Management of food safety risk in Tasmanian primary industries

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About the author

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He combines an academic career with a consulting practice. His specialties are quality assurance and HACCP systems, food safety and risk assessment. He is Technical Adviser to the food safety program of Meat and Livestock Australia and to Seafood Services Australia.

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Summary

1. Data have been gathered from branches of the Department of Primary Industries Water and the Environment (DPIWE) to assess the degree to which each branch regulates food safety of commodities within its responsibility.
2. Some regulators e.g. Meat Hygiene Standards (MHS) have legislation which clearly identifies them as the State's lead jurisdiction for food safety for that specific sector. The Tasmanian Dairy Industry Authority (TDIA) has legislation which similarly empowers it.
3. Other branches, such as Horticulture, Vegetables, Extensive Agriculture do not have the regulatory underpinning which gives them responsibility for food safety.
4. Some sectors have Food Safety Programs (FSPs) as the basis for food safety management, while others do not.
5. Local authorities can require companies to implement a FSP under Standard 3.2.1 of the Food Standards Code. Such plans are not consistent with HACCP as defined by Codex Alimentarius which could result in inconsistency between sectors.
6. The proposed Primary Production and Processing Standards (PPPSs) could lead to confusion over regulatory responsibility between branches of DPIWE and Department of Health and Human Services (DHHS); the TDIA may have similar issues. Confusion is introduced via the term "substantial transformation" which demarcates which jurisdiction is responsible. Until substantial transformation is defined for activities such as washing of fruit and vegetables and growing of sprouts, regulatory responsibility remains unclear.
7. Responsibility for smallgoods manufacture is confusing with DPIWE responsible for plants which have an integrated slaughter facility and DHHS/LG for plants without such a facility. When smallgoods manufacturers are regulated by DPIWE the Australian Standard is used and it is assumed that, when manufacturers are regulated by DHHS/LG, the Food Standards Code is used.
8. Smallgoods are also manufactured by virtually all butcher shops in Tasmania and will be required to implement FSPs because manufactured and fermented meats have been identified by the National Risk Validation Project as a high-risk sector. It is expected that this sector will be regulated via the Food Standards Code which introduces the potential for inconsistency both within the State between sectors, and nationally where jurisdictions have elected to regulate butcher shops via the Australian Standard.
9. While some regulators e.g. MHS, TDIA and the Licensing and Administration Branch of DPIWE's Primary Industry Division have consolidated lists of manufacturers together with their products and processes this is lacking across other areas of the State's food industry. Without knowing who does what by which process, food safety management can only operate reactively, not proactively.
10. Lack of sector information has prevented the semi-quantitative profiling approach to processing of vegetables, fruits, sprouts and some smallgoods; for these sectors a qualitative profile has been done.
11. Specific actions are suggested for consideration under each of the commodities comprising this report.
12. A summary table is provided of risk rating for various scenarios within industry sectors. Two risk tools have been used to generate ratings, a qualitative tool and the semi-quantitative tool, Risk Ranger. A more detailed description of Risk Ranger is presented in Appendix 2.
13. In general, risk ratings have been generated to indicate compliance with the prescribed standard *versus* non-compliance using examples from local, national and international breakdowns in regulation.

Summary of risk ratings and estimated illness according to industry sectors

Sector	Risk Rating		
	Qualitative	Semi-quantitative (Risk Ranger)	
		Rating (0-100)	Estimated Tasmanian illnesses/annum
Meat, poultry and game		0* (Low)	0*
Smallgoods			
Pathogenic *E. coli* in salami – process within Standard 1.6.2		15 (Low)	2/million years
Pathogenic *E. coli* in salami – process outside Standard 1.6.2		51 (High)	5
Salmonella in salami made from game meat – process outside Standard 1.6.2		57 (High)	60
Eggs			
Salmonella in lightly cooked eggs		54 (High)	18
Salmonella in raw egg drinks		54 (High)	15
Salmonella in egg butter used for Asian meat rolls		62 (High)	23
Dairy			
Salmonella in ice cream made without a food safety plan		54 (High)	150
L. monocytogenes in dips		52 (High)	75
Seafood			
Oysters grown in waters under a Seafood QA Program (SQAP)		25 (Low)	1/century
Oysters grown without a SQAP		55 (High)	2250
Vegetables			
Faecal pathogens in washed vegetables	Moderate		
L. monocytogenes in packaged vegetables	High		
Fruit			
Faecal pathogens in washed fruit	Moderate		
L. monocytogenes in packaged fruit salad	High		
Faecal pathogens in unpasteurised fruit juice	High		
Seeds			
Salmonella in bean sprouts	High		
Honey			
C. botulinum in honey	Low		
Agricultural chemicals and antibiotics in honey	Low		

* Products are consumed cooked – illness may result from handling at retail, food service or home sectors causing cross contamination to final products

1 Background

Involving risk as part of food safety management is a relatively new concept. In the past, hazard management was the primary tool, with the Hazard Analysis Critical Control Point (HACCP) concept coming to the fore during the 1990s. Despite the fact that the first HACCP principle required an evaluation of hazards and risks, the latter were rarely considered in HACCP plans. In the past decade, management of risks, as well as of hazards, has become a part of food safety management at the enterprise and regulatory levels.

As part of its evolution, risk management has evolved a series of terms, the most important of which are risk analysis, risk assessment and risk profile.

Risk Analysis is a process which is used to enhance protection of public health and has three parts:

- Risk Assessment
- Risk Management
- Risk Communication

Risk Assessment is the science component of risk analysis used to establish standards, guidelines and other recommendations for food safety to enhance consumer protection.

Risk Profiling is defined by the Codex Alimentarius Commission (CAC 2002) as a description of a food safety problem and its context developed for the purpose of identifying those elements of a hazard or risk which are relevant to risk management decisions.

2 Scope of the present project

For the present exercise, the terms of reference are to:

1. Gather information on the exposure of consumers to food safety hazards from the following broad commodity areas:
   - Meats, poultry, eggs
   - Seafoods
   - Vegetables
   - Horticultural products
   - Grains and other extensive agricultural products
   - Dairy products
   - Honey
2. Identify potential food safety issues which may impact adversely on Tasmanian consumers.
3. Select and develop various risk-based scenarios for specific hazard:commodity pairs which have relevance in the state.
4. Confer with Department of Health and Human Services (DHHS) staff on matters of food safety as they apply to the above commodities and to Tasmanian consumers.
5. Confer with the Department of Health and Human Services to arrange one or more meetings with EHOs to discuss their role in food safety, together with resources needed to enhance their role in a changing national climate of food safety.
6. Discuss the implications of food safety risk for Tasmanian consumers within the context of current food safety management regimes operating within the state.
7. Present the final report to the Tasmanian Primary Industries Food Safety Forum and, if requested, to senior DPIWE and DHHS officials.

3 Methodology used in the present study

The present study involves several areas within DPIWE, the Tasmanian Dairy Industry Authority (TDIA) and the DHHS. It has been progressed in several stages:

Stage 1:	Discussion of key food safety issues with staff in each area
Stage 2:	Research of hazards and exposure – gathering of data
Stage 3:	Submission of a draft report to personnel in each area
Stage 4:	Preparation of risk ratings for scenarios illustrating how perceived weaknesses in management of food safety can lead to enhanced risk. For sectors where information is lacking a qualitative profile has been done
Stage 5:	Discussion with stakeholders at DPIWE, DHHS, TDIA and local government
Stage 6:	Preparation of a draft final report for feedback by stakeholders
Stage 7:	Submission of a final report

Two rating tools have been used, a qualitative tool based on the International Commission for Microbiological Specifications in Foods (ICMSF) and Food Science Australia (2002) and a semi-quantitative tool, Risk Ranger, which is described in Appendix 2.

3.1 Risk estimates

Risk estimates from the qualitative framework give ratings of Low, Medium and High.
Ratings from Risk Ranger spread from 0-100 where zero is equivalent to 1 illness/10 billion people/century from the hazard:product combination while 100 is equivalent to everyone eating a lethal dose on one day.
A change of "6" in risk rating is equivalent to a 10-fold change in risk. Thus the difference between a rating of 30 and 60 is five orders of magnitude (100,000x difference in risk).
Estimates of illness are probably accurate only to an order of magnitude and serve to illustrate relative changes in illness pattern.
Risk ratings may be aggregated into categories of risk:

- Low risk (risk rating <30)
- Medium risk (risk rating 30-50)
- High risk (risk rating >50)

3.2 Gold standard

Among suggested actions for various entities is the establishment of a Gold Standard. This approach has been used by South Australia's Department of Primary Industries and Resources (PIRSA) to identify areas for improvement at South Australia's smallgoods and poultry plants. A Gold Standard is basically a compilation of:

1. Hazard management
   - Process validation
   - Verification
   - Corrective action
2. Factory layout and operation
3. Cleandown
4. Monitoring of cleandown

Each plant is assessed for its compliance against a range of criteria under each broad heading.

A similar approach could be undertaken for the activities and operations of food safety risk managers.

4 Responsibility for food safety regulation in Tasmania

Tasmania's food industry is regulated by four entities:

1. Tasmanian Dairy Industry Authority (TDIA)
2. Department of Health and Human Services (DHHS)
3. Local government via health departments in 29 local councils
4. Department of Primary Industries, Water and Environment (DPIWE)

Broad responsibilities of each entity are explained in Regulation of Food Safety in Tasmania's Primary Industries: Draft Issues Paper (March 2004). In summary:

4.1 TDIA

The TDIA is established under the Dairy Industry Act 1994, administers the Act and licenses dairy farmers, dairy processors, dairy manufacturers and milk vendors. The Authority also is the authorized agent of the Australian Quarantine and Inspection Service (AQIS) for Tasmanian dairy exports.

The TDIA's responsibilities embrace the supply chain from farm to delivery to retail and are exercised by licences or certificates of competency according to HACCP and risk-based food safety procedures. Licence conditions include compliance with the appropriate Australian Standards for dairy foods.

The TDIA participates in joint food safety audits with appropriate third party certifying bodies and is authorised under the *Food Act 2003* as the competent authority in dairy food safety matters.

In summary, the TDIA provides a regulatory umbrella under which most of the Tasmanian dairy processing industry (excluding ice-cream manufacture) operates via suitably-trained staff capable of modern regulation (HACCP/audit) of hazard management.

4.2 DHHS

The DHHS administers the *Food Act 2003*, the stated objectives of which are to:

- Ensure food for sale is both safe and suitable for human consumption
- Prevent misleading conduct in connection with the sale of food
- Provide for the application in this jurisdiction of the Food Standards Code

The *Food Act 2003* is the "default" Act for Tasmania in relation to food safety issues and regulates all areas of the food production chain. The Act includes provisions that limit the scope and application of the Act in relation to "primary food production". Primary food production includes growing, raising, cultivating, harvesting, collecting or catching of food. The Act exempts primary food production from the application of certain provisions such as improvement notices, auditing, notification and registration. However, primary food production is not exempt from the general requirement to produce safe food.

The DHHS administers the Tasmanian Shellfish Quality Assurance Program (TSQAP) for shellfish aquaculture operations. This program carries out continual and extensive monitoring of all commercial shellfish growing areas in the state and assigns a classification to each area based on the level of public health risk found.

4.3 Local government

Local Government Environmental Health Officers (EHOs) in conjunction with DHHS are responsible for the administration of the *Food Act 2003* and the Australia New Zealand Food Standards Code (although practically with regards to the Code, most EHOs are mainly involved with the Food Safety Standards aspect only).

While DHHS largely focuses on statewide legislative and broad policy issues, local government EHOs' primary responsibility is the enforcement of this legislation. The majority of EHOs' regulatory activities are associated with retail activities, including bakeries, restaurants, takeaway food stores, butcher and fish shops. While defined primary food production operations are generally not regulated by EHOs due to their exemptions, such operations may "default" to local government because of the lack of an alternative regulatory framework. If this occurs, food safety matters can be regulated under the general provisions of the *Food Act* 2003.

4.4 DPIWE

Within DPIWE there are a series of branches within the Biosecurity and Product Integrity (BPI) and Primary Industries Divisions of DPIWE which have the potential to administer food safety management (Fig 4.1). Some branches have obvious responsibility for food safety management. For example, Meat Hygiene Standards (MHS) Section (to be located within the new Food Safety Branch of BPI) administers the *Meat Hygiene Act 1985* and will assume administration of the *Egg Industry Act 2002* during 2004, both Acts including production of safe, quality food within their objectives. By contrast, branches such as Vegetables, Horticulture and Extensive Agriculture have no legislation which gives them responsibility for food safety.

There is linkage between DPIWE and the TDIA via the Acting General Manager - BPI, who chairs the TDIA. There is also a relationship between Agriculture and DHHS which has been formalized at the ministerial and CEO levels.

Table 4.1: Tasmanian legislation covering food safety and its application to the various sectors and activities in the food supply chain

	Production/Harvesting	Transporting/Storing	Processing	Transporting/Storing	Retail/Food Service
Seafood	*Living Marine Resources Management Act 1995* *Inland Fisheries Act 1995* (IFA)	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*
Poultry Meat	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985 & Food Act 2003**	*Food Act 2003*
Eggs	*Egg Industry Act 2002*	*Egg Industry Act 2002*	*Egg Industry Act 2002*	*Food Act 2003*	*Food Act 2003*
Red Meat			*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985 & Food Act 2003**	*Food Act 2003*
Game Meat	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985*	*Meat Hygiene Act 1985 & Food Act 2003**	*Food Act 2003*
Dairy	*Dairy Industry Act 1994*	*Dairy Industry Act 1994*	*Dairy Industry Act 1994 & Food Act 2003***	*Food Act 2003*	*Food Act 2003*
Grains	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*
Vegetables	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*
Fruits	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*
Honey	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*	*Food Act 2003*

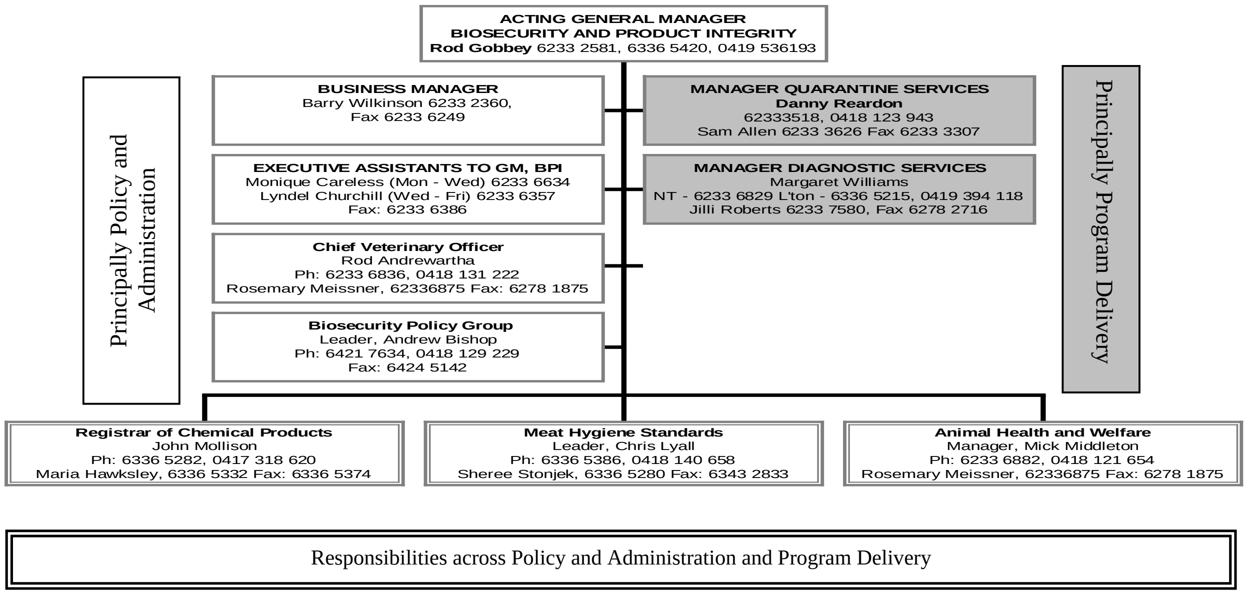
* The Meat Hygiene legislation (including Australian Standards) applies to meat transport vehicles that operate from licensed meat premises. The Food legislation (including the Food Standards Code) applies to independent meat transporters.

** Some dairy processing comes under the *Food Act 2003* e.g. ice-cream manufacture

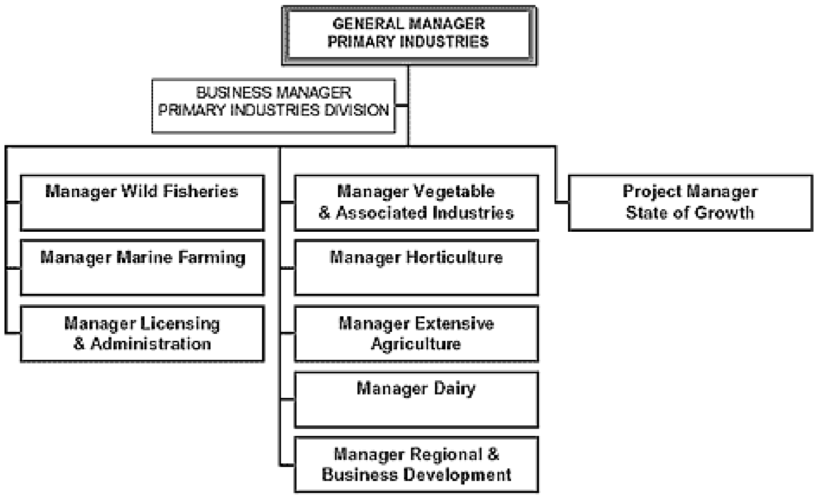
Fig 4.1: Organisation chart of branches of DPIWE

Interim Structure as at 1 October 2004

Biosecurity and Product Integrity Division



Primary Industries Division



5 Potential constraints on food safety regulation in Tasmania

Potential constraints on effective management of food safety in Tasmania include:

5.1 Primary production and processing standard

In *Regulation of Food Safety in Tasmania's Primary Industries: Draft Issues Paper (March 2004)* the genesis of primary production and processing standards is described. In 2000, the Council of Australian Governments (COAG) agreed to a nationally coordinated approach to food regulation and for the first time a single national framework was brought into existence for the development of all domestic food standards covering the entire food supply chain. The COAG Food Regulation Agreement created a clear responsibility for Food Standards Australia New Zealand (FSANZ) to develop all domestic food standards, including primary production and processing standards. These standards will form Chapter 4 of the Food Standards Code and focus on food safety risks. The policy responsibility for PPP standards rests with the Australia and New Zealand Food Regulation Ministerial Council (ANZFRMC) and its subordinate, the Food Regulation Standing Committee (FRSC).

Clearly the PPPS has importance for DPIWE firstly, because of its primary industries focus and secondly, because of its shared responsibilities with DHHS and LG. The Food Standards Code defines primary food production as *"the growing, cultivation, picking, harvesting, collection or catching of food"*. The Code adds further definition that primary production includes *"packing, treating (for example washing) or storing of food on the premises on which it was grown, cultivated, picked, harvested, collected or caught"*. The Code eliminates any process involving:

- Substantial transformation (for example, manufacturing or canning)
- Sale or service of food directly to the public

The term "substantial transformation" remains largely undefined at the national level and, for DPIWE, this lack of definition is important. For example, when fruits and vegetables go through a washing step, is this substantial transformation? When seeds are used for sprouting is this substantial transformation? Clearly the advent of PPPSs requires close liaison between DPIWE and DHHS/LG.

5.2 Food safety standard 3.2.1 (Food safety programs)

Food safety programs (FSPs) are the current tool of choice for managing hazards and risks. They comprise an underpinning of Good Manufacturing Processes (GMPs) and Standard Sanitation Operating Procedures (SSOPs) on which can be erected a HACCP system. Codex Alimentarius has defined how HACCP systems are to be implemented and operated under seven General Principles (Codex, 1997).

In Australia the Food Standards Code requires that, where a State or Territory decides to implement a requirement for FSPs, it must use Standard 3.2.1. However, Standard 3.2.1 lacks definition in several key aspects. While Standard 3.2.1 mentions that a FSP must be based on "HACCP concepts" these are undefined. The Standard refers to Clause 5 for definition of content of the FSP in which there are six elements which align broadly with six of the seven HACCP principles. Missing is Principle 3 (Establish Critical Limits, CLs) an omission without which a HACCP system cannot be operated since it is against CLs that monitoring is assessed and Corrective Actions implemented if CLs are breached.

Thus Standard 3.2.1 allows food establishments to have a FSP which is not Codex compliant with respect to HACCP principles. In the present context, Standard 3.2.1 is not mandated in Tasmania but it is open for DHHS and LG to require establishments to implement a FSP system under Standard 3.2.1. Were that to happen in the smallgoods sector it would result in some plants operating under the Australian Standard for the hygienic production and transportation of meat and meat products for human consumption (AS 2002:4696) and others (butcher shops) under Standard 3.2.1; the former would operate Codex-compliant HACCP while the latter would not.

5.3 Shared responsibility for regulation of food safety

Shared responsibility for regulation requires strict definition of respective roles of each party and clear lines of demarcation. Shellfish growing and harvesting is an example of where the responsibility of both entities is both well defined and well regulated. Two officers located within DHHS are dedicated to monitoring and closing shellfish leases, while Marine Farming Branch of DPIWE is involved in operational and audit functions (via AQIS which is the audit agent). Similarly, while the TDIA operates as an autonomous competent authority, there are shared responsibilities between DPIWE, DHHS and local government. Inspectors of both MHS and TDIA are appointed as Authorised Officers under the *Food Act 2003*.

In other areas e.g. growing of sprouts, washing of fruit and use of egg products, while there is broad regulatory definition, operational responsibility between DPIWE and DHHS/LG could be improved.

In other states memoranda of understanding are used to codify regulatory and operational roles e.g. in South Australia smallgoods are regulated by Department of Health and audited by Primary Industries and Resources (PIRSA) under a MoU.

5.4 Lack of industry databases

For some sectors e.g. meat, game, dairy, seafoods and shellfish growing databases have been compiled by the controlling authority which define products and processes of every establishment in that sector. In other sectors e.g. egg, fruit, vegetable, sprout and smallgoods no such database exists.

A database is an essential first step in managing food safety within a sector and especially in those sectors identified as high risk, such as smallgoods. If a controlling authority is unaware of an operation and its processes it can only manage reactively. For example, in recent years at least two manufacturers of Uncooked, Comminuted Fermented Meat (UCFM) within the State have operated outside the Food Standards Code.

Without up-to-date information on products and processes it is also not possible to complete a risk profile which has anything other than generalized conclusions. This factor has limited the present report to a qualitative profiling approach to processing of vegetables, fruits, sprouts and some smallgoods.

5.5 Lack of resources

As is clear from Table 4.1 the *Food Act 2003* operates over large swathes of the agri-food-retail continuum which has significant resource implications for local government.

5.6 Fragmentation of food safety management

At present the State has 33 food authorities located at 29 councils, MHS, DHHS and TDIA. While a degree of integration exists by the good offices of individuals within certain entities and by the Food Safety Forum, nonetheless day-to-day operation of food safety management within Tasmania is fragmented.

6 Red meat

6.1 Regulation

All plants are regulated under the *Meat Hygiene Act 1985* which, from the food safety viewpoints, mandates Quality Assurance (QA) plans which are based on Hazard Analysis Critical Control Point (HACCP). The Act is administered by MHS.

6.2 Practice

MHS is responsible for 26 licensed meat premises, of which the three larger were previously classed as "domestic abattoirs". Around 23 very small premises (VSPs, formerly known as "slaughterhouses") are located Statewide and on King and Flinders Islands. Since 1996, MHS has supported the uptake of QA/HACCP systems in slaughterhouses:

- Implementation of workshops to explain the concept
- Provision of one-on-one advice to support successful desk audit of the system
- Routine audit by trained auditors, of whom four are registered by the Quality Society of Australasia (QSA); the branch has one Lead Auditor.

MHS oversees red meat production from domestic slaughtering premises in the State. Production is presented in Tables 6.1 and 6.2 from which it can be seen that, in recent years, the proportion of product from VSPs has increased to almost 40% of that produced by domestic abattoirs so that, in 2003, domestic meat premises produced 225,000 and 520,000 units, respectively.

Beef and sheep/lamb carcases form the vast bulk of production, with domestic abattoirs producing 43,000 beef and 435,000 sheep carcases in 2003, compared with 19,000 and 189,000, respectively, from VSPs. Abattoirs and VSPs produced 41,000 and 15,000 pig carcases, respectively, with the remainder of production coming from deer and goats.

Since meat from export plants is also sold on the local market, data from export establishments is included in Table 6.3. It is estimated that 10% of meat from export establishments enters the local market.

Table 6.1: Slaughter numbers from domestic abattoirs (1996-2003)

	Cattle	Calves	Sheep	Lambs	Pigs	Goats	Deer	Other	Total
1996	500800	25735	314847	304860	76113	271	464	39	1223129
1997	45873	32083	318432	347851	76250	1	154	145	820789
1998	44408	35161	270542	355881	75941	16	370	0	782319
1999	39332	35944	308485	337123	74611	36	226	0	795757
2000	30556	27391	355114	341171	59487	109	285	0	814113
2001	25419	18842	198669	267747	53119	42	147	0	563985
2002	22464	9582	66555	187138	38573	4	0	0	324316
2003	27385	15991	206738	228099	41540	0	2	0	519755

Table 6.2: Slaughter numbers from slaughterhouses (1996-2003)

	Cattle	Calves	Sheep	Lambs	Pigs	Goats	Deer	Other	Total
1996	6632	2141	44133	5685	2517	448	2983	248	64787
1997	8593	1991	69068	5869	2837	474	2256	801	91889
1998	9148	1203	65445	9391	3108	422	2399	85	91201
1999	7719	825	112570	15791	3557	79	991	793	142325
2000	6774	2704	114829	13077	3532	165	595	0	141676
2001	5294	552	84546	14454	3654	159	939	232	109830
2002	10649	832	75060	53361	11595	164	883	9	152553
2003	16721	2395	122520	65603	15581	400	1662	996	225878

Table 6.3: Slaughter numbers from export establishments (1996-2003)

	Cattle	Calves	Sheep	Lambs	Total
1996	145850	15461	35712	14733	211756
1997	154548	18287	72012	43183	288030
1998	155448	21674	89469	88821	355412
1999	151440	29962	48969	91068	321439
2000	144140	21528	47317	92268	305253
2001	137981	27995	57689	105680	329345
2002	134511	29291	68602	114860	347264
2003	164814	29947	132868	118187	445816

A summary of audits and findings over the period 1999 to 2004 is presented in Table 6.4. Around 1200 site audits have been conducted by MHS staff. A consolidated list of all processes undertaken by each premises is available.

Table 6.4: Audit summary (1999-2004)

	Slaughterhouse	Poultry	Game	Abattoirs
1999	287	19	10	30
2000	163	19	10	30
2001	156	19	10	30
2002	153	19	10	20
2003	152	16	13	20
2004 (to date)	51	8	13	8
Total	962	100	66	66

6.3 Hazards in meat

As evidenced from Table 6.5, livestock carry a wide range of micro-organisms in their intestines, glands and udders which are pathogenic either to the host or to humans. These pathogens may be transferred to carcases during slaughter and dressing.

Table 6.5: Primary biological hazards in livestock

Livestock
Gram-negative pathogens
Brucella, Salmonella, pathogenic Escherichia coli, Campylobacter jejuni, Yersinia enterocolitica
Coxiella burnetii
Gram-positive pathogens
Listeria monocytogenes, Staphylococcus aureus,
Bacillus anthracis, Clostridium spp, Mycobacterium bovis, Streptococcus spp
Parasites
Cysticercus bovis, Cysiccercus ovis, Onchocerca spp, Taenia saginata, Toxoplasma gondii
Viruses
Prions

Listed in Table 6.6 are generalised categories of chemical hazards which may be taken up by livestock.

Table 6.6: Primary chemical hazards in livestock

Livestock
Agricultural and veterinary chemical residues
Environmental contaminants
Cadmium and heavy metals

6.4 Illness associated with meat and meat products

Meatborne outbreaks in Australia during the period 1990-2002, due primarily to the manufacturing process, indicate salmonellae as the most common cause (Table 6.7).

Table 6.7: Meat-borne outbreaks associated with the processing sector in Australia 1990-2002 (Sumner *et al.* in press)

Year	Product	Hazard	Cases (deaths)
1994	Pork sausage	*S.* Enteritidis	14
1996	Unknown*	*E. coli* O157	6
1996	Meat rolls	*S.* Typhimurium PT 135	71
1996	Cold roast meat	*C. perfringens*	33
1997	Unknown*	*S.* Typhimurium PT 43	7 (1?)
1997	Unknown*	*S.* Chester	25
2000	Asian food	*S.* Typhimurium RDNC	6
2000	Asian food	*S.* Typhimurium PT 44	11

* Meat was the suspected vehicle

Table 6.8: Meatborne outbreaks in Australia in the food service sector in 1991-2002 (Sumner *et al.* in press)

Year	Product	Hazard
1995	Roast pork	*S.* Typhimurium PT9
1999	Pork	*C. perfringens*
1993	Roast beef or pork	*C. perfringens*
1991	Curry and rice	*C. perfringens*
1994	Spit roast	*C. perfringens*
1997	Curry & rice	*C. perfringens*/*S.* Typhimurium PT 135
1997	Roast lamb	*C. perfringens*
1997	Pork Rolls	*S.* Typhimurium PT 1
1999	Pan rolls	*S.* Hessarek
1999	Roast lamb	Viral
2000	Thai beef salad	*Salmonella*
2000	Lamb curry	*C. perfringens*
2000	Roast beef or pork	*C. perfringens*
1998	Steak roll	Unknown
1997	Pork rolls	*S.* Typhimurium PT 1
1996	Meat rolls	*S.* Typhimurium PT 135
1993	Roasted, minced beef	*C. perfringens*
1997	Beef casserole	*C. perfringens*
1999	Meat pie	*C. perfringens*
1999	Pizza	*E. coli* O157
2001	Kebabs	*Salmonella*
2001	Eye fillet meal	*S.* Typhimurium PT 99
2001	Lambs fry	*S.* Typhimurium PT 99
2001	Beef curry	*C. perfringens*
2001	Reef and Beef meal	*C. perfringens*
2002	Lamb curry	*C. perfringens*
2002	Spit roast beef and/or pork	*C. perfringens*

Outbreaks where the catering setting was considered the prime importance during the period 1991-2002 (Table 6.8) indicate *C. perfringens* as the most common cause with illness also due to *Salmonella* and pathogenic *E. coli*.

6.5 Recalls of meat and meat products

Meat and poultry products involved in Australian recalls (Table 6.9) were predominantly cooked, cured meat and poultry, plus uncooked fermented meats. The causes of recall were microbiological and foreign matter.

Table 6.9: Meat products recalled In Australia 1990-2004 (July)

Fresh sausage	6
Minced meat	6
Other	1
Total	13

6.6 Microbiological quality of Tasmanian meat produced at VSPs

Since 1998, MHS has routinely monitored the microbial status of meats produced by VSPs. Methodology used is set out in the Microbiological Guidelines to the Australian Standard (2002:4696) and the results of these surveys are summarised in Table 6.10. A comparison may be made with data from thirteen similar (very small) premises in South Australia (Sumner *et al.* 2003) where the mean log TVC/cm^2 for beef carcases was 1.81 (2.4 in Tasmania) and for sheep carcases 2.44 (2.9 in Tasmania).

It should be noted that the SA survey was carried out over a one-week period in March 2002 during a prolonged dry period; by contrast Tasmanian data reflect five years of sampling during all seasons.

Table 6.10: Microbial quality of meat produced at Tasmanian slaughterhouses (1999-2004)

	Samples (n)	Log Total Viable Count/cm^2			*E. coli*	
		Mean	Maximum	SD	Prevalence (%)	Mean of positives
Beef	816	2.4	4.8	0.9	14.2	4.4
Sheep	1023	2.9	5.0	0.7	24.9	5.2
Pigs	530	2.3	4.7	0.8	14.3	2.3

Domestic "abattoirs" collect their own data which are appraised by MHS officers at audit. Export establishments submit microbiological data to AQIS for entry on the *E. coli Salmonella* Monitoring (ESAM) database.

6.7 Risk scenarios

Recently, Meat and Livestock Australia undertook a risk profile of the Australian meat industry (Sumner *et al.* in press) and the findings apply to the Tasmanian industry.

In the red meat sector, high risk hazard:product pairings identified were meals contaminated with *Clostridium perfringens* provided by caterers which have not implemented HACCP; kebabs cross-contaminated by *Salmonella* present in drip trays or served undercooked; meals served in the home cross-contaminated with *Salmonella*.

Medium risk hazard:product pairings identified were undercooked hamburgers contaminated with EHEC; kebabs contaminated by *Salmonella* under normal production or following final "flash" heating.

Identified low risk hazard:product pairings included cooked, ready-to-eat sausages contaminated with *Salmonella*, well cooked hamburgers contaminated with EHEC and pathogens in meat cuts which are roasted, grilled, barbecued etc.

6.8 Issues surrounding the red meat industry

In view of the overall compliance of companies and the industry in general with the Microbiological Guidelines which accompany the *Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption* (AS 2002:4696) it is recommended that MHS:

1. Undertake microbiological product testing of carcases from VSPs on an annual basis (note that other states e.g. Queensland have an annual testing regime).
2. Maintain responsibility for taking samples via officers taking samples (if testing could be linked with audit this would be most cost-effective for MHS and companies).
3. Arrange for analysis of samples at an authorised laboratory.
4. Maintain the database on a company and industry basis.
5. Continue a proactive stance with companies regarding their testing results.
6. Concentrate testing more towards carcase hygiene rather than surface testing.

7 Smallgoods

7.1 Regulation

Smallgoods manufacturers are regulated under the Food Standards Code (Standard 3.2.1) by local authorities. Production at plants with an integrated slaughter/smallgoods facility are regulated by MHS under the *Meat Hygiene Act 1985* which defers to the *Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption* (AS 2002:4696).

7.2 Practice

No consolidated list exists which identifies the State's smallgoods manufacturers, their products or the processes used. It is thought that there are around six smallgoods manufacturers in the State and, currently, all are regulated by local government. It is not known whether manufacturers operate to the Australian Standard or the Food Standards Code. Those manufacturers which service the major supermarket chains are audited by third-party auditors. As part of regulatory requirements under the *Food Act 2003*, they are also inspected at intervals by EHOs.

In addition to the main manufacturers smallgoods are processed by most, if not all, retail butcher shops in the State. It is estimated that there are around 130 butcher shops (Eric Johnson, pers. comm.). No consolidated list of manufacturers, products or processes is available. It is believed that uncooked, comminuted fermented meats (UCFM) are not produced by retail butchers.

7.3 Illness associated with smallgoods

The vast majority of outbreaks and illnesses have stemmed from fermented meats, with *Salmonella* and pathogenic *E. coli* the causes (Table 7.1). Thus, in Australia over the last decade, there have been almost 400 cases of foodborne illness involving smallgoods that were of sufficient severity to require medical treatment; there were at least three deaths from consumption of contaminated meat.

Table 7.1: Meat-borne outbreaks associated with the processing sector in Australia 1990-2002 (Sumner *et al.* in press)

Year	Product	Hazard	Cases (deaths)
1991	Salami	*S.* Anatum	>120
1992	Salami	*S.* Typhimurium	>20
1995	Salami	*E. coli* O111	>150 (1)
1997	Cured, cooked meat	*S.* Muenchen	24 (2)
1997	Cured, cooked meats	*S.* Anatum	25
1997	Unknown*	*S.* Chester	25
2000	Sucuk (fermented sausage)	*S.* Typhimurium PT 170	6
2001	Fermented sausage (home-made)	*S.* Typhimurium PT 135a	3
2002	Uncooked fermented meat (cacciatore)	*E. coli O157*	1

* Meat was the suspected vehicle

In the food service sector there have been two outbreaks during the period 1991-2002 associated with smallgoods (Table 7.2).

Table 7.2: Reported meat and meat-associated outbreaks in Australia in the food service sector in 1991-2002 (Sumner *et al.* in press)

Year	Product	Hazard
1998	Ham	*Sh. sonnei* biotype G
2000	Frankfurters	*S.* Typhimurium PT 9

7.4 Recalls of smallgoods

In Australia, there have been a total of 48 recalls of smallgoods during the period 1990-July, 2004. Around 50% of recalls were for cooked, cured meats contaminated with *E. coli*, while most of the 19 recalls for UCFM were associated with the 1995 Mettwurst incident.

Table 7.3: Meat and poultry products recalled In Australia 1990-2004 (July)

Bacon	1
Cooked and cured meat	26
Fermented sausages	19
Slow cured meat	1
Pâté	1
Total	48

7.5 Risk scenarios

The National Risk Validation Project identified fermented and manufactured meats as high-risk products, requiring mandatory Food Safety Plans (FSPs) for their manufacture. Other States are currently implementing uptake of FSPs for retail butcher shops.

Recently, Meat and Livestock Australia undertook a risk profile of processed meats. No high risk hazard:product pairings were identified.

Medium risk hazard:product pairings identified were ready-to-eat meats contaminated with *Listeria monocytogenes* and which have extended shelf life, Uncooked Comminuted Fermented Meat (UCFM)/Salami contaminated with Enterohaemorrhagic *E. coli* (EHEC) and *Salmonella*;

Identified low risk hazard:product pairings included UCFM/Salami contaminated with *Listeria monocytogenes*.

In the Tasmanian context, two scenarios are developed for the present study based on a smallgoods manufacturer making UCFM with a process which has not been validated by the controlling authority. Since 1996 it has been necessary to file a process for UCFM manufacture for approval/verification by the controlling authority; in some cases processes have been referred to a FSANZ expert panel for advice. The primary criterion for acceptance of a process was the perceived ability to reduce the level of generic *E. coli* in the UCFM batter by 99.9% (3-log reduction).

More recently, Clause 9 of Standard 1.6.2 of the Food Standards Code was implemented in which manufacturers are required to develop a protocol of assessment which must include the following control parameters:

- use of starter culture and starter culture specifications
- pH monitoring and nature of monitoring
- fermentation time and temperature
- maturation time and temperature
- water activity or weight loss
- temperature of meat storage
- monitoring of *E. coli* in raw materials
- monitoring of *E. coli* in final products
- review of previous history/records

Thus, manufacture of UCFM is a highly-regulated operation in which manufacturer and controlling authority (and their auditing agents) are required to have competence in a range of process hygiene disciplines (e.g. the effect of temperature, time, water activity and pH on inactivation of Gram-negative pathogens). Assistance is provided by recourse to the FSANZ expert panel and by information in *Guidelines for the safe manufacture of smallgoods* (pub MLA).

Scenario 1: Enterohaemorrhagic *E. coli* (EHEC) in UCFM

In this scenario comparison is made between UCFM made by a process which is adequate and one which is not, the latter operating in breach of Standard 1.6.2. Risk Ranger outputs are summarized in Table 7.4 (see Appendix 1.1 for details of inputs to Risk Ranger).

The risk rating for an adequate process is 15 with illnesses predicted only rarely. An inadequate process, however, rates 51 (1,000,000-fold increase in risk with 5 cases of EHEC per annum). The difference in inputs is in the ability of the process to inactivate EHEC, possibly by not having correct starter cultures which allows the hazard to increase. No other "negative" aspects are included from this scenario of a manufacturer processing in breach of Standard 1.6.2.

Scenario 2: *Salmonella* in UCFM made from game meat

In this scenario UCFM is made from game meat trimmings (venison and wallaby) by a manufacturer who does not operate Standard 1.6.2. While there are no published data on prevalence and concentration, data from South Australia (Department of Health) indicates that kangaroo trim may have *Salmonella* at 40% prevalence.

The risk rating for UCFM manufacture using an inadequate process from game meat is 57 with an estimated 60 illnesses per annum (Table 7.4).

7.6 Issues surrounding the smallgoods industry

The present situation where legislative responsibility is decided by whether there is a slaughter facility linked with a smallgoods manufacture could lead to inconsistency and there is a need for:

1. DHHS/LG and DPIWE to consider regularising responsibility for managing the smallgoods sector in Tasmania either under the Australian Meat Standard or the Food Standards Code; this need will become more acute when more than 100 butcher shops are required to implement FSPs
2. Production of a consolidated list of smallgoods manufacturers, their products and processes with special reference to manufacturers of UCFM.
3. A uniform approach to managing food safety risks in the sector based on scheduled and unscheduled audit of the FSP by auditors registered with QSA.
4. A proactive approach to the sector involving training based on MLA's *Guidelines for the safe manufacture of smallgoods*.
5. Assessment of the degree to which each manufacturer's processes have been validated. A Gold Standard approach similar to that implemented by PIRSA would be an effective *modus operandi*.

Table 7.4: Risk rating EHEC and *Salmonella* in UCFM produced by adequate and inadequate processes

	EHEC		*Salmonella*
	Adequate process	Inadequate process	Game meat
1.Hazard severity	Moderate	Moderate	Moderate
2.Population susceptibility	General	General	General
3. Frequency of consumption*	Twice weekly	Twice weekly	Monthly
4.Proportion consuming (%)*	5	5	5
5.Total population	50,000	50,000	50,000
6. Proportion (%) of raw product contaminated (concentration)	0.01% (0.1/g; 5/serve)	0.1% (0.1/g; 5/serve)	40% (1/g; 50/serve)
7. Effect of processing on hazard	Usually eliminates (99% reduction)	Increases (100%)	No effect on hazard
8.Post processing contamination rate (%)	Nil	Nil	Nil
9.Post processing control	Not relevant	Not relevant	Not relevant
10. Increase required	20,000x	10x	200x
11.Effects of preparation before eating	No effect	No effect	No effect
Predicted cases	2 in 1,000,000 years	5/annum	60/annum
Risk Rating	15	51	57

A change in risk rating of "6" is equivalent to a 10-fold change in risk
* Answers to these questions based on assumptions

8 Game meat

8.1 Regulation

Game meat establishments are regulated under the *Meat Hygiene Act 1985* and operate in accordance with the *Australian Standard for Hygienic Production of Game Meat for Human Consumption* (AS 4464:1997). The Standard mandates Quality Assurance (QA) plans which are HACCP-based and Codex-compliant. The Act is administered by MHS.

8.2 Practice

MHS regulates some 13 game premises located statewide including on King, Flinders, Trefoil and Great Dog Islands, of which eight premises process exclusively muttonbirds. A consolidated list is available of processors, products and processes.

Production of game meats (excluding mutton birds) is summarised in Table 8.1 and is based on slaughter of wallaby, possum, rabbit/hare and wild turkey.

Table 8.1: Production of game meats in Tasmania (1996-2003)

	Production (kg)
1996	69617
1997	58055
1998	50974
1999	67999
2000	61642
2001	63654
2002	67512
2003	86018

MHS regulates the game meat industry by audit of plant-operated systems which are based on QA/HACCP concepts. Over the period 1999-2004 some 66 audits have been undertaken of the industry.

MHS undertakes routine sampling of game meats for microbiological analysis for which summary data are presented in Table 8.2. For deer and wallaby carcases the mean TVC was log 2-3; *E. coli* were detected on 3-20.5% of carcases.

Table 8.2: Summary statistics for game meat carcases processed at very small plants and at game meat establishments (1999-2004)

	Samples (n)	Log Total Viable Count/cm^2			*E. coli*	
		Mean	Maximum	SD	Prevalence (%)	Mean of positives
Very small plants						
Deer*	73	2.0	3.5	0.9	20.5	0.8
Wallaby	44	2.3	4.3	1.0	13.6	1.0
Game meat establishments						
Wallaby**	35	2.9	4.5	0.9	3	1

* All deer are farmed, hence, not classed as ‘game’ in Tasmania. Culling feral deer for human consumption is currently not permitted by DPIWE’s Nature Conservation Branch.
** Also contain data for rabbit, goat and possum

In 2004, regulation of mutton birds passed to MHS. An initial survey of mutton bird processors indicates all are in compliance with the Australian Standards for either game meat or poultry, as appropriate.

8.3 Risk scenarios

Risks for game meat are identical with those of red meat (see Section 6.7) except when used as ingredients for UCFM (see scenarios in Section 7.5)

8.4 Issues surrounding the game meat industry

The game meat industry is based on a number of culled species and operates both at the domestic and export levels. While consolidated lists of game meat manufacturers exist, DPIWE should:

1. Evaluate production at all game meat plants against the FSP
2. Sample product for microbiological testing at all game meat plants (product at some plants has either not been monitored, or very few samples have been taken
3. Investigate the recorded prevalence of *E. coli* of 3% (this is much lower than that recorded in other states for kangaroo carcases) to confirm sampling and testing are being properly carried out
4. Cooperate with DHHS and local government to survey use of game meats in the smallgoods sector
5. Collaborate with the Australian Food Safety Centre at the University of Tasmania for example, in establishing appropriate microbiological testing criteria for muttonbird processing, specifically in relation to indicator organisms.

9 Poultry

9.1 Regulation

Poultry processors are regulated under the *Meat Hygiene Act 1985* and operate in accordance with the *Australian Standard for Construction of Premises and Hygienic Production of Poultry Meat for Human Consumption* (AS 4465:2001). The standard mandates Quality Assurance (QA) plans which are based on the Hazard Analysis Critical Control Point (HACCP) concept. The Act is administered by MHS.

Transport of poultry meat from processing plants to retail premises is covered by the *Food Act 2003* and is administered by DHHS/LG.

9.2 Practice

MHS regulates some five premises processing poultry meat. A consolidated list of processors products and processes is available. As can be seen from Table 9.1, poultry meat production has increased in recent years so that almost 7 million birds are produced in the State annually. More than 6 million chickens are processed by one national manufacturer, with the remainder also including turkey and quail. All five plants process chickens, while one also processes turkeys and another processes quail.

Table 9.1: Production of poultry meat in Tasmania (1996-2003)

	Poultry (,000)
1996	5180
1997	4968
1998	3646
1999	5777
2000	5481
2001	4586
2002	6283
2003	6989

9.3 Illness associated with poultry

It is generally accepted that poultry is responsible for a large proportion of the salmonelloses and campylobacterioses in Australia which annually amount to around 6,000 and 16,000 cases, respectively.

9.4 Recalls of poultry

In Australia during the period 1990-July, 2004 there were nine recalls of poultry products mainly for presence of *E. coli* and of foreign matter.

9.5 Microbiological status of poultry carcases in Tasmania

A survey was carried out during 2001 of all five poultry processors of which all but one are classified as Very Small Premises (VSP) for the purposes of Meat Standards Committee poultry guidelines for microbiological testing. The summary data (Table 9.2) indicate a mean log TVC of 2.70/cm^2 with *E. coli* detected on 36/69 (44%) of carcases.

Table 9.2: Summary microbiological data of Tasmanian poultry meat (2001)

Samples	Log TVC/cm^2			
	Mean	SD	Minimum	Maximum
n=69	2.70	0.9	1.40	4.06

Meat Standards Committee poultry guidelines for microbiological testing contain criteria for assessing performance (Table 9.3).

Table 9.3: Performance categories for TVC and *E. coli* on poultry

Category descriptor	TVC/cm^2	*E. coli*/cm^2
Excellent	<5.000	<10
Good	5,000-50,000	10-100
Acceptable	50,000-500,000	100-1,000
Marginal (for TVC) Action required (for *E. coli*)	500,000-1,500,000	>1,000

Surveys of microbial quality of poultry carcases have also been undertaken by South Australia (Sumner *et al.* 2004) and New South Wales and, since the testing methodology is identical, comparison can be made of the performance of the industry in each State against MSC criteria (Tables 9.4 and 9.5).

Table 9.4: Conformance (%) with MSC criteria for TVC

	SA	NSW	Tasmania
Excellent	99	65	91
Good	1	28	9
Acceptable	0	5	0
Marginal	0	1	0

Table 9.5: Conformance (%)with MSC criteria for *E. coli*

	SA	NSW	Tasmania
Excellent	65	28	48
Good	27	37	14
Acceptable	7	26	35
Action required	1	9	3

As indicated in Tables 9.4 and 9.5, the SA industry shows better conformance with MSC performance criteria than do either the NSW or Tasmanian industries. While the latter falls just behind SA in terms of TVC performance, conformance with *E. coli* criteria is inferior with 38% of birds rated in the “Acceptable” or “Action required” categories. It should be emphasized that the SA government survey data was a starting point for industry improvement in that State, following up with a detailed survey of hazard management in all plants which culminated in an industry workshop of plants and auditors.

9.6 Risk scenarios

Of the approximately 150 salmonelloses and 600-700 campylobacterioses which are notified each year in Tasmania raw poultry was probably a prime cause in an unknown proportion, though it is believed that this proportion is probably high. There is increasing evidence that many campylobacterioses may result largely from cross contamination either to finished (cooked) chicken or to uncooked accompaniments e.g. salads. It may be that salmonelloses from poultry have a similar mechanism. Unfortunately cross contamination is difficult to model for the purpose of assessing risk.

Other than by reducing the prevalence (and concentration) of Gram-negative pathogens in raw poultry there is little that can be done to reduce the prevalence of disease from consumption of poultry. It is within the responsibility of DPIWE to optimize the FSPs of all Tasmanian poultry processors.

It is believed that South Australia will begin, in late-2004, a radical initiative to reduce prevalence of pathogens on raw poultry. It may be that, by being a partner in this initiative, DPIWE can have a real effect on the burden of disease from poultry.

9.7 Issues surrounding the poultry industry

While a consolidated list of poultry processors exists, DPIWE should:

1. Ensure the list is comprehensive and contains all very small poultry plants
2. Evaluate the food safety management of all processors against a Gold Standard, similar to that undertaken by PIRSA
3. Adopt a proactive stance towards industry improvement
4. Undertake systematic microbiological monitoring of product from all processors (a survey of 69 samples in 2001 is the sole industry database)
5. Work proactively with initiatives in other States to radically reduce the prevalence of *Campylobacter* and *Salmonella* in poultry

10 Eggs

10.1 Regulation

From 2004, egg processors are regulated under the *Egg Industry Act 2002*. The Act is administered by MHS. Transportation and retailing of eggs are regulated by DHHS/LG.

10.2 Practice

As can be seen from Table 10.1, value of egg production has increased in recent years to more than $10 million in 2003. In 2001-02 around 53 million eggs were produced in the State, almost entirely chicken eggs. Current lists indicate 22 growers in Tasmania; this list requires updating.

Table 10.1: Value of egg production in Tasmania (1996-2003)

	Poultry ($m)
1996	9.7
1997	8.9
1998	11.4
1999	9.6
2000	4.5
2001	8.9
2002	10.1
2003	10.3

The Act incorporates QA programs, Food Safety, Environmental Management Systems, Animal Welfare, Labelling and Biosecurity.

10.3 Illness associated with eggs

During 1991-2002, there were 26 incidents in Australia where eggs, either alone or as ingredients, were suspected as the cause of salmonellosis (Table 10.2). A number of incidents were associated with aged-care institutions where raw egg drinks were the cause; there is evidence that despite being illegal under the FSC, cracked eggs from non-commercial sources were used.

Table 10.2: Incidents where foods containing eggs were implicated as the cause of salmonellosis

Year	State	Vehicle	Serovar/Phage type	No. Ill (Deaths)
1991	VIC	Gelati	*S.* Typhimurium PT 135	47
1996	NSW	Egg flip	*S.* Typhimurium PT 9	13 (1)
1996	QLD	Anglaise sauce/ chocolate parfait	*S.* Heidelberg PT 16	(500+)
1996	QLD	Curried egg sandwiches	*S.* Typhimurium RDNC	52 (1)
1996	VIC	Mayonnaise	*S.* Typhimurium U 307	36
1998	NSW	Curried egg	*S.* Typhimurium PT 135	11*(8)
1998	VIC	Unknown	*S.* Virchow PT 34	12(22)
1998/99	VIC	Custard cake/ fresh pasta	*S.* Typhimurium STM 9	54
1999	NSW	Fish with egg sauce	*S.* Typhimurium PT 135	16
1999	QLD	Egg nog	*S.* Heidelberg PT 1	7(7)
1999	QLD	Tiramisu/ chocolate mousse	*S.* Typhimurium PT 8	49
2000	ACT	Mayonnaise	*S.* Typhimurium PT 9	
2000	QLD	Egg & lettuce sandwiches	*S.* Mbandaka	27
2000	WA	Mock ice-cream dessert	*S.* Typhimurium PT 135	53(79)
2001	NSW	Caesar dressing/mayonnaise	*S.* Potsdam	4(4)
2001	QLD	Egg nog	*S.* Heidelberg PT 1	12
2001	SA	Mango pudding	*S.* Typhimurium PT 64	28

Year	State	Vehicle	Serovar/Phage type	No. Ill (Deaths)
2001	SA	Potato pie & rice pudding	*S*. Typhimurium PT 135	18(38)
2001	SA	Tiramisu	*S*. Typhimurium PT 135	10(20)
2001	SA	Pastry custard tart with strawberries & jelly glaze	*S*. Typhimurium PT 126	16
2001	WA	Fried ice-cream	*S*. Typhimurium PT 64	38*(28)
2002	QLD	Salmon/egg/onion/rice patties	*S*. Typhimurium PT 135	10
2002	QLD	Egg sandwiches	*S*. Typhimurium PT 135	16
2002	QLD	Asparagus & egg dish	*S*. Hadar PT 22	3
2002	SA	Caesar salad	*S*. Typhimurium PT 8	78(111)
2002	VIC	Hedgehog	*S*. Typhimurium PT 170	9(4)

* Includes person-to-person transmission as secondary infection

10.4 Recalls of egg products

Except for recalls involving undeclared egg and related allergen concerns, according to the FSANZ database from 1991 until the present there have been no recalls of eggs or products in which the egg component was contaminated.

10.5 Risk scenarios

OzFoodNet (http://ozfoodnet.org.au/index.htm) established an epidemiological link with eggs in 26 outbreaks. The only hazard identified among these outbreaks was *Salmonella*, with *S*. Typhimurium accounting for 73% of the outbreaks and *S*. Heidelberg 11.5%. *Salmonella* Enteritidis PT4 has not been isolated from intact eggs in Australia and extensive epidemiological evidence does not support locally acquired infection with this phage type.

Of major importance is the storage regime (temperature and time) for eggs through the chain from grading floor to use by the consumer. The term Yolk Mean Time (YMT) has been coined to define the period during which *Salmonella* present within the egg will be prevented from multiplying due to natural inhibitory and physical barriers. When the YMT is resolved growth can be rapid if eggs are held at ambient temperature. It is estimated the YMT for eggs stored at 16°C is 26 days and for those stored at 20°C, 17 days. Given that outer barriers may have been breached by cracks, it is possible that YMT is much shorter in cracked eggs.

A number of scenarios exist which impose increased risk through consumption of eggs, particularly of cracked eggs. Cracked eggs may be more likely to be contaminated with *Salmonella* and the concentration may also be higher. Cracked eggs from larger processors are pulped into egg fractions (white, yolk and whole egg). From smaller operators, however, they may enter the trade and form an ingredient in products which receive either no (egg drinks, egg butter, mayonnaise) or little heat treatment ("cold" puddings).

Scenarios are presented (Table 10.3) with enhanced risk involving eggs which have resolved YMT in:

- Eggs used in lightly cooked egg dishes (e.g. soft boiled eggs)
- Raw egg drinks
- Egg butter used in Asian pork rolls made from cracked eggs

Meals in which eggs are lightly cooked e.g. soft boiled eggs had a risk rating of 54 with 18 estimated annual illnesses in Tasmania. The process (2-log reduction) was inadequate to eliminate the 5-log increase predicted to occur during the period after YMT was resolved.

Raw egg drinks made from eggs which had resolved YMT had a risk rating of 54 and predicted illnesses of 15/annum in Tasmania.

Egg butter in which cracked eggs were used (illegally) for Asian meat rolls had a risk rating of 62 with 23 predicted illnesses each year in Tasmania.

More detail of inputs to Risk Ranger are given in Appendix 1.2.

10.6 Issues surrounding regulating the egg industry

There is a lack of knowledge of the Tasmanian egg industry and the following elements need urgent attention by DPIWE:

1. Production of a consolidated list of producers and processors
2. Assessment of each operation's management of food safety against a Gold Standard
3. Reconciliation of egg production with egg utilisation with special reference to small (non-commercial) producers
4. Estimation of cracked egg production and identification of any illegal use (i.e. eggs not submitted for heat processing at a recognised establishment)
5. Cooperation with DHHS and local government to prevent use of cracked eggs in retail and catering, particularly for institutional care.
6. Communication and collaboration with LG about the new Egg Act and respective roles and functions.

Table 10.3: Risk ratings for *Salmonella* from eggs with resolved YMT in slightly cooked meals, raw egg drinks and in egg butter

Risk criteria	Slightly cooked meals	Raw egg drinks	Egg butter on Asian rolls
Dose and severity			
Q1. Hazard severity	Moderate	Moderate	Moderate
Q2. Susceptibility	General	General	General
Probability of exposure			
Q3. Frequency of consumption*	Monthly	A few times a year	A few times a year
Q4. Proportion consuming*	Most (75%)	Some (25%)	Most (75%)
Q5. Size of population	500,000	500,000	25,000
Probability of contamination			
Q6. Probability of raw product contaminated	0.004%, 0.1/g	0.004%, 0.1/g	0.04%, 1/g
Q7. Effect of processing	No effect (washing etc)	No effect (washing etc)	No effect (add butter)
Q8. Possibility of recontamination	Nil	Nil	Nil
Q9. Post-process control*	100,000x increase	100,000x increase	1,000x increase
Q10. Increase to infective dose	10,000x	10,000x	1,000x
Q11. Further cooking before eating	Usually eliminates (99%)	No effect	No effect
Predicted illnesses per annum in selected population	18	15	23
Risk rating (0-100)	54	54	62

A change in risk rating of "6" is equivalent to a 10-fold change in risk
* Answers to these questions based on assumptions

11 Dairy

11.1 Regulation of the industry

The industry is regulated by an autonomous body, the Tasmanian Diary Industry Authority (TDIA) under the *Dairy Industry Act 1994*. The legislation enables the TDIA to regulate the industry based on modern food safety management practices including Codex-based HACCP systems and audit protocols via second and third parties. Manufacture of ice cream and retailing of dairy products are regulated by DHHS/LG under the *Food Act 2003*.

11.2 Practice

The Tasmanian dairy industry comprises:

- 560 dairy farms (bovine)
- 140,000 dairy cows
- 120 tanker drivers
- 100 vendors
- 1 sheep milk farm
- 8-9 goat milk producers
- 28 processors

Around 600 million litres of milk are produced each year and processed as indicated in Table 11.1.

Table 11.1: Major dairy processors in Tasmania

Company	Volume ($Lx10^6$)
Bonlac (Wynyard and Spreyton)	400
Cadbury (Cooee)	70
Lactos (Burnie)	70
Classic Foods (Edith Creek)	35
National Foods (Hobart)	35

The ambit of the TDIA extends from dairy farms to domestic and export processing via a range of documented systems:

- Tasmanian On Farm Food Safety (TOFFS)
- TOFFS Audit Protocol
- Tasmanian Code of Practice for Dairy Food Safety
- Food Safety Plan Verification Report
- Quality Systems for Tasmanian Dairy Factories
- Quality Assurance Support Services
- Code of Practice for Managing Dairy Farm Effluent

The audit system is operated by auditors registered with the Quality Society of Australasia (QSA) and complies with the AQIS Criteria for State Authorities Conducting Export Inspection.

The TDIA licenses milk and cream vendors, of which there are about 100 across the State and all of whom need to implement a FSP.

11.3 Illness from dairy products

In Table 11.2 are listed outbreaks in which dairy products were the cause and, in Table 11.3 are listed recalls of dairy products over the period 1990-July 2004. In all, in Australia there were 79 recalls of dairy products, mainly involving cheese (31 recalls), liquid milk (19) and ice cream (15).

Reasons for the recalls were microbiological in 70% cases, with foreign matter and chemical contamination making up the remainder (Table 11.4).

Table 11.2: Causes of dairy-borne outbreaks in Australia, 1996-2001

Organism	State	Cases	Outbreaks	Cause
Salmonella Oranienberg	SA	102	1	Gelati
Salmonella Typhimurium PT 44	SA	11	1	Raw milk
Campylobacter	SA	12	1	Raw milk
Cryptosporidium	Qld	6	1	Raw milk (pet cow)
Campylobacter (suspected)	Vic	6	1	Raw milk (suspected)

Table11.3: Recalls of dairy products as monitored by FSANZ (1990-2004)

Product category	Number of recalls
Cheese	31
Butter	1
Cream	4
Milk	19
Yoghurt	5
Ice cream	15
Cream cheese	1
Custard	2
Milk powder	1
Total	79

Table 11.4: Causes of recalls of dairy products as monitored by FSANZ (1990-2004)

Cause of recall	Number
Contamination - detergent	5
Contamination - chemical	4
Foreign matter	13
Labelling	2
Spoilage	12
E. coli	13
L. monocytogenes	24
Salmonella	3
S. aureus	3
Total	79

11.4 Risk scenarios

Two risk scenarios are presented:

- *Salmonella* in ice cream
- *Listeria monocytogenes* in dips

In the first scenario the manufacturer produces around 20t/annum of specialist ice creams which contain “organic” fruits and eggs. No food safety plan is required and, although milk is pasteurized, eggs from a small producer are added without sufficient heat treatment to eliminate all Gram-negative pathogens.

In the scenario 25% of eggs used have resolved YMT and salmonellae have increased to 100,000 cfu/g. Since eggs comprise 1% of the weight of the ice cream the loading in the product is 1000 cfu/g. Since frozen storage can cause some reduction in concentration of Gram-negative pathogens a 50% reduction is factored in prior to consumption.

As seen from Table 11.5, Risk Ranger predicts 150 illnesses per annum from the 200,000 serves manufactured with a risk rating of 54.

In the second scenario a small operation produces dips with added vegetables and herbs. No food safety plan is used and the premises are not adequate to prevent entry of *L. monocytogenes*. Dips are consumed by very few (5%) of Tasmanians a few times a year. Although only 1% of serves are recontaminated with *L. monocytogenes* at a concentration of 0.1 cfu/g, a 21-day storage life under refrigeration allows a 1,000-fold increase in the pathogen with predicted illnesses of 75/annum and risk rating of 52 (Table 11.5). More detail of each Risk Ranger question is given in Appendix 1.3.

Table 11.5: Risk ratings for *Salmonella* in ice cream and *L. monocytogenes* in dips

Risk criteria	*Salmonella* in ice cream	*L. monocytogenes* in dips
Dose and severity		
Q1. Hazard severity	Moderate	Moderate
Q2. Susceptibility	General	General
Probability of exposure		
Q3. Frequency of consumption*	Monthly	A few times a year
Q4. Proportion consuming*	Very few (5%)	Very few (5%)
Q5. Size of population	500,000	500,000
Probability of contamination		
Q6. Probability of raw product contaminated	0.001%, 0.1/g	0.001%, 0.1/g
Q7. Effect of processing	Complete elimination	Complete elimination
Q8. Possibility of recontamination*	1% at 10 cfu/g (1000/serve)	1% at 0.1 cfu/g (5/serve)
Q9. Post-process control*	Well controlled – no increase	1,000x increase (5,000/serve)
Q10. Increase to infective dose	10x increase	10,000x increase
Q11. Further cooking before eating	Slight reduction (50%)	No effect
Predicted illnesses per annum in selected population	150	75
Risk rating (0-100)	54	52

A change in risk rating of “6” is equivalent to a 10-fold change in risk
* Answers to these questions based on assumptions

11.5 Issues for the dairy industry

1. Currently, TDIA are responsible for all dairy processing except manufacture of ice cream, which is regulated under the Food Act 2003. This is considered anomalous and, given the expertise required to audit dairy operations, consideration should be given to defining “ice-cream” and bringing relevant ice cream manufacturers under the Dairy Industry Act 1994.
2. Products such as dips and pates have dairy products as a major component and consideration should be give to regulating manufacturers under the Dairy Industry Act 1994.
3. There are numerous small operators within the dairy industry producing a diverse range of products. TDIA and DHHS/LG should, as a matter of urgency, compile a consolidated list of manufacturers and their processes and products.

12 Seafood

12.1 Regulation of the industry

The Licensing and Administration Branch of the Primary Industries Division regulates processors via the *Living Marine Resources Management Act 1995* (LMRMA) and the *Inland Fisheries Act 1995* (IFA); small operators processing <10t/annum are not licensed. The Acts are intended primarily for licensing Tasmania's fishery, They have no food safety emphasis in the same way that the *Meat Hygiene Act* or *Dairy Industry Act*.

Regulatory responsibility for the abalone and oyster sectors is shared between DPIWE, DHHS and AQIS. The roles are well defined:

- DHSS is responsible for monitoring oyster leases, for their closure and reopening.
- DPIWE is responsible for relaying oysters.
- AQIS audits the Tasmanian Shellfish Quality Assurance Program (TASQAP).

It is stated (C. Midgeley pers. comm.) that there are also a large number of processors currently exempted under the LMRMA licensing requirements. However, like other seafood processors, these are regulated under the *Food Act 2003*.

12.2 Practice

In 2000-01, Tasmanian fisheries production was valued at $m307 (Table 12.1).

Table 12.1: Value of main fishery sectors in the Tasmanian industry

Species	Value ($ x10^6)	Volume (t x 10^3)
Abalone	129.4	2.7
Rock lobster	58.0	1.5
Wild caught fish	3.6	1.2
Salmonids	95.3	12.2
Oysters	14.4	5.2
Giant crab	2.6	0.1
Total	306.7	23.4

The Licensing and Administration Branch has consolidated lists of all operators within the various sectors of the State's seafood industry (Table 12.2).

Table 12.2: Operators in the Tasmanian fishing industry and applicable legislation

	Number of operators
Inland Fisheries Act 1995	
Freshwater fish farms and hatcheries	14
Freshwater eel licences	12
Fish dealers	26
Living Marine Resources Management Act 1995	
Marine farmers	110
Fishing vessels	850
Fish processors (not premises)	85*
Fish handlers	10

* Approximately 50% are registered with AQIS

No consolidated list of processors, products or processes exists for those companies regulated under the *Food Act 2003*.

Around eighty operations are registered by AQIS (Table 12.3).

Table 12.3: Operations registered with AQIS

	Number of operators
Vessels (factory boats)	6
Live fish exporters	11
Storage premises	11
Fish processors	44*
Registered buildings (non export)	9

* Three have an Approved Quality Arrangement (AQA) and 31 have a Food Processing Arrangement (FPA)

12.3 Illness associated with seafoods

In Table 12.4 are collated seafood-based outbreaks in Australia over the decade 1990-2000, since which time there have been additional outbreaks of ciguatera and norovirus in imported oyster meat. The data in Table 12.4 serve to illustrate the profile of seafood-borne illness in Australia. Relevant for Tasmania is an outbreak of listeriosis from imported smoked mussels where the use-by date had been extended by the retailer.

Table 12.4: Causes of seafood-borne outbreaks in Australia, 1990-2000

Category	Cases	Outbreaks	Cases/outbreak
Ciguatera	616*	10	12
Histamine	28	10	3
Viruses	1737	3	579
Bacterial pathogens	159	6	27
Biotoxins	102	3	34
Total	2642	32	82

* Includes an annual estimate of 48 cases/annum in coastal Queensland (Lehane and Lewis, 2000)

12.4 Recalls of seafoods

In Table 12.5 are listed national seafood recalls monitored by FSANZ during the period 1993-July, 2004. In all, there were 50 recalls of seafoods, 36 for microbiological and 14 for chemical hazards, some of which involved imported products.

Table 12.5: Recalls of seafoods as monitored by FSANZ (1993-July, 2004)

Product category	Number of recalls	Defects
Microbiological		
Canned seafood	7	Faulty seams or gas production
Smoked seafood	19	*E. coli*
Shellfish	6	Microbiology
Frozen seafood	3	Microbiology or packaging
Cooked seafood	1	*S. Lexington*
Subtotal	36	
Chemical		
Reef fish	1	Ciguatera
Shellfish	6	Biotoxin
	1	Aflatoxin
	1	Zinc
	1	Lead
Canned fish	3	Histamine
Shellfish	1	Additive
Subtotal	14	

12.5 Risk scenarios

In Table 12.6 is presented a scenario illustrating the effect of the Tasmanian Shellfish Quality Assurance Program (TSQAP). The only variable differing between a managed and unmanaged system is the prevalence of norovirus contamination, a figure of 15% being used, based on the prevalence of hepatitis A in the Wallis Lake incident. Risk ratings are 25 and 55 for consumption of oysters from managed and unmanaged waters, respectively with illnesses of the order of one every century from a managed fishery compared with 2250 illnesses/annum under an unmanaged system.

Table 12.6: Risk characterisation of consumption of norovirus contamination of oysters from approved and restricted waters during an unmanaged incident

	Waters under a Shellfish QA Program (SQAP)	Unapproved water, no SQAP
Dose and severity		
Hazard severity	Mild	Mild
Susceptibility	General	General
Probability of exposure		
Frequency of consumption*	Monthly	Monthly
Proportion consuming*	Some (25%)	Some (25%)
Size of population	500,000	500,000
Probability of contamination		
Probability of raw product contaminated*	0.0001% contaminated	15% contaminated
Effect of processing	Does not eliminate the hazard	Does not eliminate the hazard
Possibility of recontamination	None	None
Post-process control	Not relevant	Not relevant
Increase to infective dose	100x	100x
Further cooking before eating	None	None
Total predicted illnesses per annum in selected population	1 per century	2250
Risk rating (0-100)	25	55

A change in risk rating of "6" is equivalent to a 10-fold change in risk
* Answers to these questions based on assumptions

DPIWEs Primary Industries Division license the harvesting of clams for resource management purposes, and a similar difference in risk rating exists between a managed system (illness measured in century timeframe) and an unmanaged system during a hazardous algal bloom (hundreds of illnesses).

There are a number of large smoked seafood operations in the State which, because they export, are registered with AQIS. However, should a small processor enter the business for domestic consumption only, the operation could be undertaken without a FSP. The risk of *L. monocytogenes* contamination would approximate that established for production of dips without a FSP (see Section 11.4).

12.6 Issues for the seafood industry

1. There is confusion over the stage of processing at which "substantial transformation" occurs but, in the finfish sector, it is believed to be at sea. This locates responsibility with DHHS/LG.
2. The Licensing and Administration Branch licenses premises for resource management purposes while DHHS/LG enforces the *Food Act 2003*.
3. There are two high risk product categories in the seafood sector e.g. oysters and smoked seafoods. While the former is regulated to a high level of compliance with a Gold Standard by TSQAP, the latter is not and DHHS/LG, in collaboration with DPIWE should:
   - Produce a consolidated list of producers and processors.
   - Assess each operation's management of food safety against a Gold Standard
4. Currently, food safety programs are not required for domestic processors, despite the potential risk associated with some seafood products (shellfish and smoked products).

13 Vegetables

13.1 Regulation of the industry

The Vegetable and Associated Industries Branch of DPIWE has no statutory responsibility for food safety. The industry is regulated by the *Food Act 2003* via local government officers. Use of recycled water is regulated by the Environment Division of DPIWE.

13.2 Practice

Tasmanian vegetable production in 2002 was around 500,000t with a value around $231 million. In terms of volume, main production was from potatoes, onions, carrots and peas (Table 13.1).

Table 13.1: Production of vegetables in Tasmania (2002)

	Volume (t)
Beans, French and runner	12721
Broccoli	8594
Carrots	35745
Cauliflowers	6625
Celery	222
Cucumbers	25
Peas	25793
Lettuces	1923
Marrows	447
Mushrooms	1090
Onions	62975
Parsnips	195
Potatoes	350134
Pumpkins	1963
Sweet corn	106
Tomatoes	994
Total	509,552

More than 90% of production is said to be processed by McCain Foods at Smithton and Simplot Australia Pty Ltd at Ulverstone. There is no consolidated list of processors, products or processes.

The main functions of the Vegetable and Associated Industries Branch of DPIWE are in extension and in development of activities such as new crop development, integrated pest management, sustainable production systems, irrigation and water use. It has functional linkages with the Tasmanian Institute for Agricultural Research (TIAR).

The Branch helps with implementation of on-farm QA programs such as Nature's Choice and SQF 2000. It has also assisted growers to meet the requirements for third party QA systems such as those that are required to supply vegetables for processing.

13.3 Illness from vegetables

A range of vegetable products have cause food poisoning outbreaks both in Australia (Table 13.2) and overseas (Table 13.3); the latter are included to illustrate the wide range of products and pathogens.

Table 13.2: Food poisoning outbreaks in Australia associated with vegetables

Year	Product	Pathogen	Cases
2001	Salad	Norwalk virus	25
2001	Iceberg lettuce	*S.* Bovismorbificans PT 32	36

Table 13.3: Outbreaks associated with intact products in contact with soil and/or water

Product	Country	Organism	Ref
Salad	UK	*S.* Enteritidis PT4	1
Potato salad	UK	*S.* Enteritidis PT4	1
Lettuce, tomato	UK	*E. coli* O157	1
Mixed salad	UK	*E. coli* O157	1
Lettuce	US	*E. coli* O157:H7	2
Salads	US	*E. coli* O157	4
Lettuce	UK	*Campylobacter*	1
Salad vegetables	UK	*Shigella flexneri*	1
Salad	UK	*Shigella sonnei*	1
Iceberg lettuce	UK, GDR, Sweden	*Shigella sonnei*	5
Baby corn	Denmark	*Shigella spp*	4
Parsley	US	*Shigella spp*	3
Lettuce	US	*Hepatitis A virus*	2
Carrot	UK	Small Round Structured Virus	1
Salad (mixed)	UK	Small Round Structured Virus	1
Salad (green)	UK	Small Round Structured Virus	1
Salad (raw)	UK	Small Round Structured Virus	1
Salad (raw)	UK	Small Round Structured Virus	1
Watercress	UK	Small Round Structured Virus	1
Celery	US	Norwalk virus	2
Onions	US	*Cryptosporidium* sp	2
Mesclun lettuce	US	*Cyclospora cayetanensis*	2
Lettuce, onion	US	*Giardia lambia*	4
Basil	US	*Cyclospora cayetanensis*	3

1: Personal communications to the EU Commission; 2: Tauxe *et al.* (1997); 3: US FDA (2000)
4: Anonymous (2000); 5: Gilbert (2000); 6: Taormina *et al.* (2000)

13.4 Recalls of vegetables

National recalls over the period 1990-July, 2004 are recorded in Table 13.4.

Table 13.4: Recalls of vegetables recorded by FSANZ 1990-July, 2004

Date	Product	Cause
1990	Potato salad	Metal
	Canned beetroot	Underfilling
1995	Onion dip	*E. coli*
1996	Parsley	*E. coli*
1997	Pickled vegetables	Chemical contamination
	Vegetables	Plastic
2003	Coleslaw	*E. coli*
	Spinach	Foreign matter
	Lettuce	*E. coli*

Table 13.5: Outbreaks associated with cut, sliced, skinned and shredded products

Product	Organism	Location	Reference*
Shredded lettuce	*Shigella*	US	2
Coleslaw	*E. coli O157*	US	4
Cabbage?	*E. coli*	Canada	5
Sliced raw vegetables	*Giardia lambia*	US	4

* References listed beneath Table 13.3

In Table 13.5 are presented details of overseas outbreaks associated with processed horticulture products. In each case the contaminant is thought to have entered the products from faeces, either directly from the field or via water during processing.

All the hazards, above, are microbial, usually of faecal origin. In the Tasmanian context the use of reclaimed water for irrigation should be considered. Work has been done on the implications for growers of using reclaimed water (*Environmental Guidelines for the use of recycled water in Tasmania* by Dettrick and Gallagher; December 2002). The report considers microbial hazards, especially faecal bacteria and identifies FSPs as the mode of pathogen control.

The Branch noted the use of recycled water and believes it is used mainly for growing dry harvested crops such as poppies and cereals where irrigation ceases several weeks prior to harvest. This water is also used on pastures for livestock production. It is believed local government has arrangements with farmers adjacent to settling ponds for water to be applied for irrigation purposes. Neither of the vegetable processing companies issue production contracts for crops grown using recycled water. The Branch is aware constraints are imposed by councils on the use of recycled water, but not the specifics of the constraints.

Since harvesting and washing do not substantially transform the product it seems logical that processing by growers is DPIWE's responsibility and, for this reason, it is recommended that DPIWE undertake surveillance on use of reclaimed water.

13.5 Risk scenarios

In Table 13.6 are developed scenarios for two pathogen:product pairs of importance for the vegetable sector. A qualitative matrix has been used because little information is available on the vegetable industry in the state e.g. list of processors, processes and products. Use of a qualitative matrix establishes that faecal pathogens on washed vegetables and *L. monocytogenes* in packaged vegetables are Moderate and High risk pairings respectively, but without industry knowledge, no closer definition of risk from Tasmanian products can be made.

Table 13.6: Microbiological hazard risk rating for pathogens in processed vegetables

Severity	Occurrence Risk	Growth in product required to cause disease?	Production/process/ handling ↑↓→ hazard	Consumer terminal step?	Epidemiology link?	Risk Rating
Faecal pathogens in washed vegetables						
High	Low	No	→	No	Yes	Moderate
***L. monocytogenes* in packaged vegetables**						
Severe	Moderate	No	↑	No	Yes	High

13.6 Issues for the vegetable industry

There is a lack of knowledge of the Tasmanian vegetable industry and the following elements need urgent attention by DPIWE and DHHS/LG:

1. There is confusion at the operational level about which entity is responsible for legislating vegetable production/processing which is to be encompassed by a PPPS. Because of the definition of primary production, local government consider DPIWE responsible but there is no legislation under which DPIWE can act.
2. There is also confusion on the use of treated water. DPIWE has developed guidelines for its use but at the production/processing level these guidelines defer to company food safety plans.
3. Production of a consolidated list of producers and processors.
4. Assessment of each operation's management of food safety against a Gold Standard.

14 Fruits

14.1 Regulation of the industry

The Horticulture Branch of DPIWE has no statutory regulation pertaining to the industry which is regulated under the *Food Act 2003* by DHHS/LG.

14.2 Practice

The State produces around 53,300t of fruit (excluding grapes), the vast bulk of which is apples. The value of fruit production in 2002 was $76 million (Table 14.1).

Table 14.1: Fruit production in Tasmania

	Volume (t)
Apples	51617
Pears	681
Apricots	88
Cherries	542
Strawberries	397
Total	53325

Fruit processing in Tasmania includes:

- Drying of apricots, apples and cherries
- Juice manufacture (apples, blackcurrants)
- Washing of fruit
- Solid pie packs of apples

14.3 Illnesses caused by fruit

In Tables 14.2 and 14.3 are listed outbreaks in which fruit was implicated in Australia and overseas, respectively, the latter serving to illustrate an extended range of products:pathogen combinations.

Table 14.2: Food poisoning outbreaks associated with horticulture products

Year	Product	Pathogen	Cases (Deaths)
1990	Unpasteurised orange juice	Norwalk virus	>3,000
1999	Unpasteurised orange juice	*S.* Typhimurium *135a*	502

Table 14.3: Outbreaks associated with fruit products

Product	Organism	Location	Ref*
Shredded coconut	*S.* Java PT Dundee	US	5
Cantaloupe salad	*S.* Poona	US, Canada	5
Watermelon	*Salmonella*	US	2
Fruit salad	*Giardia lambia*	US	4
Melon	*S.* Javiana	US	2
Cantaloupe	*S.* Chester	US	2
Tomato	*S.* Javiana	US	2
Meney	*S.* Typhi	US	3
Mango	*Salmonella spp*	US	3
Raspberries	*Hepatitis A virus*	UK	2
Strawberries	*Hepatitis A virus*	US	2
Tomato	*Hepatitis A virus*	US	2
Salad (raw)	Small Round Structured Virus	UK	1
Tomato	Small Round Structured Virus	UK	1
Raspberries	*Cyclospora cayetanensis*	US, Canada	3

* References listed beneath Table 13.3

14.4 Recalls of fruits

Over the period 1990-2001, there were 81 national recalls of horticulture products monitored by FSANZ, a proportion of which were imported products (Table 14.4). The causes of recall were microbiological in 45/81 (56%) of cases, foreign matter in 18/81 (22%) with chemical and labelling defects accounting for the remainder. Note that recalls associated with canned fruits and vegetables where the cause was a canning defect *per se* have not been included.

Table 14.4: Recalls of fruit products, 1990-July, 2004

Date	Product	Cause
1990	Orange fruit juice	High sulphur dioxide
	Apple juice	Fermentation
1991	Canned peaches	Blown cans
	Paprika	*Salmonella*
	Apricot kernels	Hydrocyanic acid
	Dates	Insects
	Fruit juices	High sulphur dioxide
1993	Desiccated coconut	*Salmonella*
	Dried fruit	Rodent parts
	Cherries	Glass
1994	Shredded coconut	*Salmonella*
	Dates	Metal
	Fruit juice	Low preservative
	Desiccated coconut	*Salmonella*
1996	Dates	Foreign matter
	Fruit bars	Metal
	Orange juice	Metal
	Passionfruit	Microbial contamination
1997	Apple desert	Glass
1998	Desiccated coconut	*Salmonella*
	Fruit yoghurt	Labelling (peanuts)
1999	Coconut	Chemical contamination
	Fruit juices	*Salmonella*
	Sultanas	Labelling (peanuts)
	Coconut	*Salmonella*
	Fruit salad	*E. coli*
	Apples	Glass
2000	Sundried tomato pesto	Labelling (peanuts)
	Sultanas	Labelling (peanuts)
2002	Desiccated coconut	*Salmonella*
2003	Grape juice	Spoilage
	Strawberry puree	Underprocessing
	Dried prunes	Labelling

In Table 14.5 are presented outbreaks associated with unpasteurised fruit juices. In each process there was no Critical Control Point for the organisms, all of faecal origin. All the hazards, below, are microbial, usually of faecal origin – either via irrigation or airborne. In the Tasmanian context, the use of reclaimed water for irrigation should be considered.

Table 14.5: Outbreaks associated with fruit juices

Product	Organism	Location	Reference*
Melon & papaya	SRSV	UK	1
Apple juice	*E. coli* O157:H7	US	2
Apple juice	*S.* Typhimurium	US	2
Apple juice	*Cryptosporidium* spp	US	2
Coconut milk	*Vibrio cholerae* 01	US	4
Orange juice	*S.* Hartford	US	2
Orange juice	*S.* Anatum	US	3
Orange juice	*S.* Typhi	US	3
Orange juice	*S.* Muenchen	US, Canada	3

* References listed beneath Table 13.3

14.5 Risk scenarios

In Table 14.6 are developed scenarios for three pathogen:product pairs of importance for the fruit sector. A qualitative matrix has been used because little information is available on the vegetable industry in the state e.g. list of processors, processes and products. Use of a qualitative matrix establishes that faecal pathogens on washed fruit, *L. monocytogenes* in prepared fruit salads and pathogenic *E. coli* in unpasteurised fruit juice are Moderate, High and High risk pairings, respectively. However, there is no industry knowledge which could further define risk from such products and the risk profiles are included to indicate risk, should there be any such processing in the State.

Table 14.6: Microbiological hazard risk rating for fruits and fruit juices

Severity	Occurrence Risk	Growth in product required to cause disease?	Production/process/ handling ↑↓→ hazard	Consumer terminal step?	Epidemiology link?	Risk Rating
Faecal pathogens in washed fruit						
High	Low	No	→	No	Yes	Moderate
***L. monocytogenes* in prepared fruit salads**						
Severe	High	No	↑	No	Yes	High
Pathogenic *E. coli* in unpasteurised fruit juice						
Severe	High	No	→	No	Yes	High

14.6 Issues for the fruit industry

There is a lack of knowledge of the Tasmanian fruit industry and the following elements need urgent attention by DPIWE and DHHS/LG:

1. There is confusion at the operational level about which entity is responsible for legislating fruit production/processing. Because of the definition of primary production, in some cases local government may consider DPIWE is responsible but there is no legislation under which DPIWE can act.
2. Production of a consolidated list of producers, processors and their products.
3. Assessment of each operation's management of food safety against a Gold Standard.

15 Extensive agriculture

15.1 Regulation of the industry

The Extensive Agriculture Branch of DPIWE is responsible for the *Seeds Act 1985*. Its main responsibilities are in industry development and extension. The branch has no function in food safety. The industry is regulated under the *Food Act 2003* via DHHS and local government.

15.2 Practice

Production of grain cereal was 70,000t in 2001, with a value of $13.5 million (Table 15.1).

Table 15.1: Grain production in Tasmania

Cereal for grain	t x 10^3
Barley	26
Oats	12
Triticale	10
Wheat	25

Seeds are used in:

- Malting
- Feedlots
- Sprouting

No consolidated list is held identifying processors, products and processes.

15.3 Illnesses caused by seed products

In Tables 15.2 is listed outbreaks from seed and nut products in Australia.

Table 15.2: Food poisoning outbreaks associated with seed products

Year	Product	Pathogen	Cases (Deaths)
1996	Peanut butter	*S.* Mbandaka	Several hundred (1)
2001	Peanuts	*S.* Stanley	27
2001	Helva (imported)	*S.* Typhimurium DT 104	23

In Table 15.3 are presented outbreaks following consumption of sprouts.

In October 2001, the Codex Committee on Food Hygiene (CCFH) developed draft codes of hygienic practice for fruits and vegetables, one focused on primary production and the other on processed products. The Codex Committee also focused on sprouts with a draft code on *Sprout production*. In 2002, the European Commission released a risk profile on microbiological contamination of fruits and vegetables eaten raw.

Within Australia, in May, 2002 the Technical Advisory Group of the Food Regulations Standing Committee considered food safety regulations relating to sprouts. FSANZ has included sprouts on a priority listing for bringing within an industry standard. It is generally agreed that outbreaks in Finland (1994 and 1995) and US (2001) were caused by seeds imported from Australia. A multi-state outbreak of salmonellosis caused by *S*. bovismorbificans in USA in 2004 was also linked with seeds imported from South Australia.

Table 15.3: Outbreaks associated with seed sprouts (1973-2001)

Year	Organism	Location	Cases	Type of sprout
1973	*B. cereus*	US	4	Soy, cress, mustard
1988	*S.* St Paul	UK	143	Mung
1989	*S.* Gold-coast	UK	31	Cress
1994	*S.* Bovismorbificans	Sweden, Finland	595	Alfalfa
1995	*S.* Stanley	USA, Finland	242	Alfalfa
1995	*S.* Newport	USA, Canada, Denmark	133	Alfalfa
1996	*S.* Montevideo, *S.* Meleagridis	US	ca 500	Alfalfa
1996	*E. coli* O157:H7	Japan	11,000	Radish
1997	*E. coli* O157:H7	Japan	126	Radish
1997	*S.* Meleagridis	Canada	78	Alfalfa
1997	*S.* Infantis, *S.* Anatum	US	109	Alfalfa, mung
1997	*E. coli* O157:H7	US	85	Alfalfa
1997	*S.* Senftenberg	US	52	Alfalfa, clover
1998	*E. coli* O157:NM	US	8	Alfalfa, clover
1998	*S.* Havana, *S.* Cubana, *S.* Tennessee	US	34	Alfalfa
2000	*S.* Enteritidis PT 4b	Netherlands	27	Mung
2001	*S.* Kottbus	US	24	Alfalfa

15.4 Recalls of seed and nut products

Recalls of seed and nut products over the period 1990-July, 2004 are listed in Table 15.4. The causes of recall were microbiological in almost all cases and involved local and imported produce.

Table 15.4: Recalls of seed and nut products 1990-July, 2004

Date	Product	Cause
1990	Walnuts	Faeces
1993	Peanut butter	Aflatoxin
	Peanut bar	Glass
	Peanuts	Aflatoxin
1994	Cayenne pepper	*Salmonella*
1996	Peanut butter	*Salmonella*
	Muesli bar	*Salmonella*
	Crushed nuts	*Salmonella*
1997	Muesli bars	*Salmonella*
	Peanut snack	Fungal contamination
	Water chestnuts	Microbial contamination
	Peanut snack	Aflatoxin
1999	Peanuts	Aflatoxin
	Pepper	*E. coli*
2000	Alfalfa sprouts	*E. coli*
	Pistachio kernels	Aflatoxin
	Hazelnut snack	Microbial contamination
2001	Pistachio kernels	Aflatoxin
	Halva with pistachios	*Salmonella*
2003	Alfalfa sprouts	*E. coli*
2004	Sesame seeds	*Salmonella*

15.5 Risk scenarios

In Table 15.5 is developed a scenario for *Salmonella* in sprouts and at least two companies supply sprouts to the supermarket chains. A qualitative matrix has been used because little information is available on the sprouting industry in the state e.g. list of processors, processes and products. The qualitative matrix establishes that *Salmonella* on sprouts is in the High risk category. In the absence of industry knowledge no further definition of risk can be made.

Table 15.5: Microbiological hazard risk rating for sprouts

Severity	Occurrence Risk	Growth in product required to cause disease?	Production/process/ handling ↑↓→ hazard	Consumer terminal step?	Epidemiology link?	Risk Rating
***Salmonella* in bean sprouts**						
High	Moderate	Yes	↑	No	Yes	High

15.6 Issues for the seeds industry

There is a lack of knowledge of the Tasmanian sprouting industry and the following elements need urgent attention by DPIWE and DHHS/LG:

1. There is confusion at the operational level about which entity is responsible for legislating sprout production/processing which is to be encompassed by the PPPS. Does germination and outgrowth of seeds to the sprout stage involve substantial transformation? If it does, DHHS/LG are responsible under the *Food Act 2003*. If it does not, DPIWE are responsible but lack legislation under which responsibility could be taken.
2. Production of a consolidated list of producers, processors and their products.
3. Assessment of each operation's management of food safety against a Gold Standard.

16 Apiary

16.1 Regulation of the industry

The Animal Health and Welfare Branch administers the *Animal Health Act 1996* and the *Animal Health Regulations 1996*. The *Food Act* 2003 covers food safety in honey manufacture.

16.2 Practice

The branch also facilitates the BQAL program and has run four workshops in Tasmania. In 2001-02 the value of the Tasmanian honey industry was $2 million; there are no data for production volume contained in the ABS annual return.

There are 259 registered apiarists with 18,300 hives, of which six apiarists own 90% of the hives. Tasmanian production is rich in leatherwood honey which, because of its usefulness in blending, is sold in bulk to large mainland companies.

Three packers supply the local supermarket system and also export. They have Food Safety Plans and the branch facilitates audits via a registered auditor in the State.

16.3 Illness from honey

There have been few reports of illness associated with honey and apiary products. Honey has caused cases of infant botulism, some of which have been linked with Sudden Infant Death Syndrome (SIDS). In many countries, including Australia, infant botulism is the most common form of botulism. It occurs in children under 1 year with 95% occurring in infants younger than 6 months. Infant botulism occurs when ingested spores of *C. botulinum* germinate, multiply and produce neurotoxin in the gastrointestinal tract. Intensive care facilities have reduced the incidence of death from infant botulism to around 2%.

Honey has been implicated as one source of the spores of *C. botulinum* and is not recommended for infants of less than 1 year. In one case, 80 spores/g were reported in one sample of incriminated honey (Midura *et al.*, 1979), but in a UK survey spores were not isolated from 122 samples (Berry *et al.*, 1987).

Royal jelly has also been implicated in a case of haemorrhagic colitis involving a 53-year-old woman. Prior to the onset of symptoms the patient had taken royal jelly for 25 days.

16.4 Recalls of honey

Table 16.1: National recalls of honey and honey-containing products as monitored by FSANZ (1990-2004)

Product category	Number of recalls	Defects
Honey coated peanut bar	1	Fungal contamination
Honey in glass jar	1	Glass

16.5 Chemical hazards

Several categories of chemicals have been associated with honey:

- Agricultural chemicals - pesticides, herbicides, rodenticides
- Antibiotics used to control bee diseases
- Heavy metals which accumulate in environments
- Cleaning compounds used to sanitise hives and processing equipment
- Naturally-occurring toxins e.g. Pyrrolizidine alkaloids (PAs)

16.6 Risk scenarios

There is no Critical Control Point in honey processing to prevent spores of *C. botulinum* entering honey, or to eliminate/reduce them to an acceptable level. Managing risk to the very young therefore involves advising mothers to avoid feeding honey to babies until their gut microflora has matured sufficiently to prevent spore germination and colonisation (usually 12 months).

In line with other primary production sectors, suppliers will be required to operate Food Safety Plans for production and processing of honey. The B-Qual system advocates a HACCP-based quality system but has not rigorously identified hazards, critical control points and critical limits for various agrichemicals, natural toxins such as PAs and antibiotics such as oxytetracyclene and chloramphenicol. NRS also does some testing

16.7 Issues for the industry

1. DHHS/LG should review its advice to mothers re feeding honey to neonates.
2. BQAL is voluntary – only 3 or 4 operators are in the scheme – DPIWE should consider promoting (or even mandating) the quality system.
3. Use oxytetracycline but only between honey flows (September-November)

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Appendix 1: Data and assumptions used in risk scenarios

1.1 Uncooked comminuted fermented meat

In this scenario the manufacturer operates outside of Standard 1.6.2, manufacturing around 12t of product per annum of which 10% is made from game meats (wallaby and venison). Product is retailed locally to a population around 50,000.

Question 1. Hazard Severity

For EHEC clinical manifestations in humans include diarrhoea, Haemorrhagic Colitis (HC), Haemolytic Uraemic Syndrome (HUS), and Thrombotic Thrombocytopenic Purpura (TTP). The average period between exposure and disease is 3 days, with most patients recovering within 7 days if they only suffer diarrhoea. Based on the above, "MODERATE hazard - requires medical intervention in most cases" was chosen as the response to Question 1.

For *Salmonella* MODERATE was also chosen, based on the apparent virulence of some serovars (*S.* Typhimurium, *S.* Virchow).

Question 2. How susceptible is the population of interest

For the current assessment, one population was considered: "GENERAL - all members of the population"

Questions 3 and 4. Frequency of Consumption

A nominal 50g serving size was chosen. Total consumption was based on the manufacturer producing 12t of product/annum (equivalent to 240,000 serves). This was consumed by FEW (5%) people in a Tasmanian city (50,000) which equates with each consuming UCFM twice weekly.

In the case of UCFM made from game meat there are 24,000 serves which equates with consumption every month.

Question 5. Size of Consuming Population

The local population is estimated as 50,000.

Question 6. Probability of Contamination of Raw Product per Serving

UCFM production from pork, beef

Based on MLA Baseline studies on beef and sheep meats (Vanderlinde *et al.* 1998; 1999; Phillips *et al.* 2001a; 2001b) and on pig meats (Coates *et al.* 1997), the prevalence of EHEC in raw materials for salami manufacture was assumed to be 0.1%. More recently, information on prevalence on beef carcases and trim over the period 1998-2002 was gathered as part of a submission to the United States Department of Agriculture (USDA), Food Safety Inspection Service (FSIS). EHEC was detected in 32/185,000 (0.01%) samples.

In Australia, as elsewhere, since there are no data available on concentration of EHEC in raw materials used in UCFM manufacture, throughout this study, assumptions were made based on material accumulated during the FAO/WHO risk assessment on *E. coli* in ready-to-eat foods.

While some risk assessments (FDA/USDA, 2000) have noted that pathogens are probably heterogeneously distributed in some foods, all to date have assumed that pathogens present in foods are distributed homogenously. This is a clearly a simplification.

A consequence of the assumption of homogeneity is that prevalence and concentration of pathogens in foods are often considered to be related properties particularly at very low concentrations. The observed prevalence will depend on the sample size and the extent of contamination of the batch. If the batch is contaminated at a level of >1cfu/g, there is high probability that, in each 25g sample, the pathogen of concern would be detected. If, however, the sample size were only 1g, some samples would not contain cells of the pathogen. If the contamination level were 1/100g, we would expect only one in four 25g samples to "test positive", and it is then more usual to describe this concentration as "25% prevalence".

In fact, the distribution of bacteria in a sample is likely to follow a Poisson distribution. In that case, if the mean concentration is X per gram, and there are Y grams per sample the count per sample is Poisson distributed with mean $X*Y$. More importantly, the probability of a positive result for a sample of Y grams is then: $1 - \exp(-X*Y)$. Thus, for large amounts of product, prevalence and concentration are related and that the estimate of the prevalence depends on the level of contamination and the sample size.

Similarly, products that permit the growth of pathogens may exhibit a low prevalence of contamination at the point of production and a higher prevalence at the point of consumption. This is not necessarily due to re-contamination, but may arise because the product was initially contaminated at a very low level. Subsequent growth in the product increases the probability of detection of that contamination.

Accordingly, in the present hazard:product profile, EHEC concentration was assumed to be 0.1/g.

UCFM from game meat

In the absence of data for prevalence of *Salmonella* in game meat trim in Tasmania, data from a South Australian survey by Department of Health of kangaroo meat at retail are used. In mid-2002, a survey was undertaken in Adelaide by Department of Health in which kangaroo samples were purchased at retail and samples (25g) tested for presence of *Salmonella*. Of 35 samples of kangaroo meat tested, 13 (37%, 21%-55% 95% CI) had *Salmonella*, while 15/35 (43%, 26%-61% 95% CI) of samples of kangaroo mince were positive.

For the present work a prevalence of 40% was used, with a concentration of 1/g.

Question 7. Effect of Processing

Based on the work of an MLA expert panel on smallgoods, and of Ross and Shadbolt (2001) on inactivation of *E. coli* during fermentation and maturation of UCFM, a reduction in EHEC during the UCFM process by 2 log (99%) was assumed.

Question 8. Recontamination

Recontamination was considered not to occur.

Question 9. Effectiveness of Post-processing Controls

Post-process controls were considered to be Not Relevant; it was assumed the level of pathogen does not change, though this assumption may be conservative as inactivation may occur during storage at ambient.

Question 10. Increase in the post-processing contamination level that would cause infection or intoxication to the average consumer.

UCFM infective dose

An infectious dose of 1,000 was chosen for healthy individuals which approximates that of ca. 2000 used by Cassin *et al.* (1998). For UCFM with a concentration of 5/serve an increase to infective dose of 200x is required.

Salmonella infective dose

Infective dose is often interpreted as the dose that leads to infection and illness in all of the people who consumed a contaminated food (ID_{100}). Traditionally, the infective dose has been reported around 10^6

Salmonella, based on human feeding trials from the 1940s and 1950s (FAO/WHO, 2002). More recently, factors such as age (especially children and the elderly) and food composition, especially high fat foods such as cheese or chocolate, have been associated with infective doses around or lower than100 cells. The fat content of UCFM may range to 35%. As well, FAO/WHO (2002) work based on outbreak data suggests an ID_{50} around 10,000 cells and this infective dose is used for the present exercise.

Thus, for UCFM with a concentration of 50/serve an increase to infective dose of 200x is required.

Question 11. Effect of preparation before eating

It is assumed that, during storage at ambient either at retail or in the home, no reduction in concentration of EHEC occurs.

1.2 Consumption of eggs in the Tasmania

Question 1. Hazard Severity

For *Salmonella* MODERATE was chosen, based on the fact that *S*. Typhimurium was implicated in over 70% of the 26 outbreaks in which OzFoodNet considered eggs the most likely source.

Question 2. How susceptible is the population of interest

For the current assessment, one population was considered: "GENERAL - all members of the population"

Questions 3 and 4. Frequency of Consumption

A nominal 50g (one egg) serving size was chosen. The flow of egg volume into each category is based on consumption patterns established in a risk profile currently being undertaken for the national egg industry with the assumption that eggs are consumed no differently in Tasmania from the national pattern. Thus, for the three scenarios selected the following patterns were used:

- Lightly cooked egg dishes: Most (75% of a population of 500,000) eat Monthly
- Raw egg drinks from cracked eggs: Some (25% of a population of 500,000) eat a few times a year
- Egg butter used in Asian meat rolls: Most (75% of a population of 25,000 Tasmanians who consumer Asian meat rolls) eat a few times a year

Question 5. Size of Consuming Population

The local population is estimated as 500,000.

Question 6. Probability of Contamination of Raw Product per Serving

A summary of overseas prevalence surveys of all non-SE *Salmonella* in egg contents established a prevalence of 0.004%. Prevalence data for barn laid and free-range eggs which represent approximately 10% of commercial production are unknown and are assumed to be the same as cage laid for these risk ratings.

While cracked eggs form a component of the industry there is no information on prevalence of *Salmonella*s. Accordingly, for the present study, cracked eggs were considered to have a 10-fold increased prevalence compared with uncracked eggs.

Question 7. Effect of Processing

It is assumed that the grading floor process, including washing has no effect on hazards.

Question 8. Recontamination

Recontamination was considered not to occur.

Question 9. Effectiveness of Post-processing Controls

This phase in the egg marketing chain represents time between the grading floor and consumption.

The term Yolk Mean Time (YMT) has been coined to define the period during which *Salmonella*s present within the egg will be prevented from multiplying due to natural physical and inhibitory barriers, particularly within the albumen. The term expresses of the interaction of storage time and temperature and capacity for growth from farm to retail for *S*. Typhimurium.

Yolk by contrast to albumen is an excellent growth medium for *Salmonella* and does not contain the inhibitory compounds found in albumen. Growth of *Salmonella* in yolk is rapid compared with albumen; typical generation times of <2 hours at 25°C have been reported, with Humphrey *et al.* (1994) determining counts up to 10^9 cfu/g egg pulp.

For the present analysis it was assumed that:

- 50% of cracked eggs are consumed before YMT is resolved
- Increase of 100,00x (5-log) occurs when YMT is resolved

Question 10. Increase in the post-processing contamination level that would cause infection or intoxication to the average consumer.

The FAO/WHO (2002) estimate of ID_{50} around 10,000 cells is used for the present exercise.

Question 11. Effect of preparation before eating

The end use pathway process has categorised egg meals and dishes into four groups (Table 1.2.1) based on their degree of pathogen reduction in preparation (Humphrey *et al* 1989). In the present scenarios thermal treatment is either absent (raw egg drinks) or light, leading to a 2-log reduction.

Table 1.2.1: Thermal inactivation of *S*. Typhimurium in typical egg meals (after Humphrey *et al.* 1989; Bates and Spencer 1995)

Thermal treatment	Decimal reduction	Types of meal
None		Raw egg drinks, some desserts
Light cooking	100-fold	*Boiled 4 min, fried (“sunny side up”), microwave
Medium cooking	10,000-fold	Fried (“easy over”), lightly scrambled or omelette, pasta
Heavy cooking	1,000,000,000	Hard boiled or scrambled, cakes, biscuits

* Where some liquid yolk remains

1.3 Consumption of dairy products

Two scenarios are followed:

- *Salmonella* in ice cream
- *Listeria monocytogenes* in dips

1.3.1 *Salmonella* in ice cream

The scenario is based on manufacture of ice-cream from raw materials and ingredients not subject to scrutiny under a food safety program. Although milk is pasteurized, eggs and berry fruit are added, with the potential for recontamination with *Salmonella*.

Question 1. Hazard Severity

For *Salmonella* MODERATE was chosen, based on the fact that *S*. Typhimurium was implicated in over 70% of the 26 outbreaks in which OzFoodNet considered eggs the most likely source.

Question 2. How susceptible is the population of interest

For the current assessment, one population was considered: "GENERAL - all members of the population"

Questions 3 and 4. Frequency of Consumption

The manufacturer produces 20t of product per annum, which equates with 200,000 serves of 100g. This is modeled as Very few (5%) Tasmanians consuming monthly.

Question 5. Size of Consuming Population

The local population is estimated as 500,000.

Question 6. Probability of Contamination of Raw Product per Serving

A prevalence of 0.001% of milk servings is assumed to be contaminated at a concentration of 0.1/mL.

Question 7. Effect of Processing

The process is sufficient to pasteurize milk. But the egg component is contaminated at 1,000 cfu/mL (YMT resolved). A one-log increase in the ice cream mix is selected to allow for 1:100 dilution of egg component in the ice cream mix to give a concentration of 10/g (1000/serve).

Question 8. Recontamination

Recontamination of 1% serves is assumed to occur causing contamination of ice cream mix at 1000 cfu/g (this is modeled by selecting 1000-fold increase at Question 7).

Question 9. Effectiveness of Post-processing Controls

Post-process storage is considered well-controlled (frozen storage) with no increase in contamination.

Question 10. Increase in the post-processing contamination level that would cause infection or intoxication to the average consumer.

Increase from 1000/serve to an ID_{50} of 10,000 cells is 10-fold.

Question 11. Effect of preparation before eating

If the frozen storage time is sufficiently long there is the possibility of some reduction and 50% reduction is assumed.

1.3.2 *Listeria monocytogenes* in dips

The scenario is based on manufacture of dips with added fruit or vegetables. Although milk is pasteurized, added ingredients bring the potential for recontamination with *E. coli*.

Question 1. Hazard Severity

For *E. coli* MODERATE severity was chosen.

Question 2. How susceptible is the population of interest

For the current assessment, one population was considered: “GENERAL - all members of the population”

Questions 3 and 4. Frequency of Consumption

The manufacturer produces sufficient product so that 50g serves are consumed by Few (5%) Tasmanians a few times a year.

Question 5. Size of Consuming Population

The local population is estimated as 500,000.

Question 6. Probability of Contamination of Raw Product per Serving

Raw milk is assumed to be contaminated with *E. coli* at a prevalence of 0.001% and a concentration of 0.1 cfu/mL.

Question 7. Effect of Processing

It is assumed that pasteurisation eliminates all pathogens.

Question 8. Recontamination

Recontamination with *E. coli* of 1% serves is assumed to occur at a concentration in the dip of 0.1 cfu/g (5 cfu/serve).

Question 9. Effectiveness of Post-processing Controls

Post-process storage over 21 days under refrigeration is assumed to allow a 3-log increase in *E. coli*. Thus a serve now has a *E. coli* loading of 5,000 cfu/serve.

Question 10. Increase in the post-processing contamination level that would cause infection or intoxication to the average consumer.

Increase from 5,000/serve to an ID_{50} of 50,000,000 cells is 10,000-fold.

Question 11. Effect of preparation before eating

Since dips are eaten cold there is no reduction in contamination level during meal preparation.

1.4 Consumption of seafoods

A scenario is presented which shows the effectiveness of the State's oyster monitoring protocol, compared with what might be expected were a system in place similar to that in the Wallis lake incident of 1997; the hazard is norovirus, responsible for three large outbreaks from oysters in NSW.

Question 1. Hazard Severity

For norovirus MILD severity was chosen.

Question 2. How susceptible is the population of interest

For the current assessment, one population was considered: "GENERAL - all members of the population"

Questions 3 and 4. Frequency of Consumption

A proportion of SOME (25%) of Tasmanians were considered to eat oysters once a month with a serving size of 100g (half dozen oysters).

Question 5. Size of Consuming Population

The local population is estimated as 500,000.

Question 6. Probability of Contamination of Raw Product per Serving

Oysters from approved waters were considered to have a prevalence of norovirus of 0.0001% compared with 15% from unapproved waters during a contamination incident.

Question 7. Effect of Processing

It was assumed that depuration and subsequent storage did not eliminate norovirus.

Question 8. Recontamination

Recontamination was considered not to occur.

Question 9. Effectiveness of Post-processing Controls

Post processing controls were considered to have no effect on prevalence or concentration of viruses.

Question 10. Increase in the post-processing contamination level that would cause infection or intoxication to the average consumer.

An increase of 100x was considered necessary for infection.

Question 11. Effect of preparation before eating

Product was eaten raw with no effect on norovirus.

Appendix 2: Risk Ranger

1 Background to developing Risk Ranger

If you're a risk manager you need to be able to compare and prioritise risks. There are a number of decision support tools which will rank or rate a hazard:product combination. There are several semi-quantitative scoring systems such as those by Pierson and Corlett (1992), shown in Table 1 and by Huss *et al.* (2000), which is illustrated in Table 2.

Table 1: Hazard Classification of Corlett and Pierson (1992)

Hazard	Risk characteristics
A	Special class restricted for at-risk populations, e.g. the aged immunocompromised, infants
B	Product contains sensitive ingredients
C	Process has no step which destroys sensitive organisms
D	Product is subject to re-contamination between processing and packaging
E	Potential for abuse by distributor or consumer which could render the product hazardous
F	Product is consumed without further process to kill micro-organisms

Table 2: Qualitative risk assessment based on the process of Huss *et al.*

Risk criteria	Raw molluscan shellfish	Canned fish	Dried fish
Bad safety record	+	+	-
No CCP for the hazard	+	-	-
Possibility of contamination or recontamination	+	+	-
Abusive handling possible	+	-	-
Growth of pathogens can occur	+	-	-
No terminal heating step	+	+	+
Risk category	High	Low	No risk

These tools can help you categorise risk but they can't measure the way individual factors affect because they don't focus on the steps or variables where control could be applied.

Risk Ranger is a simple food safety risk calculation tool intended to help determine relative risks from various product/hazard combinations it. In particular, it's intended to make the techniques of food safety risk assessment more accessible to non-expert users, and to users with limited resources, both as a decision-aid and an educational tool.

Risk Ranger incorporates all factors that affect the risk from a hazard in a particular commodity including:

- Severity of the hazard and susceptibility of the population of interest
- Likelihood of a disease-causing dose of the hazard being present in a meal
- Number of meals consumed by a population of interest in a given period of time

A number of factors affect each of the above.
Disease severity is affected by:

a) Intrinsic features of the pathogen/toxin
b) Susceptibility of the consumer

Exposure to the food will depend on how much is consumed by the population of interest, how frequently they consume the food and the size of the population exposed.

Probability of exposure to an infectious dose will depend on:

a) Serving size
b) Probability of contamination in the raw product
c) Initial level of contamination
d) Probability of contamination at subsequent stages in the catching-processing-distribution chain
e) Changes in the level of the hazard during the chain, including concentration or dilution, growth or inactivation of hazard

2 User Interface – the Risk Ranger shopfront

Risk Ranger has a "shopfront" with a list of boxes into which you enter information using your computer's mouse. In total, you need to answer eleven questions and a mathematical model then converts each answer to a numerical value or 'weighting'. The weightings are detailed in the paper by Ross and Sumner (2002). Some of the weightings are arbitrary, while others are based on known mathematical relationships e.g. from days to weeks, or years. To help you make your responses as objective as possible, and to maintain transparency of the model, descriptions are provided and many of the weighting factors are specified. As well, in some cases, if the options provided don't accurately reflect the situation being modelled, you can enter a numerical value by using "Other".
Behind the shopfront is the model, developed in Microsoft Excel software, using standard mathematical and logical functions. The list box macro tool is used to automate much of the conversion from qualitative inputs to quantities for calculations. For each selection you make from the range of options, the software converts that selection into a numerical value.

The Risk Rating value is a scaled logarithmically between 0 and 100. The former is equated to a probability of food-borne illness of less than, or equal to, one case per 10 billion people (greater than current global population) per 100 years. At the upper limit (Risk Rating=100), every member of the population eats a meal that contains a lethal dose of the hazard every day. A Risk Rating change of 6 corresponds to 10-fold difference in the absolute risk. Thus an increase in Risk Rating from 36 to 48 means that the risk increased 100-times.

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The Risk Ranger shopfront