest. Only first and second instar larvae are known to occur on harvested fruit (Hortnet, <http://www.hortnet.co.nz/key/keys/info/lifecycle/oss-desc.htm>). The absence of females means it is highly unlikely there will be high numbers of crawlers present that can disperse from waste fruit discarded into the environment.
3. The hosts of Oystershell Scale are a wide range of woody plants mainly deciduous trees and shrubs (Townsend, 2005; Hortnet, accessed February 2006). The absence of herbaceous hosts indicates that the likelihood of an apple core or dumped waste fruit landing close enough to a suitable host is relatively low.

The above considerations indicate the probability of distribution of Oystershell Scale is **'low'**.

Probability of entry

Combining the probabilities of importation (**‘high’**) and distribution (**‘low’**) gives a probability of entry of **‘low’**, according to the matrix of rules.

Probabilities of establishment and spread

The Australian Apple and Pear Industry concurs with the **‘high’** rating for probability of establishment in the 2005 DIRA, but considers the rating for spread should be **‘high’** rather than **‘moderate’**. This is because dispersal of Oystershell Scale within a region is mainly by movement of crawlers on the wind. There are no barriers within the south west of Western Australia that would prevent wind dispersal of crawlers. Suitable deciduous hosts are widely distributed as planted ornamentals or feral populations. While dispersal may be relatively slow, it can be expected that Oystershell Scale would spread throughout the more closely settled parts of the south west.

Overall probability of entry, establishment and spread

The combined probability of entry establishment and spread in the current analysis is **‘low’** by contrast to **‘very low’** in the 2005 DIRA.

Unrestricted risk

If the consequences of introduction of Oystershell Scale (**‘low’**) are considered reasonable the unrestricted risk becomes **‘very low’** which is Australia’s ALOP. Hence, APAL agrees with the 2005 DIRA that no additional risk management measures are needed for this pest, despite the higher probabilities of entry and spread, and higher unrestricted risk, for this pest than in the 2005 DIRA.

7.5.7 Wheat Bug

Biosecurity Australia has chosen not to analyse Wheat Bug in the 2005 DIRA.

The Australian Apple and Pear Industry disagrees strongly with this decision, since fruit imports from New Zealand represent a high risk pathway for this pest (see earlier comments).

The Industry considers Wheat Bug should have been subjected to the full semi-quantitative analysis in the 2005 DIRA. Accordingly, the Industry repeats below, with some additions, its response the semi-quantitative analysis presented by Biosecurity Australia in the 2004 RDIRA.

Probability of Entry

For a hitchhiker species like Wheat Bug, the IRA analysis based on individual infested fruit is entirely inappropriate. For this reason the analysis in this review has been done in two ways in Table 7.1; one taking the fruit as the unit of analysis, and the other using the pallet of fruit, since Wheat Bug is more likely to be associated with the pallet than the fruit itself. The pallet analysis results in a much higher Probability of Entry for Wheat Bug, viz; **‘low’** versus **‘very low’** for individual fruit.

Table 7.1 Reassessment of Risk of Entry for Wheat Bug, *Nysius huttoni*.

<i>Importation Step</i>	<i>Risk in 2000 IRA</i>	Risk in 2004 IRA	Recommended Risk	Justification
Imp 1		Very low	Certain	The distribution of <i>N. huttoni</i> throughout New Zealand, its wide host range, and often high abundance, indicate that it is likely to be present in every orchard.
Imp 2		Extremely low	Very low (fruit); Moderate (bins)	The IRA likelihood of ‘ extremely low ’ is not based on any data, indicating this estimate is subjective and may be too low. However, the most likely route for infestation of fruit shipments is insect invasion of bins in the orchard, or when placed outside the packing shed (Sale, 2003). A likelihood of moderate, with the bin as the unit of infestation, is considered more appropriate (see discussion above).
Imp 3		Low	Low (fruit); Moderate (pallets)	High infestation levels of bugs on low weeds in the orchard may result in movement of bugs into bins where they would shelter between the slats or amongst the fruit. This could also happen for bins of freshly picked fruit left outside the packhouse, if the packhouse apron is weedy. The rating of moderate is based on the bin as the unit of infestation rather than an individual fruit (see discussion above).
Imp 4		Very low	Very low (fruit)	The likelihood of ‘ very low ’ assigned at this step is subjective, since no quantitative supporting data is presented, however, is accepted as reasonable.

Imp 5		Negligible	Low (fruit); Moderate (pallets)	While it is reasonable to consider most bugs would be removed from fruit during washing, brushing or waxing in the packhouse, it is likely that recontamination could occur during packing due to the mobility of this insect. Bugs that lodged in bins or among fruit would be disturbed during bin tipping and other processes, and would likely fly out into the packhouse with some settling in or on cartons of fruit. At the carton level a rating of low is considered reasonable, which would become moderate for a pallet of cartons.
Imp 6		High	Certain	Nothing has been identified in the IRA in the palletisation, quality inspection, containerisation and transportation steps that would reduce Wheat Bug infestation levels. On the contrary, it is likely that all but a very few larvae would survive, so that the likelihood is close to certain.
Imp 7		Negligible	Low (fruit); Moderate (pallets)	The main routes of Wheat Bug contamination appear to be movement of bugs to shelter in the cracks and joints of bins and pallets in contact with infested weeds outside the packhouse, or on the packhouse floor. In the latter case disturbed bugs flying or crawling in the packhouse will likely seek shelter in pallet stacks waiting to be transported or stored.
Imp 8		High	Certain	The likelihood of survival of Wheat Bug through on-arrival minimum border procedures is considered to be close to 100 percent, or certain. Nothing has been identified in the IRA that would reduce survival through this step.
Probability of Entry	Not assessed	Very low	Very low (fruit) Low (pallets)	

Probability of Distribution, Establishment and Spread

The inappropriateness of the risk analysis in the 2005 DIRA is reinforced when it is realised that Wheat Bug does not damage the fruit and is unlikely to escape into the Australian environment from waste apples. Accordingly, as for Apple Leaf Curling Midge and New Zealand Flower Thrips, the risk analysis model in the 2005 DIRA is particularly unsuitable for this species, and no change to the 2005 DIRA analysis has been attempted here. The most likely points from which multiple individuals could escape to allow population establishment to occur are from locations where relatively large quantities of apples are stored, such as warehouses and packing sheds, and to a lesser extent, supermarkets.

Unrestricted Annual Risk

The 2005 DIRA calculated a semi-quantitative unrestricted annual risk of **‘moderate’** for Wheat Bug, which seems appropriate, given the relative ease with which this pest could establish, and the relatively high consequences. In fact, Wheat Bug had the highest unrestricted annual risk in the 2004 RDIRA of all potential pests, indicating that Biosecurity Australia recognised the high risks associated with apple (and other fruit) imports from New Zealand for this pest. It is therefore incongruous that specific consideration of this pest has been removed from the 2005 DIRA.

Risk Management

The Australian Apple and Pear Industry consider that the high risks demonstrated in the 2004 RDIRA warrant specific risk management measures for Wheat Bug in New Zealand.

Measures considered appropriate by the Australian Apple and Pear Industry were outlined above, and are repeated here.

- a) Weeds must be eliminated from all bin and pallet storage areas, outdoor holding areas and loading yards from at least 4 weeks prior to harvest until harvest is completed.**
- b) Consideration should also be given to preharvest orchard inspections and spraying of the orchard floor with an effective insecticide if Wheat Bug is found.**
- c) Wheat Bug must be specifically targeted during preclearance fruit inspections with thorough examination of packing materials, boxes and pallets.**
- d) Shipments found to be infested with Wheat Bug must be rejected or fumigated prior to acceptance.**

7.5 Overall results of The Australian Apple and Pear Industry risk assessment

Table 7.2 summarises the results of the Australian Apple and Pear Industry evaluation of the risk assessment for insect pests on New Zealand apples in the 2005 DIRA.

Table 7.2. Summary of the Australian Apple and Pear Industry assessment of unrestricted risk for insect pests on New Zealand apples (Biosecurity Australia assessment in brackets).

Pest	Annual probability of entry, establishment and spread	Consequences	Unrestricted annual risk	Risk management required?
Pests for all of Australia				
Apple leaf-curling midge	High (High)	Low (Low)	Low (Low)	Yes (Yes)
Garden featherfoot	Low (V. Low)	Low (Low)	V. Low (Neg.)	No (No)
Grey-brown cutworm	Mod (Low)	Mod (Low)	Low	Yes (No)
Leafrollers	Mod (Low)	Mod (Mod)	Low (Low)	Yes (Yes)
Wheat bug	Mod (-)	Mod (-)	Low (-)	Yes (-)
Pests for Western Australia only				
Codling moth	Low (Low)	Mod (Mod)	Low (Low)	Yes (Yes)
Mealybugs	High (Mod)	Low (Low)	Low (Low)	Yes (Yes)
Oriental fruit moth	V. Low (V. Low)	Mod (Mod)	V. Low (V. Low)	No (No)
Oystershell scale	Low (V. Low)	Low (Low)	V. Low (Neg.)	No (No)

From the above table it can be seen that, apart from Wheat Bug, the outcomes of the Australian Apple and Pear Industry and Biosecurity Australia analyses are the same in terms of the species requiring risk management strategies.

7.6 Risk Management

This section considers the adequacy of the risk management measures proposed by Biosecurity Australia to bring the risks associated with importation on New Zealand apples of the following five pests to within Australia's Allowable Level of Protection (ALOP):

1. Apple leaf-curling Midge
2. The Leafroller complex
3. Wheat Bug
4. Codling Moth
5. Mealybugs

Some aspects of risk management have been discussed in the preceding sections on each pest and are drawn together below.

7.6.1 Pre-clearance

The Australian Apple and Pear Industry strongly support the proposed pre-clearance regime supervised by AQIS officers in New Zealand that is directed primarily at the threat posed by Apple Leaf-curling Midge. However, the Industry is concerned that the 2005 DIRA commits only to maintain the pre-clearance regime ‘for the initial trade’ and that it ‘would be reassessed after experience had been gained following significant trade.’

Should such a review take place, the Australian Apple and Pear Industry seeks the assurance of Biosecurity Australia and AQIS that Industry, through APAL, would be fully consulted before any decision to change the pre-clearance regime is made. It is of significance that, after many years of pre-clearance inspections, APHIS in the USA has maintained its pre-clearance regime in New Zealand. This is no doubt due to the prevalence of significant quarantine problems with New Zealand apples including Apple Leaf-curling Midge, Leafrollers and Wheat Bug.

7.6.2 Management of Apple Leaf-curling Midge

The Australian Apple and Pear Industry supports the risk management measures proposed for Apple Leaf-curling Midge, including the use of the 3000 fruit pre-clearance sample to obtain data on the prevalence of all insects of quarantine concern. However, the following amendments to the sampling procedure should be implemented:

1. To obtain a true measure of the infestation levels by pests that hide in the calyx, there should be mandatory cutting of the calyx of all 3000 fruit in the sample, irrespective of whether the calyx is suspected of harbouring pests. This is the only way to provide accurate data on infestation levels by Codling Moth, Leafrollers and Mealybugs. The cut calyces should be examined with a 10 times hand lens to ensure that any scales and mealybugs are detected.
2. Wheat Bug must be a targeted pest for inspections of cartons and packaging.
3. If the above requirements are too onerous to be met, then the Australian Apple and Pear Industry consider all shipments must be subjected to a mandatory and reliable disinfestation treatment.

7.6.3 Management of other quarantine pests – adequacy of the AQIS standard 600 fruit sample

The Australian Apple and Pear Industry does not consider that the risk management measures proposed for Leafrollers, Mealybugs, Codling Moth and Wheat Bug are sufficiently robust to meet Australia’s ALOP. Risk mitigation in these cases relies entirely on inspections based on the standard AQIS 600 fruit sample and container inspections. The 600 fruit sample has been shown in the 2005 DIRA to be inadequate to detect low, but threatening, levels of Apple Leaf-curling Midge. It is clear that the same inadequacy would apply to similar pests, such as Mealybugs and Wheat Bug, and possibly also Leafrollers, which can be expected to occur on infested apples or packaging in

multiple numbers and which have high establishment capabilities. The Industry considers that if these pests had been subject, as they should have been, to the same rigorous semi-quantitative analysis as Apple Leaf-curling Midge, the outcome in terms of the need for pre-clearance inspections and the 3000 fruit sample would likely have been the same.

To be effective a quarantine sampling regime must be geared to reliably detect threatening pests at the lowest levels resulting in risk exceeding Australia's ALOP. The 600 fruit sample clearly fails this test. **The Australian Apple and Pear Industry considers that a minimum 3000 fruit sample should be routine for all inspections for all fruit crops, whether in pre-clearance or on-arrival in Australia.**

7.6.4 Management of quarantine pests in other countries

United States of America

APHIS on-arrival inspection requirements into the USA are worth noting (USDA, 2003). APHIS do not have a single 'one-size fits all' sampling regime. Rather, sampling varies according to the risk associated with the commodity, the size of the shipment and the track record of the shipper. In general, sampling rates are set at 2 percent of the shipment, but may be varied up or down, with low risk items receiving lower levels of inspection. The 2 percent sampling rate is completely different in principle from the AQIS fixed sample size. With a 2 percent sample the absolute size of the sample increases with the size of the shipment, and is spread evenly through it. This approach makes much more sense than the AQIS approach which uses the same 600 fruit sample for shipments of all sizes, which for large shipments means that only a minute proportion of the shipment is inspected.

The following are examples of sampling regimes used by APHIS:

1. Apples and Pears from Australia and New Zealand

The sampling rate for Australian and New Zealand apples and pears is 250 cartons per inspectional unit. The latter may be defined as all containers in a shipment or a fixed number, such that several lots of 250 cartons need to be inspected. The 250 carton inspection level means that, for an inspectional unit of 8,000 cartons in 4 containers, one carton in 32 is inspected. Assuming 80 fruit per carton, the sample size is 20,000 fruit. The AQIS 600 fruit sample is miniscule in comparison. The high sampling rate for Australian and New Zealand fruit reflects the perceived high risk associated with fruit from this region, mainly on account of Light Brown Apple Moth and other leafrollers, Wheat Bug and Apple Leaf-curling Midge.

2. Apples and Pears from Chile

A different sampling regime applies to fruit from Chile reflecting the lower levels of risk associated with fruit from that country. The sample size per

inspectional unit varies according to shipment size. The minimum sample size is 30 cartons, or 2,400 fruit (assuming 80 fruit per carton), which is still four times the AQIS standard sample for all shipment sizes. The maximum sample for Chilean fruit, for shipments of 10,000 cartons or more, is 100 cartons or approximately 8,000 fruit.

3. **Kiwifruit from New Zealand**

The main concern in the USA for New Zealand kiwifruit is Wheat Bug loose in the container and on packaging materials. Less attention is paid to the fruit. On-arrival sampling is based on a sliding scale dependent on shipment size. The maximum size of the inspectional unit is set at five containers. For a five container shipment 100 trays of fruit are drawn equally from at least three of the containers. Sampling levels increase with the size of the shipment, so that 460 trays are examined for a shipment of 50 containers.

Canada

The Canadian approach to quarantine is much more risk averse than that proposed by Biosecurity Australia. For countries supplying new products to Canada for the first time, there is a two year trial period during which high levels of inspection are employed to ‘verify the absence of quarantine pests’. Within this trial period imports may be suspended if Canadian Food Inspection Agency requirements are not ‘routinely’ met. The trial period of high inspection levels may be extended until such time as shipments routinely meet Canadian requirements.

Canadian inspection requirements for trial shipments include:

1. 100% of shipments will be inspected
2. A random sample of **5 percent** is taken for inspection. If no pests are found, but there are signs of the presence of living insects, e.g. frass, a further **5 percent** sample is taken.

These Canadian requirements apply to apples from Brazil (CFIA 2004a) and China (CFIA 2004b), and pears from Japan (CFIA 2005), amongst others

Korea

The National Plant Quarantine Service of Korea has similar inspection requirements to the United States for citrus imports from South Africa. The Koreans conduct pre-clearance inspections after cold treatment for 22 days and sample **2 percent** of all boxes in a treatment lot. Shipments cold treated in transit are subject to the 2 percent sample upon arrival in Korea.

The AQIS 600 fruit standard sample, which could be as few as 6 to 8 cartons, pales into insignificance against the sampling levels routinely employed for fruit shipments into the USA, Canada and Korea. These countries are used only as examples; no attempt has been made to conduct a full review of

quarantine protocols internationally. Nevertheless, the clear implication of this is that the Australian sampling levels are manifestly inadequate and are a token response to the need for risk management at the border. It is APAL's view that the currently proposed on-arrival inspection regime for New Zealand apples in the 2005 IRA in no way constitutes an adequate response to the high risks posed by New Zealand apples (and other fruit). **Therefore, it is the view of the Australian Apple and Pear Industry that, in the absence of an adequate on-arrival inspection regime, all apples from New Zealand should be fumigated, as fumigation is the only risk management option that provides the level of assurance needed to meet Australia's ALOP.**

7.6.5 Post-arrival risk management

The Australian Apple and Pear Industry is concerned about the lack of any post-arrival risk management strategies in the 2005 DIRA document, or in any other similar documents. Two broad post-arrival strategies are needed:

1. Monitoring for escape and establishment of pests associated with New Zealand apples.
2. Mandatory destruction of waste from New Zealand apples at repacking and distribution centres.

Monitoring

Several pests of concern in New Zealand apples can be detected by pheromone trapping. These include the four species of leafrollers in the Brown-headed and Green-headed groups (of concern for all of Australia), and Codling Moth and Oriental Fruit Moth (of Western Australian concern only). The highest risk of escape for these pests is associated with repacking and distribution centres. Placement of sex pheromone traps around such centres would provide an early warning of moths escaping from these places. Such trapping would allow eradication measures to be undertaken before establishment and dispersal occurs.

Destruction of waste

Another high risk associated with distribution and repacking centres is the emergence of pests (and diseases) from bulk waste fruit that may be left in bins outside, dumped nearby or disposed of at the local waste recycling facility. A simple and effective risk mitigation measure would be to treat such fruit to kill any pests and diseases before it is disposed of, for example, by heating it. Protocols should be developed for handling and treating waste fruit that minimises the escape of pests and diseases. Implementation of such measures should be mandatory for distributors and packers of New Zealand apples, and should be audited by AQIS or its agents.

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APPENDIX 7.1. Summary of reports of Codling Moth in pome and stone fruit in Orchard Spray Guides and other literature.

Ref No.	Reference & Web Address	Pome Fruit	Stone Fruit	Comments
1	www.hortnet.co.nz/key/stone/info/hostplat/cm-host.htm	Apples/Pears main hosts, Walnuts less frequent	Plums, less frequent. Peaches/nectarines / apricots rare hosts	<i>'Pipfruits, especially apples and pears, are the main hosts Other plants less frequently but consistently attacked are walnuts and plums. Other known but rare hosts include peaches, nectarines and apricots.'</i>
2	Pennsylvania Tree Fruit Production Guide 2004-2005 http://tfpg.cas.psu.edu	Apples/Pears	Nil	
3	Home Fruit Spray Guide (1999) University of Minnesota Extension Service. www.extension.umn.edu/distribution/horticulture/DG0675.html	Apples/Pears	Nil	
4	Virginia-West Virginia-Maryland 2005 Spray Bulletin for Commercial Tree Fruit Growers. West Virginia University Cooperative Extension Service. www.ento.vt.edu/Fruitfiles/SprayGuide/TreeFruitSprays.html	Apples/Pears	Nil	
5	2005 Crop Protection Guide for Tree Fruits in Washington. Washington State University Extension http://cru.cahe.wsu.edu/CEPublication/eb0419/eb0419.pdf	Apples/Pears	Nil	
6	Midwest Tree Fruit Pest Management Handbook www.ca.uky.edu/agc/pubs/id/id93/id93.htm	Apples/Pears, serious pest	Nil	

7	Codling Moth on Fruit Trees. Ohio State University Extension Fact Sheet. HYG-2203-92	Apples most serious Pears/crabapples/ English and black walnuts/quince		<i>'The codling moth... is one of the most serious pests of apples, but the larvae may attack pears, crabapples, English and black walnuts, quince and other fruits.'</i>
8	Integrated Fruit Production Guide for Commercial Tree Fruit Growers 2004 Edition. Ministry of Agriculture, British Columbia. www.agf.gov.bc.ca/cropprot/fruitspray.htm	Apples/crabapple s/pears	Nil	
9	A guide to Fruit Tree Sprays for the Home Garden. Ministry of Agriculture, British Columbia www.agf.gov.bc.ca/treefrt/product/tfguide.htm	Apples/Pears	Nil	
10	Barrett, B.A., M.R. Warmund and P.L. Byers (2005) Fruit Spray Schedule for the Homeowner. University of Missouri Extension Service http://extension.missouri.edu/explore/agguides/hort/g06010.htm	Apples/Pears	Nil	
11	Fruit Insect and Disease Control Guide for the Home Gardener (1992). North Dakota State University Extension Service. www.ext.nodak.edu/estpubs/plantsci/hortcrop/e299w.htm	Apples	Nil	
12	D.F. Ritchie, K.A. Sorensen, J.R. Meyer (2005) Peach and nectarine Spray Guide, 2005 North Carolina Agricultural Chemicals Manual http://ipm.ncsu.edu/agchem/chptr7/708.pdf	—	Nil	

13	Bernt Solymar (2005) Codling Moth Ontario Ministry of Agriculture, Food and Rural Affairs www.omafra.gov.on.ca/english/crops/facts/codling.htm	Apples/hawthorn/ crabapple/pear/qu ince/ walnut and other Juglans species	Nil	<i>'The codling moth, Cydia pomonella (Linnaeus) is considered a major pest of apples in Europe, Asia and North America... Alternate hosts of codling moth include hawthorn, crabapple, pear, quince, walnut and other Juglans species.'</i>
14	South Australian Research and Development Institute (2001) www.sardi.sa.gov.au/pages/horticulture/apricot/specific_pests.htm : sectId=139&tempID=83		Nil	
15	Commercial Tree Fruit Insecticide/Fungicide Recommendations New Jersey (1996). Rutgers Cooperative Extension. New Jersey Experiment Station. http://virtualorchard.net.rce.96tfrecs/default.htm	Apples/Pears	Nil	
16	Commercial Tree Fruit Productions 2005 Online version Cornell University Cooperative Extension. www.nysaes.cornell.edu/ent/treefruit/	Apples/Pears	Nil	
17	UCIPM: UC Management Guidelines University of California www.ipm.ucdavis.edu/index.html	Apples/Pears/Wa lnuts	Plums/Prunes in California	<i>'Codling moth has the greatest potential for damage of any apple (or pear) pest...can be a problem in plums in California.'</i>
18	Swift, C.E., H.J. Larsen, R. Hammon (2005). Backyard Orchard: Stone Fruits Factsheet 2.804. Colorado State University Cooperative Extension www.coopext.colostate.edu/TRA/PLANTS/index.html	–	Nil	

19	Swift, C.E., R. Hammon, H.J. Larsen (2005) Backyard Orchard: Apples and Pears Factsheet 2.800 Colorado State University Cooperative Extensions www.coopext.colostate.edu/TRA/PLANTS/index.html	Apples/Pears		
20	English, L.M. (2004) Codling Moth (<i>Cydia pomonella</i>) and its control. Guide H-427. New Mexico State University Cooperative Extension Service.	Apples/Pears	Less important	<i>'Codling moth is the most serious pest of apples and pears in New Mexico. It is less important on walnuts, plums and other stone fruit.'</i>
21	Peach IPM. Mid-Atlantic Orchard Monitoring Guide www.ento.vt.edu/Fruitfiles/peach-fruit-ipm.html		Nil	
22	Eaker, T.H., D. Horton and H.C. Ellis (2002) 2002 Disease and Insect IPM in the Home Orchard. Cooperative Extension Service, The University of Georgia College of Agriculture and Environmental Sciences	Apples/Pears	Nil	
23	IPPC Codling Moth Information Support System. Natural enemies of Codling Moth and Leafrollers of Pome and Stone Fruits www.ippc.orst.edu/codlingmoth/biocontrol/natural/	Apples/Pears/ Quince/Walnut	Apricot/Plum/Peach/ Nectarine/Prunus ssp.	<i>'The most important codling moth hosts are apple and pear, but it can also be a key pest of quince, walnut, apricot, plum, peach, nectarine and even Prunus species (like sweet cherry and almonds).'</i>

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