Legionnaires' Disease:
Managing the Health Risk Associated with Cooling Tower and Warm Water Systems

Human Services

Peoplefirst

Regulatory Impact Statement
Health *(Legionella)* Regulations 2001

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Summary

The proposed *Health (Legionella) Regulations 2001* form part of a larger package of measures being implemented by the Victorian Government to reduce the risks of contracting Legionnaires' disease associated with the operation of cooling tower systems and warm water systems. The package of controls is based on the recommendations of the *Legionella* Working Party and on consultation undertaken with stakeholders during 1999-2000.

This Regulatory Impact Statement discusses the expected costs and benefits of the package as a whole, while clearly separating the discussion of the likely impacts - including cost estimations - of the proposed regulations with which it deals specifically. The reason for providing this broader policy context is that the package of measures is inter-dependent in nature and, as a result, the estimated benefits of its adoption can only be considered in the aggregate, rather than being distributed among the different regulatory and legislative elements.

The package of controls represents an innovative and comprehensive approach to the issue. It combines the adoption of proactive management requirements, through annually audited and reviewed risk management plans, enhanced monitoring through better testing and inspection of systems and better information flows, through the establishment of a register of cooling tower systems and an enhanced technical support and enforcement role for the Department of Human Services.

The proposed regulations will replace Division 3 of *the Health (Infectious Diseases) Regulations 1990*. The effect of these current regulations is to adopt "by reference" *the Guidelines for the Control of Legionnaires' disease*, published by the then Health Department Victoria in 1989. The regulations and guidelines prescribe requirements for the maintenance of cooling tower systems and warm water systems including cleaning, disinfection, water treatment to control bacteria and other problems, regular water testing and procedures for commissioning or re-commissioning systems. In addition, the guidelines set out requirements for addressing detected *Legionella* in systems and for addressing high bacterial counts.

The costs and benefits of the major elements of the control package are summarised below. The nett present value (NPV) of the package ranges from -$28.6 million to -$39.3 million. The range in NPV reflects different assumed values for the effectiveness of the package in reducing the incidence of Legionnaires' disease. These assumed values vary between 25% and 50% and are based on judgements as to the comprehensiveness of the package and the general performance of regulatory interventions in this area.

It must be emphasised that these NPV calculations do not incorporate any valuation of the lives that would be saved by the package of measures. It is estimated that 10 - 20 lives will be saved over 10 years. In addition, up to 1248 cases of Legionnaires' disease would be averted. Given the range of NPVs indicated, the implicit cost per life saved of the control package is in the range of $1.57 million to $4.21 million. This is a cost that falls within widely accepted benchmarks and compares favourably with a range of other possible policy interventions.

Costs and benefits of proposed package of controls over *Legionella* risk

Control	Costs (present value)	Benefits (present value) (PV)	Nett present value (NPV)
Health (Legionella) Regulations 2001	$19.6 million		
Building Act 1993 requirements	$26.4 million		
Other (non-regulatory)	$4.0 million		
Total	**$50.1 million**	**$10.8 to $21.5 million**	**(-$28.6 to -$39.3) million**

Note: It is not possible to calculate the PV or NPV for the individual elements of the package due to the uncertain and aggregated nature of the estimated benefits.

A range of policy alternatives was considered and rejected by the *Legionella* Working Party in the course of its deliberations and is documented in its report. These alternatives are canvassed in the Regulatory Impact Statement and their implications are discussed both qualitatively and quantitatively. It is concluded that no combination of these alternatives would provide a more effective or efficient system of control of *Legionella* risk.

Given these conclusions, and the high level of public concern regarding Legionnaires' disease evident in Victoria in recent years, it is proposed to make the *Health (Legionella) Regulations 2001* as part of an integrated package of measures to control and minimise the risks to the community posed by *Legionella* infection of cooling tower systems and warm water systems.

1. Introduction

Legionnaires' disease [1] is a potentially fatal respiratory disease caused by bacteria belonging to the genus *Legionella*. It particularly affects the elderly, the very young and the immuno-compromised. Sufferers are admitted to hospital in 95% of cases, generally for lengthy periods, and typically spend a portion of their hospital time in intensive care. For a minority of sufferers, the disease proves fatal, while a small proportion suffer permanent disablement as a result of the disease. In total, 82 people died from Legionnaires' disease in Victoria from 1979 to 1999. During the same period, 422 people were diagnosed with the disease and recovered. It is likely that a considerably larger number contracted the disease but were not correctly diagnosed.

Legionnaires' disease was first identified during the 1970s. Widespread agreement that the disease is frequently not correctly identified means that there is considerable uncertainty as to trends in its incidence. Mortality from the disease shows a slight increasing trend. Given that death rates are likely to have reduced due to earlier diagnosis and better treatment, this implies that incidence rates may be increasing somewhat more quickly. However, the relatively low absolute incidence of the disease combines with a high variability from year to year to make trends difficult to discern.

Despite this uncertainty as to incidence rates, public concern about the disease has increased significantly in recent years. This concern has been reinforced by a number of well-reported outbreaks of the disease, most recently that associated with the Melbourne Aquarium. The proposed regulations discussed in this Regulatory Impact Statement (RIS) form part of an integrated strategy being implemented by the Victorian Government to control the risks posed by *Legionella* and address public concerns in this regard.

The larger strategy for the control of the risks posed by *Legionella* bacteria was endorsed by Cabinet in June, 2000. The strategy substantially reflects the recommendations of the expert *Legionella* Working Party convened by the Department of Human Services (DHS), as published in its June 2000 paper *Legionnaires' Disease: Managing the Health Risk Associated with Cooling Towers* [2]. The remaining elements of this strategy will be implemented through amendments to the Building Act 1993 and the passage of new regulations under that Act, as well as through changes to the Plumbing Regulations 1998. Taken as a whole, this strategy will constitute a substantially new approach to the minimisation of the risks posed by *Legionella* by adopting pro-active hazard identification, risk assessment and risk control approaches, together with enhanced monitoring and control. It is expected to reduce substantially both the incidence of Legionnaires' disease and mortality from the disease.

It is necessary to introduce the elements of the strategy through a mix of different legislative instruments in order to reduce costs and duplication by combining new and existing duties where possible and taking advantage of existing sources of expertise. The present RIS relates specifically to the *Health (Legionella) Regulations 2001* but will, in addition, include discussion of the measures being taken under the other legislative powers noted above, and their likely impacts, wherever it is believed this will improve understanding of the subject matter. *The Health (Legionella) Regulations 2001* will be the first part of the legislative package relating to the control of risk associated with *Legionella* to be implemented. The remaining legislation and regulations are expected to be implemented within the next few months.

[1] In this document, the terms "legionellosis" and "Legionnaires' disease" are used in the same context and are interchangeable. Both terms refer to an acute infection caused by any bacteria belonging to the genus *Legionella*. Because the proposed regulations refer to the condition "legionellosis", discussion in this document regarding the requirements of the regulations refers to that term, while all other discussion refers to the more commonly used term "Legionnaires' disease".

[2] Legionnaires' Disease: Managing the Health Risk Associated with Cooling Towers Findings and Recommendations of the Department of Human Services Legionella Working Party. Public Health Division, DHS, Melbourne, June 2000.

DHS is engaging in a broad consultation process for the RIS. In addition to the statutory advertising requirements, the Department has circulated the RIS for comment to over 2500 stakeholders and will be conducting three public consultation forums.

The forums will include representatives of DHS, the Building Control Commission and the Plumbing Industry Commission, and provide overviews of the Government's *Legionella* package, this RIS and the proposed regulations.

The public consultation forums will be held as follows -

1.30 pm to 4.00 pm on Monday 11 December 2000
at Senior Citizens Hall,
Welsford Street
SHEPPARTON

9.30 am to 12.00 noon on Wednesday 13 December 2000
at Dandenong Town Hall
Main Hall, 226 - 228 Lonsdale Street
DANDENONG

1.30 am to 4.00 pm on Thursday 14 December 2000
at Altona Civic Receptions
Hall 1, 115 Civic Parade
ALTONA

9.30 am to 2.00 pm on Friday 15 December 2000
at Cooinda Centre
10 Leamonth Road, Wendouree
BALLARAT.

1.30 pm to 4.00 pm on Monday 118 December 2000
Armadale Reception Centre,
63 Desailly Street
SALE

The public forums will be open to all interested persons and, in this respect, invitations have been distributed to over 2500 organisations and individuals.

Comments or questions regarding the proposed regulations or this RIS should be directed to the Department of Human Services, which will have responsibility for the regulations. Contact details are given in Appendix 1.

2. Background

The control of risk from *Legionella* in Victoria is currently achieved via Division 3 of the *Health (Infectious Diseases) Regulations 1990*. Sections 25(1) and 25(2) of the regulations require the owner or manager of a cooling tower or warm water system to maintain the tower or system in a way that is consistent with the *Guidelines for the Control of Legionnaires' disease*, published by the then Health Department Victoria in May 1989. Thus, the guidelines are, in effect, incorporated into the regulations "by reference".

In response to rising public concern at the incidence of Legionnaires' disease, the Minister for Health established the *Legionella* Working Party in December 1999. The working party was requested to advise the Government on the enforcement of best practice for the maintenance of cooling tower systems to reduce the risk of Legionnaires' disease. Associate Professor Christopher Fairley, Department of Epidemiology and Preventive Medicine, Monash Medical School chaired the working party. It included representatives of the Municipal Association of Victoria, local government, the Australian Institute of Environmental Health, the Victorian Employers' Chamber of Commerce and Industry and government agencies. At the request of the Government, the working party was subsequently asked to review the experience of the recent major outbreak of Legionnaires' disease at the Melbourne Aquarium. The report of the working party was published in June 2000. Consultation with stakeholders has been conducted on the basis of the working party's report and has provided input to the shape of the final regulations.

3. Objectives of the Proposed Regulations

The objectives of the proposed regulations are:

- to minimise the incidence of legionellosis deriving from *Legionella* contamination of cooling tower systems and warm water systems.
  and
- to minimise the rate of mortality from cases of legionellosis due to infections originating from cooling tower systems and warm water systems.

These objectives are to be achieved through an integrated approach to the management of risk from these sources, as detailed in the following sections of this RIS.

4. The Nature and Impact of the Proposed Reforms

The strategy endorsed by Cabinet in June 2000 to improve controls over legionellosis is based around the following seven points:

1. establishment of a register of cooling tower systems to facilitate improved educative programs and enhanced outbreak investigations;
2. requiring risk management plans for the control of *Legionella* to be developed for all cooling tower systems;
3. requiring annual audit of risk management plans;
4. providing for an enhanced program of inspections of cooling tower systems on the basis of risk assessments or information received through audits;
5. requiring the regulation of cooling tower systems and warm water systems to be upgraded to improve levels of maintenance and enhance standards of practice;
6. providing an enhanced technical advisory service and an enhanced outbreak investigation service through the Department of Human Services; and
7. undertaking further consultation with industry to assess the impact of requiring a capital upgrade of existing cooling tower systems which do not meet the requirements of the Australian and New Zealand Standard AS/NZS 3666 [3].

Thus, the new approach to controlling the risks of *Legionella* combines upgraded capital and maintenance requirements with the adoption of a preventive, risk management-based approach, based on documented and independently audited risk management plans, plus enhanced information flows. This systematic approach is expected to improve significantly the ability of government and the owners and managers of cooling tower systems and warm water systems to manage and control the risks of *Legionella*.

The first three of the above control mechanisms are to be implemented via amendments to the *Building Act 1993*. Resources will be provided to enable the enhanced program of inspections referred to in point 4. The proposed *Health (Legionella) Regulations 2001* deal primarily with point 5. Point 6 does not require a legislative head of power, while any capital upgrade of existing cooling tower systems could be achieved through new regulations under the authority of the *Building Act 1993*.

Hence, the regulations to which this RIS refer are concerned with improving levels of maintenance and standards of practice in relation to cooling tower systems and warm water systems.

4.1. Outline of the Proposed Health *(Legionella)* Regulations 2001

A copy of the proposed Health *(Legionella)* Regulations 2001 is appended to this RIS as Appendix 2. The regulations provide for improved levels of maintenance and standards of practice in relation to both cooling tower systems and warm water systems.

The regulations define a number of terms, such as "biocide", "clean", "disinfect" and "responsible person", for the purposes of the regulations, and include the meanings of "cooling tower" and "cooling tower system" that have been adopted for the purposes of the regulations and the Government's wider package of measures.

It is worth noting that, while the proposed amendments to the *Building Act 1993* place obligations in respect of cooling tower systems on the "owner" of the land, as defined in the *Building Act 1993*, the proposed Health *(Legionella)* Regulations 2001 place all obligations, other than those of the Secretary of the Department of Human Services, on the "responsible person". For the purposes of the regulations, this term means "a person who owns, manages or controls the cooling tower system or warm water system.

This section now summarises the key provisions of the proposed regulations.

[3] Standards Australia/Standards New Zealand. 1995 and 2000. Australian/New Zealand Standard AS/NZS 3666. Air-handling and water systems of buildings – Microbial control. Parts 1 to 3. Standards Australia.

4.1.1. Key provisions of the proposed regulations in relation to cooling towers:

- cooling tower water must be kept clean and be treated with (a) biocide(s) to control the growth of *Legionella* and other micro-organisms; and (b) chemicals and other agents to minimize scale formation, corrosion and fouling;
- cooling tower systems must have a chlorine-compatible bio-dispersant added, and be disinfected, cleaned and re-disinfected before start-up, after shut-downs of more than one month duration and at intervals not exceeding six months;
- cooling tower systems must be inspected at least monthly to check that the systems are operating correctly;
- cooling tower water must be tested at least monthly to determine the heterotrophic colony count (HCC) - i.e. the total bacterial count of the system;
- where on testing the water is shown to contain more than 100,000 colony forming units (CFUs) of bacteria per millilitre, the water must be dosed with additional quantities of biocide or an alternative biocide to that being used; the water treatment program, tower operation and maintenance program must be reviewed; any faults must be corrected, and any changes necessary to prevent a re-occurrence of those faults must be implemented. The water must then be re-tested;
- where on re-testing the water is shown to contain more than 100,000 CFUs of bacteria per millilitre it must be disinfected, cleaned, re-disinfected and further re-tested;
- where on the further re-testing the water is shown to contain more than 100,000 CFUs of bacteria per millilitre, the above steps must be repeated until the bacterial count does not exceed 100,000 CFUs in two consecutive water samples taken approximately one week apart or, alternatively, the system must be closed until the problem has been remedied;
- where *Legionella* is detected in a system without any suspected or known case of legionellosis the system must be disinfected; the water treatment program, tower operation and maintenance program must be reviewed, any faults must be corrected, and any changes necessary to prevent a re-occurrence of those faults must be implemented. The water must then be re-tested;
- where on re-testing the water is shown to contain *Legionella* the water must be disinfected, cleaned, re-disinfected and further re-tested;
- where on the further re-testing the water is shown to contain *Legionella*, the above steps must be repeated until *Legionella* is not detected in two consecutive water samples taken approximately one week apart or, alternatively, the system must be closed until the problem has been remedied.

4.1.2. Key provisions of the proposed regulations in relation to warm water systems:

- systems are to be disinfected and cleaned immediately prior to start-up;
- systems are to be disinfected monthly by heat or chlorination, continuously by low-level chlorination or ultra-violet light treatment, or by an alternative method approved by the Secretary;
- outlets not in use for one week or more are to be flushed;
- thermostatic mixing valves are to be cleaned and maintained at least annually;
- where the method of disinfection of systems supplying health or welfare premises is by heat or chlorination, testing for *Legionella* is to occur three monthly for twelve months, and subsequently at six monthly intervals provided that *Legionella* has not been detected during the previous twelve months;
- where the method of disinfection of systems supplying any premises is by ultra-violet light treatment or a method approved by the Secretary, testing for *Legionella* is to occur monthly for the first twelve months, then three monthly thereafter, provided that *Legionella* has not been detected in the system during the previous twelve months;
- where *Legionella* is detected in a system without any suspected or known case of legionellosis the system must be disinfected, the system maintenance program reviewed, faults corrected as necessary and, alternatively, retesting to occur until no *Legionella* is detected in two consecutive samples taken approximately one week apart, or the system must be closed until the problem is remedied.

4.1.3. Generally applicable provisions

In addition to the above, the following provisions apply to both cooling tower systems and warm water systems -

- records must be kept up to date and on the premises of all systems maintenance, microbiological test results and approvals of different methods of maintenance;
- the records must be produced on request to an authorized officer;
- the Secretary of the Department of Human Services is given the discretion to approve the use of different methods of maintenance and testing in respect of any system and may make such an approval subject to any conditions (s) he or she sees fit, including the specification of an alternative maintenance and testing regime; and
- where a system is suspected of being the source of a case or an outbreak of legionellosis, the water of the system is to be promptly sampled for testing for *Legionella* and decontaminated in accordance with the instructions of the Secretary of the Department of Human Services.

4.2. Comparison of the proposed regulations with the current regulatory controls

The existing controls on the maintenance and standards of practice in relation to cooling towers and warm water systems are established by the *Health (Infectious Diseases) Regulations 1990*. Section 25 of these regulations states that whoever has "management or control" of a cooling tower or a warm water system must maintain it in a manner set out in the *Guidelines for the Control of Legionnaires'* disease, published by the Health Department Victoria in May 1989. They must also keep records of the maintenance and testing of the system, also in a manner consistent with the guidelines. The regulations also provide for the Chief General Manager (now the Secretary of the Department of Human Services) to approve an alternative method of maintenance or a different form of record-keeping from those specified in the guidelines.

The effect of these provisions is to incorporate the guidelines into the body of the *Health (Infectious Diseases) Regulations 1990* "by reference". This means that the guidelines effectively become part of the regulations.

In broad terms, the guidelines cover the same range of control measures as the proposed regulations. They also provide information and advice on a wide range of additional matters, including the microbiology of *Legionella*, the key elements of different types of cooling towers and warm water systems, other sources of *Legionella* infection and occupational health and safety considerations. In most regards (see below) the standards specified in the guidelines are similar to those contained in the proposed regulations.

However, a key difference is in the nature of the drafting of the guidelines. The guidelines are written in a discursive and advisory manner, rather than setting out clearly specified and enforceable requirements. This reflects their original purpose of providing "Information, advice and guidance.....for minimising the risk of significant contamination in waters of systems such as cooling towers and cold and heated water distribution systems" [4]. As a result, there are clear potential difficulties in terms of cooling tower and warm water system owners and managers determining what precisely are their obligations under the law and, conversely, in terms of ensuring the enforceability of the requirements established in the guidelines.

Consequently, a key difference between the proposed regulations and the current requirements is the establishment of a clear, enforceable set of requirements. This is expected to lead to considerably increased effective compliance, especially when combined with the requirement for annually audited risk management plans under amendments to the *Building Act 1993*. Beyond this threshold change, there are a number of specific differences between the existing controls and the proposed regulations. The similarities and differences between the proposed regulations and existing regulations/guidelines are summarised in Tables 1a and 1b.

[4] Guidelines for the Control of Legionnaires' disease. Health Department Victoria, May 1989, p1.

Table 1a: Comparison of provisions relating to cooling tower systems – proposed regulations vs existing regulations/guidelines.

Requirement	Proposed Regulations	Existing Regulations/guidelines
Cleanliness, functionality	System to be kept clean and free of scale, corrosion and fouling	Similar requirements
Biocide dosing	Required to prevent growth of *Legionella* and other organisms	Similar requirements
Pre-start-up requirements	Cleaning/disinfection prior to start up or after shutdown of more than one month	Similar requirements prior to commissioning. Post shutdown requirement not specified
System inspection	Monthly inspection of proper operation of system	Similar requirement
Bacteriological testing	Monthly laboratory testing for heterotrophic colony count (HCC)	Monthly testing for HCC), but dipslide testing allowed
Remedial action in case of HCC (total bacterial count)	If HCC exceeds 100,000 CFU/mL, biocide dosing, review of treatment and maintenance program, correction of faults and implementation of any changes necessary to prevent a re-occurrence of those faults, retesting, then while the HCC continues to exceed 100,000 CFU/mL, ongoing disinfection, cleaning, re-disinfection and retesting or closure of system	If HCC exceeds 500,000 CFU/mL, action is triggered. "May include" cleaning/disinfection, review of treatment program, repeat sampling
Regular cleaning/disinfection	Intervals not to exceed six months	Three monthly intervals; may be increased to six-monthly based on "relevant performance data"
Remedial action in case of *Legionella* detected (with no link to a suspected or known case of legionellosis)	Disinfection, review of treatment and maintenance program, retesting, and while *Legionella* is still detected ongoing disinfection, cleaning, re-disinfection and retesting or closure of system	No provisions
Remedial action in case of link between cooling tower and suspected or known case of legionellosis	Test water for *Legionella;* decontaminate as directed by Secretary	Test water for *Legionella*. Detailed decontamination protocol specified. Review system design and operation, retest water, repeat steps as necessary

As Table 1a indicates, the proposed regulations would impose stricter controls over cooling tower systems in a number of areas. In particular, threshold levels of bacteria triggering remedial action are lowered by 80 per cent and requirements for remedial action where *Legionella* is detected but without a link to any suspected or known case of legionellosis. It should be noted that other new provisions expected to be implemented via the *Building Act 1993* support these additional requirements. These include the requirement for risk management plans to be prepared and regularly audited for all cooling tower systems

Table 1b: Comparison of provisions relating to warm water systems – proposed regulations vs existing regulations/guidelines.

Requirement	Proposed Regulations	Existing Regulations / Guidelines
Start-up procedure	Disinfect and clean	Flush
Routine disinfection	Monthly using heat or chlorination, or continuously using low-level chlorination or ultra-violet light treatment, or by a method approved by the Secretary	High risk categories: monthly heat disinfection. Low-risk: weekly flushing
Unused outlets	Flush weekly	No requirements
Routine testing of water for presence of *Legionella*	Monthly if disinfection is solely by ultra-violet light treatment or a method approved by the Secretary (quarterly if no detection in last 12 months). Quarterly where system is in health/welfare premises and disinfection is by heat or chlorination or continuous low-level chlorination (6 monthly if no detection of *Legionella* in past 12 months)	No requirements
In case of *Legionella* detection (no link to suspected or known case of legionellosis)	Heat or chlorination disinfection, review system and operation, correct as necessary,. retest. While *Legionella* is still detected, ongoing disinfection, cleaning, re-disinfection and retesting or closure of system	No requirements
Legionella detected with link to suspected or known case of legionellosis	Test water for *Legionella*; decontaminate as directed by Secretary	Water and temperature testing, heat disinfection (chlorine if needed)
Thermostatic mixing valves	Same requirements as above, with the exception of routine disinfection and routine testing. In addition, annual cleaning and maintenance	Fortnightly testing, annual dismantling/cleaning, 3 yearly replacement, record all actions

Table 1b indicates that the requirements for warm water systems have been upgraded in a number of areas, while in one case, (routine maintenance of thermostatic mixing valves) a requirement judged unnecessarily strict has been relaxed. The disinfection regime that previously only applied to "high risk" installations has now been extended to all warm water systems, disinfection is now required on start up of the system and flushing is required for rarely used outlets. Water testing requirements have been implemented in cases where systems serve health or welfare premises (i.e. for most systems) and where disinfection is by ultra-violet light treatment or a method approved by the Secretary of the Department of Human Services. Disinfection and system requirements have also been added where *Legionella* has been detected but there is no link to a suspected or known case of legionellosis. On the other hand, and as mentioned above, the former requirements in relation to the maintenance of thermostatic mixing valves have been eased in some respects in recognition of the high cost and limited benefits attaching to the former requirements.

5. Expected Costs of the Proposed Regulations

This section considers the expected costs of the proposed regulations in relation to cooling tower systems and warm water systems.[5]

Table 2, below, provides a summary of the incremental costs estimated to be associated with each of the regulatory requirements. It identifies both the year one cost and the present value of the costs that would be incurred over the ten year life of the proposed regulations.

Table 2: Summary of costs associated with the proposed Health (*Legionella*) Regulations

Regulatory Requirement	Year 1 cost	Present value of costs over 10 years
(a.) Cooling tower systems		
Cleaning/disinfection after shutdowns	$862,500	$6,348,075
Monthly testing for HCC	$1,671,000	$11,808,510
Remedying high HCC readings	$396,000	$485,724
Remedying detected *Legionella*.	$697,500	$1,996,370
(b.) Warm water systems		
Start-up requirements	$2,800	$20,608
Routine disinfection	$15,600	$114,817
Routine water testing	$304,000	$774,461
Flushing unused outlets	$312,000	$2,296,347
Thermostatic mixing valves	-$716,645	-$5,274,570
Record keeping	$146,250	$1,076,413
Total	$3,691,005	$19,646,757

5.1. Expected costs in relation to cooling tower systems

The cost estimates presented have been developed on the basis of the best estimates of DHS officers and on information supplied by industry participants and laboratory personnel. The fundamental assumptions underlying the cost estimates are that the number of cooling towers currently in operation in Victoria is 10,000, that they form approximately 5,000 “cooling tower systems” (i.e. integrated systems containing one or more cooling towers) and that these are distributed among 3,500 premises. The costs associated with each of the provisions relating to cooling tower systems is discussed in turn.

5.1.1. Cleaning/disinfection following shutdown of more than one month

While the proposed regulations are consistent with the existing requirements in mandating, cleaning and disinfection of cooling tower systems prior to start-up, they also explicitly require that this procedure be carried out following any shutdown of more than one month. They have also added a new re-disinfection stage, to be completed after system cleaning. This dual disinfection process improves effectiveness, particularly when the second disinfection is performed immediately after the cleaning process, which has the effect of flushing material - including bacteria - into circulation in the system and improving the ability of the biocide to kill the bacteria.

[5] Where feasible, both total costs and incremental costs (i.e. the costs that are additional to those implied by the existing controls) are identified. In general, RIS analysis is concerned with incremental costs and benefits. However, where regulations are "sunsetting", replacement regulations should attempt to assess the full costs and benefits of the proposed replacement regulation. The existing *Health (Infectious Diseases) Regulations 1990*, which contain the current requirements in relation to control of Legionella risk are shortly due to sunset.

A proportion of the cooling tower systems serving air conditioning systems are shut down during the winter months. This proportion is estimated at 25% of the total number of cooling tower systems. To this figure is added an estimate of the number of systems that are shut down annually due to the normal vacancy rates applying to commercial properties. This is estimated at 5% of the remaining 75% of systems, or an additional 3.75% of systems. Thus, a total of 28.75% of systems are estimated to require cleaning and disinfection upon recommissioning each year. This is equivalent to 2875 systems.

Industry sources have indicated that the cost of disinfecting, cleaning and re-disinfecting a cooling tower system varies quite widely, from around $200 to $1000 or more. For the purposes of this analysis, an estimate close to the lower end of this range has been made, to reflect the fact that a high proportion of systems will be near the lower end of the size range. Thus, an average cost of $300 has been assumed. This implies that the annual cost of disinfecting systems upon recommissioning is:

2875 x $300 = $862,500.

5.1.2. Regular cleaning and disinfection

The proposed regulations require that disinfection, cleaning and re-disinfection of cooling tower systems should occur no less frequently than every six months. This appears to be a less rigorous requirement than the current provision that disinfection should be conducted on a three-monthly basis with provision for this to be extended to intervals of no more than six-months if justified by "relevant performance data".

However, this requirement must be considered in the context of the enhanced requirements, of both the proposed regulations and remaining parts of the regulatory package, in relation to testing for *Legionella* and for HCC and in relation to the thresholds for action and remedial requirements. It is apparent that the costs of failing to meet these testing requirements would be considerable, and that these costs will constrain any tendency for owners and managers to adopt the minimum disinfection requirement. Hence, it is not expected that the implementation of this new standard will lead in practice to any diminution in the frequency of disinfection. What is expected is that the frequency of disinfection will be more rationally related to the performance requirements of the system, as indicated by the enhanced testing regime. Therefore, disinfection activity will be better targeted and more effective. It is also possible that it will be somewhat more frequent than at present, though the extent of any such increased frequency cannot be estimated here. In sum, the new requirements in this regard are estimated as being cost-neutral.

While the incremental costs of this requirement are therefore estimated at zero, it should be noted that the total costs associated with disinfection of cooling tower systems are considerable. If it is assumed that 50% of systems are disinfected and cleaned on a six-monthly basis and the remaining 50% on a three-monthly basis, the total costs can be estimated as follows.

As indicated in Section 5.1.1, the average cost of disinfection, cleaning and re-disinfection of a cooling tower system is estimated, on the basis of industry consultation, as being around $300 per system. If all cooling tower systems are cleaned at a minimum twice per annum, the gross cost of this requirement would be $3 million per annum. This compares with a cost of $6 million per annum for three-monthly disinfection, cleaning and re-disinfection.

Thus, if it is assumed that 50% of cooling tower systems are currently disinfected, cleaned and re-disinfected three-monthly and the remainder are treated six-monthly, this implies an annual cost of $4.5 million. As noted above, this is a cost that is already borne by cooling tower system owners and managers due to the requirements of the current regulations.

While the average frequency of cleaning and disinfection, and hence the costs incurred in total, are not expected to change, it is anticipated that there will be a positive impact on performance. This derives from the fact that cleaning and disinfection intervals may become either more or less frequent for individual cooling tower systems due to better system monitoring and control leading to a better matching between risks and cleaning/disinfection effort.

5.1.3. Monthly microbiological testing

Monthly water testing for heterotrophic colony count (HCC) for all cooling tower systems is required under the current regulations, but water samples are able to be analysed in situ via the "dip slide" method. The proposed regulations will require

laboratory analysis of samples taken, thus significantly increasing costs.

Advice from testing laboratories is that this test costs an average of $25. To this must be added the cost of collecting the samples and conveying them to the laboratory. An estimate of $45 per premises has been derived for this function, which represents 1 1/2 hours work (at average weekly earnings + 100% overheads). There are believed to be approximately 3500 premises equipped with cooling tower systems in Victoria. Thus, the 1 1/2 hours covers the costs of collecting samples from all cooling tower systems on the premises and conveying them to a laboratory. Clearly, collecting and transporting samples from multiple, co-located cooling tower systems will entail significant time savings, though the costs to individual premises may vary widely.

The cost estimate thus obtained has also been discounted by 50% to account for the fact that a significant proportion of owners and managers - estimated for current purposes at around half - are currently conducting laboratory based-testing in preference to on-site "dip slide" testing, which is also acceptable under current controls.

The estimated costs of testing are therefore:

($25 per cooling tower system plus $45 per premises per month)/2.

This sums to [($25 x 5,000) + ($45 x 3500)]/2 = $141,250 per month, or

$141,250 x 12 = $1.695 million annually.

To this must be added the costs of re-testing for systems that fail to meet the standards for one or both tests. Based on survey data and the judgements of DHS experts, it has been assumed that failure rates will initially average 7.5 % for each test, with a halving of this rate to 3.75% in year 2, as the new requirements are made fully operational and better compliance is achieved. The failure rate assumed to decline again to 2% in year 3 and stabilise thereafter. Finally, it is assumed for simplicity that all cooling tower systems reach compliance after a single re-testing.

As noted in Section 5.1.1, a proportion of cooling tower systems serving air-conditioning plant are shut down during the cooler months. Therefore, the costs of testing will not be incurred in respect of this proportion of systems during these periods of disuse. It is assumed that 25% of systems are shut down for an average of four months per annum, suggesting a saving of 8.25% in testing costs vis-à-vis the above calculations.

The initial annual cost of the monthly testing program is therefore:

$1.70 million x 1.075 x .9175 = $1.671 million.

This declines to $1.59 million in year 3 and thereafter.

5.1.4. Remedial action in case of high bacterial counts

The proposed regulations incorporate two key changes to existing requirements in relation to responses to high bacterial counts as revealed in testing. Firstly, the threshold level of bacterial activity, which will trigger a requirement for remedial action, would be reduced by 80% under the proposed regulations, from 500,000 colony forming units (CFUs) per millilitre to 100,000 CFU/mL. This suggests that there will be a significant increase in the number of tests resulting in the need for remedial action, as any result between 100,000 and 500,000 CFU/mL will now require action, where it would not have done so under the current regulations.

Comparison of the forms of remedial action required are made difficult by the format of the existing, guideline-based, regulatory requirement. The current requirement notes that appropriate remedial action "may include" cleaning/disinfection, review of the water treatment program and repeat sampling. The proposed regulations include specific requirements for manual biocide dosing and re-testing. In addition, in the event of the re-testing resulting in continued high levels of HCC, disinfection, cleaning and re-disinfection is required. Review of the water treatment program is not included as a requirement of the regulations, as these systemic issues are to be addressed through the risk management plan (RMP) requirements to be implemented under an amendment to the *Building Act 1993.*

Given the above, the cost implication of the changes contained in the proposed regulations is believed to derive solely from the reduction in the threshold for remedial action. As indicated in Section 5.1.3, and based on survey data and the judgements of DHS experts, it is estimated that increased failure rates under the new requirements will initially average 7.5 % for each test, with a halving of this rate to 3.75% in year 2, as the new requirements in relation to RMPs

in particular are made fully operational and better compliance is achieved. The failure rate assumed to decline again to 2 per cent in year 3 and stabilise thereafter. Finally, it is assumed for simplicity that all systems reach compliance after a single re-testing.

Estimation of the incremental cost of the proposed requirement also requires an estimate of existing non-compliance rates. In the absence of firm data on this question, an assumption of a 2% non-compliance rate has been made. Therefore, an additional 5.5% of cooling tower systems will require remedial action in year 1, falling to 1.75% in year 2 and to zero in year 3.

Industry sources have estimated the cost of manual biocide dosing as varying between approximately $100 and $200 per cooling tower system, with an overall average of $120, reflecting the numerical preponderance of smaller towers. Thus, the incremental cost in year 1 of the lowered HCC threshold for remedial action would be of the order of:

5.5% x 5,000 cooling tower systems x $120 x 12 months.

This is equivalent to

275 x $120 x 12 = $396,000.

The year 2 incremental cost is therefore $126,000, while the incremental cost from year 3 onward is zero.

5.1.5. Remedial action where *Legionella* is detected with no suspected or known case of legionellosis

The proposed regulations specify a series of remedial actions to be taken where *Legionella* is detected in a cooling tower system, but has not been linked with any suspected or known case of legionellosis. These comprise disinfection of the system, a review of the water treatment, operation and maintenance programs, correction of any faults and implementation of any changes necessary to prevent a re-occurrence of those faults, retesting and, if *Legionella* continues to be detected, ongoing disinfection, cleaning, re-disinfection and retesting until *Legionella* is not detected in two consecutive samples taken approximately one week apart, or the closure of the system until the problem has been remedied.

The cost of remedying detected *Legionella* is estimated by summing the costs of disinfection of the system and the costs of re-testing. Given that regular review of the water treatment and system maintenance programs is a requirement of the RMP provisions, no costs have been attributed to this aspect of the regulatory requirement. Thus, for each detection of *Legionella*, a cost averaging around $310 would be incurred. This is composed of the following elements:

- Disinfection of the system: average cost $120
- Review of the maintenance/operation of system: average cost (2 hours labour by a water treatment contractor @ $50/hour) $100
- Testing for continued presence of *Legionella*: average cost (includes costs of collection of samples and conveying samples to laboratory) $90

Total: $310

To determine the likely total cost of this provision, an estimate of the frequency of detection of *Legionella* in cooling tower systems must be derived. In making this estimation it must be noted that neither the current nor the proposed regulations require testing for the presence of *Legionella* to be undertaken. However, this will be a key issue to be addressed in the formulation of RMPs. While RMPs will be developed for individual cooling tower systems, based on individual risk assessments, guidance on the likely frequency of testing can be derived from the guidelines for development of RMPs currently being drafted within the Department of Human Services.

Review of these draft guidelines suggests an average frequency of *Legionella* testing of around two months. This implies that 30,000 tests would be conducted annually. Current estimates are that approximately 7.5% of towers would test positive for the presence of *Legionella*. This implies that approximately 2,250 positive tests would be returned in year one. While the cost of the testing is attributed to the Building Act and associated regulations (which establish the requirement for RMPs) in the accompanying spreadsheets, the costs of the remedial action must be attributed to the proposed regulations, since they specify the regime to be followed in this case.

Therefore, the year one cost of remedying detected *Legionella* will be equal to:

$310 x 2,250 = $697,500

As noted elsewhere, it is assumed that the RMPs will be effective in reducing these rates of *Legionella* detection over time. Thus, the year 2 level of detection is assumed to halve to 3.75%, while the rate for years 3 and thereafter is expected to stabilise at 2%. Thus, the year 2 cost is $348,750 and the year 3 and thereafter cost is $186,000.

5.1.6. Record-keeping requirements.

The proposed regulations set out record-keeping requirements that are applicable to both cooling tower systems and warm water systems. A log book is required to be kept up to date and on the premises showing the details of all systems maintenance, microbiological test results and approvals of different methods of maintenance. System maintenance recording is assumed to be carried out by the maintenance contractor and to be a cost included in the price of the maintenance contract.

The records of testing are assumed to be kept by the officer responsible for collecting and conveying samples to the laboratory. The time taken to record these 1/4 hour per month (given monthly maintenance and monthly microbiological testing). This is an average figure, reflecting the fact that recording costs may be slightly less in an "uneventful" month, but may be considerably more where bacteria are detected and/or system maintenance or repair are carried out.

Recording costs are estimated at $37.50/hr. This amount is an average of the quote cost for a maintenance contractor of $45/hr and the cost for sample collection of $30/hr assumed above. Thus, annual costs per cooling tower system amount to 3 hours @ $37.50/hr = $112.50 per system. This implies an annual cost of $562,500.

While the requirement for records maintenance is included in the proposed regulations, it is also a feature of the amendments to the *Building Act 1993* and associated regulations. The latter also requires that these records be maintained on site for a period of seven years. Given the duplication of this requirement, it is a question of judgement whether the costs involved should be attributed to the regulations or to the *Building Act*. Given that the *Building Act* is the source of the broad RMP framework, this RIS has attributed the costs of record-keeping in respect of cooling tower systems to it. However, it should be noted that the costs of the equivalent record-keeping requirement in relation to warm water systems is included among the estimated costs for the proposed regulations. This is due to the fact that the proposed new *Building Act* provisions do not extend to warm water systems.

5.2. Expected costs in relation to warm water systems

The cost estimates presented in this section have been developed on the basis of estimates supplied by relevant DHS officers, independent engineering consultants and industry participants. The "base case" cost estimates are predicated on an estimate that there are approximately 200 warm water systems installed in Victoria, plus about 10,000 thermostatic mixing valves (TMVs) used to provide warm water [6].

Approximately 90 per cent of each group is believed to be used in connection with the supply of health or welfare services. Of this group, around 60 per cent are located in aged care facilities, 25 per cent are located in hospitals and the remaining 15 per cent are located in mental health and community health facilities. The remaining 10 per cent of warm water systems are believed to be located in swimming pools and gymnasiums, though data on these are extremely limited.

Box 1: Warm water systems [7]– some different types

The term warm water systems is used in relation to systems that ensure a supply of water at temperatures in the vicinity of 40 degrees Celsius[7], compared with around 60 degrees in the case of hot water systems. Their purpose is to minimise scalding risk, particularly in institutional settings and amongst vulnerable groups. However, at least four technologies are in common use to achieve this output.

The most common of these technologies is the use of TMVs in conjunction with a hot water system. In this case, hot and cold water are mixed to give warm water at a point very near to the outlet(s). This minimises *Legionella* risk as there is no standing warm water. The second major type of system heats water to the required (circa 40deg) temperature "on demand" and recirculates any water not drawn through outlets via means of a pump system. These systems typically incorporate ultra-violet (UV) lamps as a supplementary, and continuous, form of disinfection.

The third type of system uses TMVs to mix hot water and cold but recirculates unused warm water to the hot water tank, again via a pump, rather than leaving such water standing in the system as with a simple TMV system. Finally, a recent trend is to the use of "instantaneous" water heaters to supply warm water on demand.

[6] It should be noted that, while TMVs are formally included within the definition of "warm water systems" contained in the proposed regulations, they are excluded from the requirements relating to routine disinfection and testing (regulations 17 – 19).

[7] The proposed regulations define warm water systems as being any piped water system designed to supply water at a temperature of between 30 and 60 degrees Celsius. In practice, a temperature of around 40 degrees is generally the "target" sought in managing such systems.

The proposed regulations add significant new requirements to the provisions of the current guidelines. However, one requirement, relating to the frequency of replacement of thermostatic mixing valves, has been relaxed after review of the existing requirement concluded that it was unnecessarily strict and costly, while adding no discernible benefits in terms of reduced risk. The overall cost impact of the proposed regulations in relation to warm water systems will clearly be much smaller than for cooling tower systems due to the much smaller number of systems in use. The costs associated with each of the proposed provisions relating to warm water systems is discussed in turn in the following sections.

5.2.1. Start-up procedure

The proposed regulations require warm water systems to be disinfected and cleaned upon start-up. By contrast, the existing requirement is for the system to be flushed on start-up. The incremental cost per system start-up is therefore ($325 - $45) = $280, as per the preceding section. The number of warm water systems subject to this requirement is estimated at 10 per annum, or 5% of the total number of systems in service. Thus, the annual cost of this requirement is estimated at $280 x 10 = $2800 per annum.

5.2.2. Regular Disinfection

The proposed regulations would require the disinfecting of all warm water systems using one of the following methods:

- monthly disinfection by heat or chlorine;
- continuous disinfection by automatic, low level chlorination;
- continuous ultra-violet light treatment; or
- an alternative method approved in writing by the Secretary of the Department of Human Services.

This provision differs slightly from the existing requirements, which specify monthly heat disinfecting of warm water systems used by people in "high risk" categories and weekly flushing for all other applications. High risk groups are defined as the immuno-compromised, the elderly, smokers, those with alcohol problems and people with chronic respiratory disorders. Thus, warm water systems involved in the provision of health and welfare services will fall within this definition.

As noted above, it is estimated that approximately 90% of warm water systems are used in the provision of such services. For this group, the requirement for regular disinfection is essentially unchanged under the proposed regulations. Consequently, there would be no additional costs for warm water systems in "high risk" categories.

For the remaining warm water systems, the cost differential is that implicit in moving to monthly (or continuous) disinfection, rather than using weekly flushing. The cost of heat disinfection of a warm water system averages $325. The incremental cost of requiring disinfection of warm water systems used in "low risk" applications is equal to this average cost less the currently incurred cost of weekly flushing of the system. The cost of flushing the system consists solely in the labour time required to flush each outlet in turn. Thus, it is estimated to average two hours of labour time at $30/hour [approximately average weekly earnings plus 100% overheads] or $260 per month. The incremental cost is therefore $65 per month. The number of warm water systems affected by the stricter disinfection requirement under the proposed regulations is estimated at 20, or 10% of the total of 200 warm water systems estimated to be in place statewide.

Thus, the annual cost of this requirement is $15,600.

5.2.3. Water testing

The proposed regulations require quarterly testing for the presence of *Legionella* in warm water systems used in health and welfare service provision, but require monthly testing for an initial twelve-month period in cases where alternative disinfection methods to those specified are being used. They are then able to adopt quarterly testing, provided that the presence of *Legionella* was not detected in any of the preceding twelve samples.

Virtually all owners and managers of warm water systems currently use UV-based disinfection, and are expected to continue to do so. Thus, it is expected that the majority of owners and managers will be required to adopt monthly testing in year one. It is estimated that, given compliance with the new regulatory requirements, a negligible number of warm water systems would test positive for *Legionella* at any given time. Consequently, all owners and managers are assumed able to move to the quarterly testing requirement from year two.

The laboratory charges for conducting tests are estimated at $50 per sample, while a further $45 cost (representing 1 1/2 hours work at average weekly earnings + 100% overheads) is estimated for the collection of samples and transport of samples to the

laboratory. Hence, a total cost of $95 per test is assumed.

The cost implications of the testing requirement are therefore as follows:

Year 1: $95/test x 12 tests x 200 systems = $304,000

Subsequent years: $95/test x 4 tests per annum x 200 systems = $76,000.

It is not expected that the testing requirement will lead to additional disinfection costs, since all systems will, in any case, be required to be disinfected on a monthly basis.

The above are incremental costs, given that the current regulations do not include any requirement for the conduct of testing for *Legionella*.

5.2.4. Unused outlets

The proposed regulations require unused outlets to be flushed on a weekly basis, while the existing regulations do not contain any requirement in this regard. It is considered likely that some unused outlets will exist in all systems. The process of flushing these outlets should take only a few minutes each, as the requirement is that the outlet be turned on at full flow for sufficiently long to remove all stagnant water from the system and raise the outlet water temperature to that of the system. A notional average time of one hour is estimated as being required to flush all unused outlets and record this activity. At $30/hour (average weekly earnings plus 100% overheads), this implies a cost of $30 per week for each of 200 systems. Thus, the total cost of this provision is estimated at:

$30 x 200 = $6,000 per week, equals [$6,000 x 52], or $312,000 per annum.

5.2.5. Thermostatic mixing valves

The proposed regulations would significantly change the existing requirements with regard to thermostatic mixing valves. These valves mix hot and cold water to ensure that the water delivered in this type of warm water system is at the desired temperature. The existing requirement is that they be tested fortnightly, dismantled and cleaned annually and that the thermostatic elements be replaced every three years. This requirement would be replaced, under the proposed regulations, with a simple requirement for annual cleaning and maintenance of the valves.

The less onerous requirement is proposed for the following reasons:

- experience indicates that the incidence of failure of the valves is very low and that their effective life is well beyond three years;
- the valves are equipped with fail-safe mechanisms, so that the risk of injury in the event of their failure is also very low; and
- the cost of the existing program of testing and maintenance of the valves, as well as their replacement on a 3 yearly basis, is considerable, while the benefits are limited.

Given the above, the proposed requirements should result in considerable cost savings, vis-à-vis the current regulations. These are estimated as follows:

Engineering advice suggests that, in order to implement the existing requirements in relation to a large system, such as those found in major hospitals, the services of a plumber almost totally dedicated to this task would be required. This may amount to around $50,000 per annum [8]. However, few systems - perhaps fewer than 10 of the 200 estimated to be installed in Victoria - would be on this scale. The vast majority would be much smaller in scale. In the absence of more detailed data, it is assumed that the average maintenance cost for the 200 installed systems would be around $5,000 annually. It is likely that the fortnightly inspection requirements would account for approximately one half of this labour input. Given that the number of valve replacements would also be halved under the proposed regulations (due to the abandonment of the 3 year replacement requirement) it is estimated that the labour costs of mixing valve maintenance and replacement could fall by an average of 50%, or $2,500 per system per annum.

To this must be added the reduction in the number of replacement mixing valves to be purchased. It is estimated that an "average" warm water system contains approximately 50 such valves, with the largest systems containing 400 or more valves [9].

[8] It is noted that these maintenance tasks have increasingly been contracted out in recent years.

[9] Valves are capable, in flow terms, of serving 4 – 5 water outlets. Good practice, however, tends to limit this number somewhat due to the need to ensure relatively short distances from valve to outlet, so that outlet temperature is similar to valve temperature. It is estimated that there would be approximately 1 valve per 2 beds in most health/welfare facilities.

Given a total of 200 operational systems, this suggests that 10,000 valves are in operation at any one time and that an average of 3,333 would be replaced annually. Engineering advice suggests an average 6 year service life for these valves. Thus, the proposed regulations should reduce the number of valves to be replaced by approximately half, to around 1666 per annum. The average cost of the thermostatic element for a mixing valve is $130.

The total cost savings associated with this change are therefore:

Labour:
$2,500 x 200 systems = $500,000 per annum

Materials
1666 valves x $130 per valve = $216,645 per annum

Total:
$716,645 per annum

5.2.6. Disinfection requirements where there is a link with a suspected or known case legionellosis

Detailed comparisons between the existing requirements and those of the proposed regulations in this respect are not possible, given that the proposed regulations will provide for the decontamination of systems in this situation to be conducted as directed by the Secretary of the Department of Human Services. By contrast, the existing regulations set out detailed disinfection procedures.

In general, it is intended that an amended form of the current guidelines will be published and will continue to be a major source of detailed guidance in relation to many of the regulatory requirements [10]. Hence, it is anticipated that the disinfection procedures to be followed under the proposed regulations will be broadly similar to those currently followed, perhaps updated to reflect current best practices. Consequently, it is likely that the incremental costs of this requirement will be approximately zero.

The benefit of providing discretion to the Secretary in this circumstance is to ensure that the disinfection regime is appropriate to the specific circumstances encountered. This should provide greater assurance as to the effectiveness of the procedure, while also allowing for potential cost savings due to the potential to better adapt the response to the particularities of a given warm water system.

5.2.7. Record maintenance

The proposed regulations establish record-keeping requirements that are applicable to both cooling tower systems and warm water systems, as noted above. The requirements in relation to warm water systems are likely to be more onerous than for cooling tower systems, since the frequency of actions taken that are required to be recorded is greater. For example, the weekly flushing of outlets would need to be recorded for warm water systems, whereas events requiring recording may occur no more than monthly in the case of cooling tower systems.

A conservative estimate of 52 recording requirements at an average of 15 minutes per recording has been made. This implies a total of 13 hours per annum in record-keeping time. Taking the average cost of $37.50 per hour estimated above, this implies an annual cost of $487.50 per warm water system or $97,500 in total.

To this amount must be added the record-keeping requirements applicable to TMV based systems. The cost for each system is likely to be somewhat less than that incurred in relation to other types of warm water system, given that TMVs are explicitly exempted from some regulatory requirements (see above). The cost per TMV system is therefore estimated at 50% of the cost for other kinds of warm water systems, or $243.75 per annum. It is estimated that the 10,000 TMVs believed to be in use are contained in an additional 200 systems. Hence, the cost of record-keeping for TMV based systems is estimated at $48,750 per annum.

In total, therefore, the cost of record-keeping requirements in respect of warm water systems is estimated at $146,250 per annum.

[10] The Guidelines currently form part of the body of the regulations, being adopted by reference in the Health (Infectious Diseases) Regulations 1990. Under the proposed new arrangements, the Guidelines will revert to being purely Guidelines – that is, they will not be called up in the proposed regulations.

6. Summary of Costs of Total *Legionella* Control Package

As noted above, the proposed package of measures to minimize the risk posed by *Legionella* consists of a number of inter-linked elements. Hence, while practical considerations dictate that the package is to be implemented via a number of different legislative and regulatory provisions, it is essential that the overall impact of the package be considered when weighing the impact of any one element (as in the case of the proposed regulations that are the subject of this RIS). The estimated benefits of the package have been derived in an aggregate form and are not able to be attributed, even notionally, to the different individual instruments. In line with the requirements of the *Subordinate Legislation Act 1994*, Section 5 of this RIS has identified the costs directly associated with the proposed regulations as accurately as possible. This section adds to that analysis and provides the broader context by summarizing the analysis of likely costs and benefits of the *Legionella* control package in its entirety that has been undertaken for the Department of Human Services. The costs of the full package of measures are summarised in the spreadsheet which forms Appendix 3 to this RIS.

6.1. *Building Act* requirements (including matters to be implemented via *Building Regulations*)

Some of the most important changes to the management of *Legionella* risk from cooling tower systems are to be implemented through amendments to the *Building Act 1993* and regulations made consequent to those amendments. The new Building Act provisions cover the registration of cooling tower systems, the adoption of RMPs and their annual review, auditing and record-keeping requirements. The purpose and expected effects of these provisions are set out below.

6.1.1. Registration of cooling tower systems

The compilation of a register of cooling tower systems is expected to provide a much needed understanding of the number and location of all cooling tower systems in Victoria. In particular, the expected benefits of the register relate to the investigation of reported cases, clusters or outbreaks Legionnaires' disease, as well as assistance in monitoring conformity with the regulatory requirements more generally. More effective outbreak investigation should allow for more timely identification and treatment of patients, improving medical outcomes and lowering costs. It will also tend to reduce the numbers exposed, as the potential sources of Legionnaires' disease should be identified, isolated and treated more expeditiously. A single registration application form will cover all cooling tower systems on a given premises.

Table 3 sets out the costs to government of establishing and maintaining a register of cooling tower systems. The costs involved are heavily weighted toward the initial establishment of the register, with start-up costs in the range of $630,000 - $645,000, compared with recurrent annual costs of $421,250.

In addition, the direct costs in connection with registration are estimated at $210,000. The estimate of the cost is calculated on the basis of two hours work (at average weekly earnings + 100% overhead) per premises to obtain and complete relevant forms and lodge them with the relevant authority.

Table 3: Costs to government of establishing and maintaining a register of cooling tower systems

Item	Description	Start-up	Recurrent
Develop software	(incl. scope, specification, system development, implementation)	$100,000	$10,000
Hardware	(Covered within existing budget)	–	–
Update BCC website	(incl. general information, public access to register, download of forms	$10,000	–
Geo-spatial information system (GIS)	(incl. development of application system, licensing of standard software, conversion of registration data to GIS)	$85-100,000	$10,000
Filing system	Equipment cost (incl. GST)	$11,000	–
Processing registrations		$152,500	$105,000
Printing	(registration forms, information kits, RMP templates)	$50,000	$5,000
Registration awareness campaign		$50,000	–
Mail-outs	Application kits plus registration certificates	$40,000	$20,000
Credit card payments	(Merchant fees at 1.5% of turnover for, say,) 75% of registrations	$11,250	$11,250
Professional indemnity insurance	(contingent)	$120,000	$120,000
Register enforcement	Salary, overheads and legal costs	–	$140,000
Total		**$630-645,000**	**$421,250**

Cost Recovery

Registration fees for cooling tower systems are to be set to recover three types of cost. Firstly, they will recover the above costs of establishing and maintaining the register. Secondly, they will cover the costs of a random inspection program, to be administered by DHS. This is expected to amount to two full time equivalent staff, plus overheads, yielding a total recurrent cost of $200,000 per annum. Thirdly, the fees will cover the costs of an enhanced advisory and technical support program, also to be run by DHS. This is budgeted at $250,000 per annum.

In sum, registration fees are to be set to recover year one costs in the range $1.08 - 1.1 million, plus recurrent costs of $871,250 per annum. Given an estimate of 10,000 cooling towers, achievement of cost recovery implies initial registration fees of $110 per tower with renewal of registration fees of $85 per tower.

6.1.2. Development of risk management plans

The requirement for owners to develop and ensure regular auditing and review of RMPs constitutes a fundamental change in the approach to managing the risks posed by cooling tower systems under the new legislative package. The RMP approach is based on the concept of a system-oriented and pro-active approach to identifying and managing the risks of *Legionella* infection posed by individual cooling tower systems. The RMPs are therefore central to the expected benefits of the new approach.

RMPs will be required to be developed for all cooling tower systems. It is to be a condition of registration that a separate RMP be prepared for each cooling tower system, even where multiple systems exist on the same premises. This reflects the view that different approaches to risk management may be required where different types of cooling tower systems are concerned. Nonetheless, it is considered that there will be a relatively high degree of commonality between the RMPs, for the following reasons:

- the development of RMPs will be strongly influenced by guidelines to be issued by the Department of Human Services; and
- a template RMP will be developed by DHS to assist small businesses, in particular, in meeting their obligations. Other templates developed by industry groups may supplement this. These templates are also expected to promote a degree of commonality between RMPs.

For the purposes of this analysis, it is assumed that specific RMPs will be developed in respect of the largest 10 per cent of cooling tower systems, given the relative complexity and site -specific nature of some issues in relation to these larger systems. These plans are assumed to require an average of 2 days work per system to develop, given the employment of an expert consultant. At an assumed $150/hr, the average cost per premises is equal to $2400. Where more than one plan is required in respect of a single premises (i.e. where multiple cooling tower systems exist on a similar site) it is expected that the cost of developing second and subsequent RMPs will be somewhat smaller than for the initial RMP, as there will be a substantial commonality in issues/approaches. The average figure of $2400 per cooling tower system recognises this variation.

The remaining 90 per cent of cooling tower systems are expected to rely on the DHS template RMP and any industry derived templates. It is expected that up to twenty such templates will be developed. The average cost of these is estimated at $10,000, reflecting the greater complexity involved in drafting a broadly applicable plan. This represents a cost of $200,000 for the development of industry-based templates. To this cost must be added the cost incurred by individual premises in developing their specific RMPs from the basis of an industry (or DHS) template. Given the industry or situation specific nature of these templates, it is believed that this will be a relatively minor task, largely involving the making of specific choices and preparing documentation of the RMP. This cost is therefore estimated at $150 per premises, representing 5 hours labour at $30 per hour (i.e. approximately average weekly earnings plus 100% overheads).

The total costs involved in preparing RMPs are therefore summarised as:

1. Preparation of site-specific RMPs; $2,400 x 350 premises = $840,000
2. Development of industry specific templates; $10,000 x 20 = $200,000
3. Development of RMPs by smaller premises from industry templates; $150 x 3150 = $472,500

Thus, the total initial cost of developing RMPs is estimated at $1.51 million. An annual cost of $65,625 for developing new RMPs is estimated in respect of RMP development for new cooling tower systems, implying that new systems equal to about 5 per cent of the existing total will be commissioned each year on average. It should be noted that the initial cost of developing RMPs is allocated to year 2 in the accompanying spreadsheet, reflecting the fact that the proposed requirement of the Building Act is that the RMP be completed prior to the lapsing of the initial cooling tower registration.

6.1.3. Annual auditing and review of risk management plans

The costs associated with RMPs also include those of the required annual reviews and updates of RMPs, plus the requirement for annual auditing of RMPs. Annual reviews of plans are expected to be conducted by maintenance contractors as part of their standard contracts. In most cases, there will be no need to update plans from year to year. Updates are expected to be required primarily in cases in which there is a change in the external environment surrounding the cooling tower system, or where the performance of the system has been a problem during the preceding year.

Therefore, the review of an RMP is in most cases expected to be limited to a consideration of the RMP provisions against any changes to RMP templates or guidelines that have been made during the course of the year. It could generally be conducted in approximately two hours by the system's normal maintenance contractor (including recording of the fact of the review having been completed). The cost of such reviews is estimated at $90 per system, or $450,000 per annum. For approximately 2 per cent of systems, the review may lead to substantive amendments to the plan. In these cases, costs equal to around one third of the average cost of developing a plan may be incurred. This would give an additional $120,000, yielding an annual review/updating cost of $570,000.

Auditing of plans is required to be conducted by independent accredited persons. This is expected to mean that a building surveyor, environmental health officer or water systems contractor other than the contractor charged with the ongoing maintenance of the cooling tower system would be able to conduct audits. These audits are to be "paper audits", limited to verification that an RMP is in place, that it addresses the requirements of the regulations and that it is being implemented in practice (via checking of maintenance and treatment records). These audits will usually be conducted on site, due to the requirements that records remain on-site at all times

and to the potential need to verify issues with cooling tower system controllers. It has been estimated that these audits will require an average of four hours (an estimate that includes travel time, as well as the issue of audit documentation). At the ruling labour cost for water treatment of contractors of $45 per hour, the audits are expected to cost $900,000 annually.

The requirements for review and auditing of RMPs will become operative from year three of the operation of the regulations: i.e. one year after the preparation of the RMPs.

6.1.4. *Legionella* testing

Regular testing of cooling tower water for the presence of *Legionella* is expected to constitute an important part of the risk management strategy to be developed under the auspices of the RMPs. The frequency of testing for *Legionella* is to be determined as part of the overall assessment of risk factors undertaken in developing the RMP, rather than an arbitrary standard being set out in regulation. Clearly, *Legionella* testing offers direct evidence of the success of control mechanisms being employed.

Given that the frequency of testing will be determined in individual RMPs, estimates of this frequency must be derived on the basis of the RMP guidelines being developed by the Department of Human Services. Best estimates at present are that *Legionella* testing will be conducted, on average, every three months. The costs of such testing are estimated at $50 per sample [11]. A cost for conveying samples to laboratories has not been added to this item, as it is assumed that the sampling will occur in conjunction with the monthly water testing for heterotrophic colony count required under the proposed *Health (Legionella) Regulations 2001*. However, an additional cost must be added to account for re-testing of cooling tower systems where a positive result is obtained on the first test. It is assumed that 7.5% of towers will require retesting in year 1 (consistent with estimates of their current status) and that this will halve to 3.75% in year 2 and then reduce to 2% in year 3 and thereafter. This reflects the expected impact of both the RMPs and the other improvements to cooling tower system management that will be mandated under other elements of the *Legionella* control package. Testing is assumed to be conducted on the basis of one test per cooling tower system.

The costs of testing for *Legionella* are therefore $50 x 5,000 x 4 x 1.075 = $1.075 million annually in year 1, reducing to $1.02 million in year 3 and thereafter.

6.1.5. Maintenance of records

Records of all system maintenance, microbiological tests and any approvals made under the regulations must be kept in a log book, to be stored on site. System maintenance recording is assumed to be carried out by the maintenance contractor and to be a cost included in the price of the maintenance contract. The records of testing are assumed to be kept by the officer responsible for collecting and conveying samples to the laboratory. The time taken to record these is estimated at 1/4 hour per month (given monthly maintenance and monthly microbiological testing). This is an average figure, reflecting the fact that recording costs may be slightly less in an "uneventful" month, but may be considerably more where bacteria are detected and/or system maintenance or repair are carried out.

Recording costs are estimated at $37.50/hr. This amount is an average of the quoted cost for a maintenance contractor of $45/hr and the cost for sample collection of $30/hr assumed above. Thus, annual costs amount to 3 hours @ $37.50/hr = $112.50 per cooling tower system. This implies an annual cost of $562,500.

6.2. Requirements of the Plumbing Regulations 1998

Proposed amendments to the *Building Act 1993*, developed as part of the package to control *Legionella* risk, include provisions enabling plumbing regulations to be made under Part 12A of the *Building Act* in relation to the construction and installation of cooling towers and cooling tower systems, and in relation to the installation and use of particular equipment in existing and new cooling towers and cooling tower systems.

The Plumbing Industry Commission is presently considering amendments to the *Plumbing Regulations 1998* to introduce the Australian and New Zealand

[10] While it has been reported that some laboratories are performing *Legionella* tests at prices as low as $25 at present, this is believed unsustainable, particularly in the light of expected new standards for the conduct of the test. Thus, an estimate of $50 as the long term average price for the test has been used.

Standard AS/NZS 3666 as a relevant standard for the installation of all new cooling tower systems. This proposal has been canvassed with industry, and will also be the subject of a separate regulatory impact statement, after the amendments to the *Building Act 1993* come into operation.

However, the need for regulations affecting existing cooling tower systems will not be considered until there has been an opportunity to consider the data that will become available after the establishment of the register of cooling tower systems. The register will provide additional information on the numbers of cooling tower systems and the characteristics of these systems, and will guide future consultation on the need for and desirable scope of regulations requiring modifications to be made to existing cooling towers and cooling tower systems.

6.3. Other non-regulatory requirements

Two other measures contained in the package of *Legionella* control measures approved by Cabinet do not require legislative action for their implementation. They are discussed here, and their costs estimated, for the sake of completeness.

Firstly, an amount of $250,000 per annum is to be added to the budget of the Department of Human Services to fund the provision of additional technical assistance to cooling tower owners, managers and contractors in order to improve the standards of practice achieved in maintenance and remedial measures. This cost is to be recovered via the registration charge to be applied to all cooling tower systems under the *Building Act*.

Secondly, an amount of $300,000 per annum has been estimated for the conduct of random inspections of cooling tower systems, including inspection of records kept in accordance with the regulatory arrangements. This includes a $200,000 budgetary allocation to the Department of Human Services and an estimate of $100,000 in business compliance costs associated with the inspections process. This is expected to enhance the level of compliance achieved in practice.

6.4. Incidence of the expected costs

Owners and managers of cooling tower systems and warm water systems will incur the costs associated with the *Legionella* control package. The above analysis has indicated that the new provisions may, in total, result in cost savings for warm water system owners and managers. At a minimum, the costs to this group will be considerably less than for cooling tower owners and managers. This reflects the more prominent role of cooling tower systems in relation to cases and outbreaks of Legionnaires' disease.

Information about the precise extent of the use of cooling tower systems is scarce. So too, is information as to the sectors in which cooling tower system use is widespread. This lack of data constitutes one important reason for the adoption of the registration requirement for cooling tower systems. In broad terms, the use of cooling tower systems is known to be prevalent in the following contexts:

- air-conditioning systems in medium and large buildings, including offices, high density residential buildings, hospitals, major cinema complexes and shopping centers;
- large refrigeration units, likely to be concentrated particularly in food industry premises;
- the cooling of milk on dairy farms;.[12] and
- the removal of heat generated during many industrial processes, for example, in the dry-cleaning industry.

Warm water systems are largely concentrated in the health and welfare sector, being installed in all hospitals and most residential care facilities.

It is probable that cooling tower systems are in many cases used by small business operators, with dry cleaning premises being one known incidence. In line with the Government's small business policy, particular attention has been given to the likely impacts on small business of the package of control measures. An information and consultation evening was hosted by the Department of Human Services on September 18, 2000, and was attended by a wide cross-section of industry and small business interests. In addition, small business interests will feature prominently in the proposed consultation process to determine the nature and extent of any

[12] It should be noted, however, that the adopted meaning of "cooling tower system" (refer Section 4.1) is expected to exclude many dairy farm-based units, while others may be modified in such a way as to fall outside this meaning.

requirements to retro-fit capital improvements to cooling tower systems for adoption under the auspices of the *Plumbing Regulations*.

The following table presents estimates of the likely costs to be incurred by a small business operator of a cooling tower system in implementing the full *Legionella* control package. These are presented in a comparative form in order to indicate the magnitude of the expected cost increases in relation to the existing costs of cooling tower system maintenance. It should be noted that these figures, being based on small business, can be expect to vary from the above cost analysis, which is based on average and total costs for cooling tower and warm water system owners and managers as a whole.

Table 4: Small business cost estimates for cooling tower system maintenance

Item	Current requirements	Proposed new requirements	
	Recurrent/Operating	Recurrent Operating	One-off operating
Chemical costs	$200 - $500	$200 - $500	
Monthly service/inspection	$720 - $900	$720 - $900	
Cleaning and disinfection	$300 - $550	$300 - $550	
Decontamination following adverse result	$150 - $275	$150 - $275	
Bacterial testing - HCC (total bacterial counts)	$120 - $840	$300 - $840	
Bacterial testing - *Legionella*	$70 - $95/test (if needed)	$70 - $95/test (if needed)	
Development of RMP			$0 - $800
Audit of RMP		$90 - $225	
Review of RMP		$45 - $500	
Registration of system		$85	$110
Record-keeping	$0 - $112	$0 - $112	
TOTAL	**$1490 - $3177**	**$1890 - $3997**	**$110 - $910**

The estimates contained in the table are implicitly based on the assumption that external contractors carry out most of the maintenance requirements in connection with cooling tower systems. To the extent that cooling tower system owners and managers carry out these tasks themselves, the *cash* cost to the small business would be lower. However, the size of any *real* cost savings from such internal provision of maintenance will be much less, as well as being less amenable to estimation, as the value of the time of the small business owner or employee(s) would need to be considered to complete this calculation. For this reason, separate costings based on internal provision of maintenance services are not provided.

Table 4 indicates that the *minimum* annual cost of maintaining a cooling tower system will increase by $510, comprising $400 in recurrent costs and $110 in "one-off" operating costs. This constitutes an increase of 34per cent over the current minimum operating cost of $1490 per annum. The *maximum* annual cost would rise by $1,730, or 54 per cent of the current maximum cost of $3177.

7. Expected Benefits of the *Legionella* package

As has been acknowledged throughout this RIS, the proposed regulations represent one part of an integrated strategy to control and reduce the risks posed by *Legionella* in the context of cooling tower systems and warm water systems. Given this, and the overall degree of scientific uncertainty surrounding the question of transmission mechanisms in relation to Legionnaires' disease, it is not regarded as possible to provide estimates of benefits that would derive specifically from the implementation of the current regulations.

Consequently, the approach taken is to discuss the likely benefits of the adoption of the whole package of measures described in this RIS and to compare them with the overall costs estimated for the whole package. Two key methodological issues which arise in relation to the estimation of the various benefits must be acknowledged at the outset.

Firstly, in common with many regulatory issues, the issue of estimating the "base case" - that is, the expected incidence of Legionnaires' disease and the expected number of deaths from the disease in the absence of new regulation - is particularly important. The following sections adopt different approaches to the estimation of base case death rates and incidence rates, for reasons that are discussed in detail below. In brief, the small absolute number of deaths from the disease and high degree of variability in these numbers from year to year make the use of trend estimates essential. In relation to incidence, the widespread view that reported incidence rates substantially underestimate real rates must be factored into the calculation.

Secondly, the proposed package of measures represents a substantially new approach to the control of Legionnaires' disease. Given this, the estimation of the likely effectiveness of the measures proposed is subject to major uncertainty. Additional uncertainty arises from the lack of scientific understanding of the major transmission mechanisms for the disease, particularly for the large proportion of cases that are "community acquired", rather than outbreak-related. Due to this uncertainty, a "base case" estimate of likely effectiveness has not been proposed. Instead, a range is proposed within which it is considered the rate of reduction in incidence and in deaths is likely to fall. This range is from 25 per cent to 50 per cent. This range has been estimated on the basis of a number of factors, including:

- the advice of DHS and other experts;
- the more general experience of the effectiveness of regulatory measures in practice, particularly in relation to health and safety issues; and
- the need for a conservative approach to be taken, given the high degree of uncertainty surrounding many of the issues in relation to controlling risk from *Legionella*.

Benefit calculations are thus made for values at either extreme of this range, indicating probable "best case" and "worst case" scenarios. The estimated benefits are summarised in Table 5, below, and are discussed in detail in the following sections.

Table 5: Summary of quantified benefits estimates due to *Legionella* package

Benefit item	Lower bound (25% effectiveness)	Upper bound (50% effectiveness)
Hospital cost savings	$7,997,683.15	$15,995,366.30
Other medical cost savings	$250,404.93	$500,809.87
Output losses avoided	$2,504,049.33	$5,008,098.66
Total	**$10,752,137.41**	**$21,504,274.83**

N.b. All data are expressed as present values over 10 years at a real discount rate of 6%.

7.1. Direct benefits

The direct benefits of the proposed regulations are those related to the expected reductions in the incidence of the disease that are expected to be their result. Fundamentally, this involves a reduction in the incidence of mortality from Legionnaires' disease. Secondly, there will be savings in terms of the medical costs of treating sufferers of the disease due to an associated reduction in non-fatal incidence of the disease. Thirdly, there is the reduction in the loss of economic output that is occasioned when sufferers of Legionnaires' disease are unable to work during convalescence.

7.1.1. Reduced mortality

Data for the twenty years since 1979 indicate that the number of deaths from Legionnaires' disease in Victoria has been extremely variable from year to year, from a low of zero in 1980, 1981 and 1989, to a high of nine in 1994. The relatively low absolute numbers of deaths and the major variability in numbers of deaths from year to year must reduce the level of confidence in determining any trend. However, in order to determine the likely benefits of regulatory changes in terms of preventing mortality it is first necessary to determine a "base case", representing the number of mortalities that would be expected in the absence of any regulatory change.

In order to do this, a simple linear regression has been performed on the data for recorded deaths from Legionnaires' disease in Victoria from 1979 to 1999. The result of this regression analysis suggests a very slowly rising trend in mortalities, described by the equation:

$$Y = 3.18589 + 0.065352X$$

Where Y = the expected number of deaths, and X = the year (with 1979 = 1).

Applying this trend, the expected number of mortalities over the next ten years, in the absence of any regulatory changes would be 49.8.

There are reasons for speculating that this estimate may be slightly conservative. These include the rapidly increasing number of households living in high density apartment blocks - a factor which is likely to continue to grow in importance - and the continuing trend toward shopping malls and to greater use of air conditioning in office buildings and other public spaces. While these factors suggest that the number of cooling towers will continue to increase, relative to population, and therefore also exposure, it can also be observed that all these trends have also been in place for several years.

While there is reason to believe that the incidence of Legionnaires' disease is significantly under-reported (see below) this is not likely to be the case in relation to deaths. Attempts to treat the disease being necessarily dependent on accurate diagnosis, it is unlikely that sufferers would die without the condition being properly identified. Thus, the following benefit calculations proceed from the assumption that all deaths from Legionnaires' disease are currently identified. In total, then, this trend estimate is considered acceptable for the current modelling purposes.

As noted above, approximately 80 per cent of Legionnaires' disease cases in Victoria in recent years have been "community acquired"[13], rather than being related to an outbreak or a cluster of cases. There is considerable uncertainty as to the transmission mechanism operating in this 80 per cent of cases, whereas cooling tower systems are generally accepted to be the major source of transmission in the 20 per cent of outbreak or cluster related cases.

Despite this uncertainty, it remains likely that the bulk of community acquired cases of Legionnaires' disease have cooling tower systems as their transmission mechanism. This is so given the fact that no other major transmission mechanisms have been identified to which community acquired cases might otherwise be attributed. Thus, given the known prominent role of cooling tower systems in outbreak related cases, they are assumed to also be the major factor in community acquired cases.

The second factor to be determined in calculating the expected benefits of the package of control measures is their expected effectiveness in reducing the incidence of Legionnaire's disease. The proposed regulations represent a significant departure from practice in other Australian States and Territories and also differs from overseas practices as far as is known. Certainly, the recently revised approach taken in the United Kingdom does not contain many of the major elements of the proposed regulations.

[13] This figure is, however, quite variable. For example, in the first half of 2000, only 40% of identified cases were "community acquired".

Given this, the likely effectiveness of the regulations is subject to considerable uncertainty.

Notwithstanding this degree of uncertainty, it is considered likely that the proposed controls are likely to have a relatively high level of effectiveness in reducing deaths from Legionnaires' disease. Major factors pointing to this conclusion are the following:

- the package of controls adopts a comprehensive approach to the problem, embracing both HACCP-type risk management strategies and detailed prescriptive requirements, backed by extensive testing and monitoring; and
- the package has been formulated on the basis of the advice of a highly qualified committee of experts following considerable research and consultation.

As note above, the high degree of uncertainty attaching to the impact of the package makes it appropriate to express the likely effectiveness of the proposed package in terms of a range of potential rates of effectiveness. As noted above, it will be assumed that the effectiveness of the package in practice is likely to be in the range of 25 - 50 per cent. However, this percentage reduction will be applied only to the 80% of cases that are assumed to be related to cooling tower systems or warm water systems. Thus, the likely percentage reduction in terms of total observed mortality rates is estimated at 20-40 per cent. This implies that the expected number of lives saved over the ten year life of the regulations would be in the range of approximately ten to twenty. These estimates are used below as the basis of estimated "cost per life saved" calculations.

7.1.2. Reduced hospital expenditures

Calculation of the reduction in medical costs due to reduced incidence of Legionnaires' disease must commence with an estimate of the true incidence of the disease. As noted above, it is widely believed that the number of reported cases significantly underestimates this incidence. Notwithstanding improved treatment, the much more rapid rate of increase in notified cases than of deaths tends to support the presumption that a higher percentage of cases is now being correctly identified. This assumption is also supported by the availability in recent years of a simpler and more rapid diagnostic test [14].

An important piece of evidence regarding under-reporting is a study of hospitalised pneumonia patients conducted in South Australia in 1991 [15]. This suggested a prevalence of infection in the general population equal to ten times the notified number of cases of Legionnaires' disease. No equivalent study has been conducted in Victoria. However, as overall incidence as well as procedures for diagnosis would be expected to be comparable, the level of under-reporting implied by this study may also have been similar in Victoria at that time. Reported cases in 1991 in Victoria numbered 20. This suggests that the true number of cases may have been in the vicinity of 200. These numbers can be compared with the reported number of cases of 68 in 1998 and 216 in 2000 to date [16]. A recent review of the epidemiology of Legionnaires' disease concluded that:

> *"Under-reporting should be acknowledged when discussions are made about the extent of likely morbidity/mortality of the disease in Victoria. Incidence rates suggest that it is a rare condition, but it is not as rare as it may appear."* [17]

However, acknowledgement of the under-reporting issue creates difficulties in terms of adopting an analytical approach consistent with that used above to identify a "base case" for expected mortalities. Performing a regression on the reported incidence of the disease and extrapolating it into the future would effectively ignore the under-reporting issue and lead to a seriously flawed base case being constructed. A variant of this approach might be to apply a multiplier, consistent with the 1991 study quoted above, to the results of such a regression to adjust for this under-reporting. However, to do so would not account for the clear view held by researchers and health practitioners that the proportion of cases being correctly diagnosed is steadily rising. It would

[14] At the same time it must be noted that earlier identification and treatment is speculated to be a significant factor in the observed reduction in the observed death rate from Legionnaires' disease.

[15] See Formica, N Legionnaires' disease study: Review of the epidemiology of cases of Legionnaires' disease 1995-1998 and review of public health and clinical impacts of the *Legionella pneumophila* serogroup 1 urinary antigen test since its introduction. Department of Human Services, Victoria.

[16] As at November 29, 2000

[17] Formica, N. Discussion Paper: The Investigation of Legionnaires' Disease. Department of Human Services, Victoria.

thereby tend to over-estimate the expected incidence of the disease.

An alternative would be to take the calculated "true" incidence for 1991 - of 200 cases - and extrapolate it into the future. This effectively implies assuming that the true incidence of the disease has been stable over the past decade and, more importantly, that it would remain so over the coming decade in the absence of further regulatory intervention. This approach also appears unsatisfactory. As the number of deaths from the disease has been rising, albeit gradually, this model would effectively embody an assumption of an increasing rate of mortality. In fact, experts in the field generally believe the converse to be the case, with better treatment and, in particular, earlier diagnosis [18] leading to a reduction in rates of mortality. Observed mortality rates have declined very quickly, although it is believed that this decline is an over-estimate of the reality, due to success in tackling the under-reporting issue, as discussed above.

Given these issues, it is argued that a third approach must be taken which uses the calculated figure of 200 cases in 1991 as the starting point in constructing the base case, as it represents the best available single data-point in relation to incidence. It then applies an assumed rate of increase in cases in order to conform with the observations of both increasing absolute mortality and reduced rates of mortality.

Estimation of this rate of increase must necessarily be extremely imprecise. While the use of the regression results, coupled with the multiplier of ten, predicts an increased incidence between 1991 and 2011 of over 370% [19], it is argued above that this is likely to be a significant over-estimate. If this figure is taken as the upper bound of possible mortalities and the continuation of the number of cases at 200 is taken as it is reasonable to argue that a conservative assumption of an increase in the twenty years from 1991 totalling 100 per cent would yield a defensible base case. It should be recalled that the "lifestyle" factors discussed in the previous section all point to an increase in the relative prevalence of cooling tower systems and hence to an increase in the exposure of the population. This tends to support further the notion that this base case represents a conservative estimate.

This base case yields an expected incidence of 390 cases by 2010. For simplicity, the increase is assumed to be linear, that is, that the number of cases will rise by 10 per annum over this period in the absence of regulatory changes. By way of verification, it can be noted that the predicted number of cases for 2000 under this model (290) compares plausibly with the observation of 216 cases to end-October 2000.

The regulations are assumed to be equally effective in reducing the number of cases of Legionnaires disease as in reducing mortality (see above). That is, they are assumed to lead to a 25 - 50 per cent reduction in cases within the 80 per cent of cases assumed to be cooling tower system related. Thus, the upper bound estimate is that the number of cases of the disease will reduce by .5 x .8 = .40 or 40 per cent. This implies a reduction in cases of 120 in 2001, rising to 156 in 2010. The lower bound estimate is for a reduction of .25 x .8 = .20 or 20 per cent in the number of cases. This implies a reduction of 60 cases in 2001, rising to 78 in 2010.

The cost of medical care has been calculated by the Department of Human Services to average $16,810 per hospital admission, for an average stay of 14.3 days. As approximately 95 per cent of cases of Legionnaires' disease require hospitalisation, the upper bound of the expected reduction in hospital costs rises from 120 x .95 x $16,810 = $1.92 million in 2001 to 156 x .95 x $16,810 = $2.49 million in 2010. The lower bound estimate thus ranges from $0.95 million in 2001 to $1.25 million in 2010 [20].

7.1.3. Other reduced medical expenditures

In addition to the costs incurred during hospitalisation, medical costs are incurred during home-based convalescence from the disease. These will include the costs of doctors' consultations and pharmaceutical costs. In the following section, the

[18] Earlier diagnosis is largely made possible by the increasingly widespread use of a simpler, cheaper and more rapid urinary antigen test in recent years.

[19] The regression equation obtained from estimating the trend in reported incidence of Legionnaires' disease between 1979 and 1999 is of the form Y = -8.43 + 2.59X

[20] It can be noted that the average cost of treatment of a case of Legionnaires' disease may experience some decline due to the expected earlier identification of those infected as a result of the better information base to be derived from the cooling tower system register. This benefit, while not able to be quantified with any confidence, constitutes a key justification for the inclusion of the registration process in the package.

average period of absence from the workplace is estimated at five weeks, entailing two weeks hospitalisation and three weeks home-based convalescence. It is assumed here that medical expenditures will, at a minimum, be incurred throughout this three week period of convalescence. Data on the extent of these costs have not been obtainable in the course of preparing this report and are therefore estimated at a notional $500 per patient, implicitly comprising several doctor consultations and a number of courses of prescription drugs. Thus, the benefit associated with reducing the incidence of the disease rises from $60,000 to $78,000 annually over the life of the regulations under upper bound estimates and $30,000 to $39,000 under lower bound estimates.

7.1.4. Reduced loss of output

As noted above, sufferers of the disease spend an average of approximately two weeks hospitalised. To this is added a period of home-based convalescence, during which they will be unable to work. Data on the average length of this convalescence are not available, but its average duration has been estimated at a further three weeks for the purposes of this study. Thus, the average sufferer will be away from the workplace for five weeks in total.

During an absence of such a length, employers will generally be able to take steps which will mitigate the loss of output which they suffer due to the absence of the employee. The extent to which such steps are effective depends on a range of factors including the degree of specialisation of the employee's job, the flexibility of the employer's productive processes and labour market conditions including the availability and cost of suitable temporary staff. As a result of these measures, the actual loss of output for the employer of a Legionnaires' sufferer would be expected to be somewhat less than the average value of the employee's output over the period.

On the other hand, there will generally be upstream and or downstream impacts of the employee's absence, related to possible interruptions of supply to downstream markets or interruptions of demand in upstream markets, etc. These costs are additional to the direct cost borne by the employer of the Legionnaires' disease sufferer.

For the purposes of the current analysis, a simplifying assumption has been adopted in an attempt to capture these two factors. The total loss of output (direct and indirect) is assumed to be equal to the total value of the product of the employee suffering Legionnaires' disease. Given an approximate value of GDP per employee of $1000/week, the value of this product is estimated at $5000 per case of Legionnaires disease. Thus, the output benefit of reduced incidence of Legionnaires' disease is equal to $5000 per case avoided. This implies benefits of $600,000 in 2001, rising to $780,000 in 2010 for the upper bound estimate and $300,000 to $390,000 for the lower bound estimate.

7.1.5. Other unquantified direct benefits

Three other direct benefits associated with the proposed regulations have been identified, but are not able to be quantified for the purposes of the current report. Firstly, it can be expected that litigation activity will be associated, in particular, with outbreaks of Legionnaires' disease. This appears, for example, to be the case with the recent Melbourne Aquarium outbreak. Clearly, reducing the probability of outbreaks will reduce the costs associated with such litigation. The costs of legal fees and of running the courts are real costs, since they represent resources diverted from other ends. That is, they are costs that would not have been incurred in the absence of the outbreak. The costs of any damages awarded through this process, on the other hand, are conceptually treated as transfers, since their effective role is to redistribute the incidence of the real costs borne as a result of the incidence of the disease.

The second direct cost is that associated with insurance for proprietors of cooling tower systems. It can be expected that the regulations, by reducing risks, will lead to reduced premiums (to the extent that the costs associated with outbreaks are insured by system owners and managers. Again, a distinction must be made between real costs and transfers. While insurance payouts are in the latter category - effectively representing a redistribution of the incidence of real costs - the costs of administration (including profit) for insurance companies are real costs.

Thirdly, and most importantly, the adoption of the proposed regulations will lead to very significant reductions in the pain and suffering endured by

those who contract the disease. This is, in most cases, extremely severe and of long duration - a number of months - and even results in permanent incapacity in a minority of cases. Methodologies to value such pain and suffering are very poorly developed and most attempts to do so are quite arbitrary. Hence, it is not appropriate to seek to quantify this benefit in the current report. It can, however, be noted that the sums awarded in compensation for pain and suffering through the court system are, in many cases, extremely large. Given the large number of cases that are expected to be prevented (totalling 1248 cases over 10 years in the base case), and the extent of the suffering involved, this is clearly a highly important additional benefit to be weighed in favour of the regulations.

7.2. Indirect benefits

A number of indirect benefits of reducing the incidence of Legionnaires' disease may arise. Firstly, there has been a significant incidence of industrial dispute connected to concerns about the disease in recent years. It can reasonably be expected that a robust regulatory strategy that led to an observable and significant diminution in the number of cases of the disease could significantly reduce the incidence of such disputes.

On the other hand, there is a possibility that the increased rigour required in HCC testing, plus the implementation through RMPs of frequent testing for *Legionella* for all cooling tower systems, will serve to increase levels of concern about *Legionella* in the short to medium term. Up to 10 per cent of cooling tower systems are currently estimated to harbour *Legionella* at any given time. Despite the fact that the regulations are expected to be highly effective in reducing this number, it has been assumed that 7.5% of systems - or 750 - will initially be found to be infected with *Legionella*. It is clear that there is potential for such a rate of detection to raise industrial concerns, even in the absence of outbreaks of the disease.

Given the lack of reliable data on the incidence of *Legionella*-related disputes, uncertainty as to the extent of any likely reduction in disputes due to better regulatory management and the possibility that aspects of the new regulatory regime may have a perverse effect on the rate of such disputes, no quantitative estimate of benefits due to reduced industrial disputation has been incorporated in this analysis.

A second major indirect benefit often cited in favour of better regulation of *Legionella* is the avoidance of possible negative impacts on tourism due to adverse publicity surrounding outbreaks. While such an effect is theoretically plausible, there is no known evidence of its occurrence to date. There are also reasons to suspect that the effect may not be significant. Firstly, the incidence of *Legionella* and of outbreaks of Legionnaires' disease are widespread, and Victoria's incidence rates are not notably higher than those experienced elsewhere. This fact may cast doubt on the extent to which publicity surrounding rare outbreaks in Victoria (or, indeed, elsewhere) would be likely to affect tourism choices. No evidence is known, for example, of Victorian travel agents advising customers to avoid any destinations on the grounds of *Legionella* risk.

For this reason, as well as the difficulties of quantifying any notional impact, no estimate of indirect benefits due to securing tourism revenue have been incorporated into the current analysis.

A third benefit mooted widely is that of the positive impact on the economy from avoiding the shutdown of businesses due to Legionnaires' disease outbreaks and the associated costs. Such costs can be extremely significant for the individual businesses affected. In addition to the costs of remediation and lost revenue, they may also include the costs of legal actions and potential compensation payments to those affected. Certainly, it is possible that the continued viability of some businesses could even be threatened in extreme cases.

However, this analysis considers all costs and benefits from the society-wide perspective, as required by the *Subordinate Legislation Act 1994*. It is important to recognise that costs of the above type largely represent transfers within the economy. While losses to individual businesses that are identified as the source of outbreaks may be great, the funds that would have been expended there will have largely been diverted to other options. Thus, there would be little, if any, impact on the overall level of economic activity, even though the level of utility is notionally reduced, due to people shifting to less preferred expenditure options.

Given the above, no estimates of benefits due to reduced costs to individual businesses attendant on outbreaks of Legionnaires' disease are included in the current analysis.

An important qualitative benefit that should be considered, however, is that of the maintenance of public confidence in the safety of public buildings and in the effectiveness of Government in protecting the public health. This benefit, though intangible, represents an important part of the justification for proceeding with the regulatory proposals. It is clear that the public sees the current reported incidence of the disease, which has risen sharply over the last three years, as unacceptable and requiring government action.

While the risk of contracting Legionnaires' disease remains objectively low, it is clear that it is a cause of major public concern. An analogy can be drawn with the incidence of asbestos related disease acquired from in situ building related exposures. These observations are consistent with the findings of research into risk which indicate that subjective evaluations of the acceptability of risk are closely related to the public's ability to control the risk and to identify the risk ahead of time. Because members of the public individually have little control over the risk of contracting Legionnaires' disease the "outrage" factor attached to the disease is high, while the acceptability of the risk, though it is objectively quite small, is low. On these grounds, there is a more compelling case for public action to reduce the risk of *Legionella* than the objective risk data would otherwise suggest.

As noted above in relation to industrial impacts, there is an expectation that large numbers of cooling tower systems will be found to be infected with *Legionella* under testing regimes likely to arise from the implementation of the RMP requirements. This implies that there may be negative impacts on public confidence associated with the adoption of the new regulatory package in the short term. However, it seems most likely that increasing understanding of the rigorous nature of the new control measures, together with the expected quite rapid decline in detection rates, will lead to a significant enhancement in public confidence in the medium term. In the longer term, as the regulations have an increasingly visible effect in reducing the incidence of the disease, and of mortality from the disease, this impact should be strengthened further.

Moreover, the control package is expected to be particularly effective in preventing outbreaks (vis-à-vis sporadic or isolated cases). It is clear that it is the incidence of outbreaks that is the primary factor in terms of public confidence. Thus, the expected percentage reductions in incidence and mortality would tend to underestimate the likely impact on public perceptions of the risk of the disease and, hence, of the improvement in public confidence likely to be brought about.

8. Summary of Costs and Benefits.

The attached spreadsheet analysis (Appendix 3) sets out the nett present values (NPVs) of the costs and benefits expected to be associated with the whole package of proposed measures for controlling *Legionell*a risk. Included within it is a separate identification of the costs directly attributable to the proposed *Health (Legionella) Regulations 2001*. The above discussion sets out the basis on which these estimates have been constructed and indicates the major areas of uncertainty. The analysis has been conducted over a ten year timeframe, given that this is the expected duration of regulations in Victoria, due to the operation of the *Subordinate Legislation Act 1994*. The discount rate applied is a real (i.e. after inflation) rate of 6 per cent, which represents the real cost of capital to the businesses which will bear most of the direct costs. The quantitative implications of the package are summarised below:

Table 6: Summary of expected quantitative impacts of the proposed reforms

Measure	Value
Present value of total costs	$50.1 million
Present value of benefits	$10.8 to $21.5 million
Nett present value	-$28.6 million to -$39.3 million
Benefit/cost ratio	1:2.3 to 1:4.6
Number of lives saved (over 10 years)	10 to 20
Cost per life saved	$1.43 million to $3.931 million

The spreadsheets indicate that the benefits of the proposed package have a present value in the range of $10.8 – $21.5 million dollars over ten years. These benefits are composed exclusively of savings in terms of medical costs not incurred and economic output not lost. The benefits of the regulations are expected to be distributed relatively evenly over the life of the regulations, with a year one benefit of approximately $1.3 – $2.6 million.

The anticipated costs of the package have a present value of $50.1 million over ten years. These costs are also relatively evenly distributed, with a peak cost of $7.1 million in year two of the package's implementation. Some decline in annual costs is expected as better practices lead to lower detection rates and therefore lower costs for disinfection and re-testing of cooling towers. The major cost elements are:

- monthly testing for HCC, initially at $1.7 million per annum;
- testing for *Legionella* (averaging three-monthly, under RMP requirements) at $1.1 million per annum;
- cleaning/disinfection after shutdowns of cooling tower systems ($0.9 million per annum);
- registration of cooling tower systems ($0.9 million initial cost plus $0.6 million per annum);
- records maintenance ($0.7 million per annum, including warm water systems); and
- remedying detected *Legionella* (initially $0.7 million, declining to $0.2 million per annum).

Box 2: Cost elements specifically attributable to the proposed regulations

This RIS has indicated that the proposed regulations are considered as an integral element of a larger package of *Legionella* control measures and that the benefits expected to flow from this package cannot be dis-aggregated and attributed to the individual elements of the package. However, the analysis contained in section 5, above, has separately identified the costs attributable to the proposed *Health (Legionella) Regulations 2001*. The present value of these costs sum to $19.6 million, or around 39% of the total of $50.1 million in costs attributable to the package of control measures considered as a whole. Consideration of the incidence of these costs shows that $20.6 million in costs are incurred by cooling tower system owners and managers, while warm water system owners and managers are expected to see a slight decline in operating costs - having a present value of $1.0 million, due to the cost savings attributable to the more targeted approach to maintenance of thermostatic mixing valves.

Thus, the proposed package has a negative NPV ranging between approximately $28.6 million and $39.3 million over ten years. Considering their impact in a different way, the ratio of costs to benefits ranges between 4.6:1 and 2.3:1. That is, there are between $2.30 and $4.60 of costs for each $1 of benefits.

This calculus has, however, deliberately not incorporated a value for lives saved due to the proposed package. Such values are widely used in regulatory analysis and can be extremely useful in some circumstances. However, they are in many or most cases predicated on the discounted flow of future earnings expected to be earned by the people whose lives are statistically "saved" by the regulations. This has the effect of valuing the lives of the elderly at a considerably lower amount than that of the young. This is clearly an important limitation in regard to an analysis centred on *Legionella*, which predominantly attacks the elderly.

An alternative to adopting a value for lives saved is to turn the present value formulae around, so that one "solves for the nett cost of lives saved". That is, by quantifying all other variables to the extent feasible, it is possible to arrive at a nett cost per life saved. This is the approach adopted in the current analysis. As noted above, the NPV of the package is between -$28.6 million and -$39.3 million over ten years. The number of lives assumed to be saved over the same period varies between ten and twenty. Therefore, the nett cost per life saved associated with the proposed package varies from a low of $1.43 million to a high of $3.931 million. This is an amount that is broadly within accepted benchmarks for effective policy [21], comparing favourably to many alternative policy interventions [22].

Moreover, it is a figure that should also be considered in the context of the very significant reductions in pain and suffering that have been identified due to the major reduction expected in the incidence of the disease. In the base case, it is estimated that the number of cases of the disease would be reduced by 1248 over the ten year life of the regulations. Sufferers are known to spend on average two weeks hospitalised, with the majority spending some time in intensive care. In addition, further home-based convalescence will imply a total absence from the work place of at least five weeks. For a minority of sufferers, permanent disablement also results from the disease. Clearly, the avoidance of this outcome for well over one thousand people represents a very significant additional benefit, but one that cannot reasonably be quantified. Because this benefit has not been quantified, it must be weighed during consideration of the cost per life saved calculation above.

Given the above, it is considered that the analysis supporting the introduction of the wider package of measures, of which the proposed *Health (Legionella) Regulations 2001* forms part is robust in relation to the likely areas of uncertainty.

[21] W Kip Viscusi, the pre-eminent academic theorist in this area has proposed a benchmark figure in the order of US$3 - $5 million per life saved – or around A$6 - $10 million.

[22] The range of NPVs, and of costs per life saved, discussed above relates solely to changes in the assumptions made as to the likely effectiveness of the regulatory package. Other key areas of uncertainty relate to the numbers of cooling towers and cooling tower systems in Victoria and the "base case" incidence of Legionnaires' disease. As noted, changes in the base case could either raise or lower the cost per life saved by a substantial percentage. Changes in the number of cooling towers would substantially increase the cost per life saved, since 10,000 is considered a slightly conservative estimate of their numbers and many estimated costs rise proportionately with the number of cooling towers assumed.

9. Assessment of Alternatives to the Proposed Regulations

As noted earlier in this RIS, the package of proposed *Legionella* control measures is the product of the deliberations of the expert Legionella Working Party, specifically appointed to undertake this task. The working party's deliberations necessarily included the consideration of a wide range of feasible alternative means of controlling risk. The working party's report [23] describes the range of alternatives that were considered for adoption and rejected, and provides the working party's reasoning. This section of the RIS sets out the essentials of this discussion, as well as adding material on the likely costs and benefits of each option, where possible.

9.1. Compulsory workplace hazard identification, risk assessment and control of risks

This option would involve amending the *Occupational Health and Safety (Plant) Regulations 1995* to apply the requirements for workplace hazard identification, risk assessment and risk control to cooling towers as an item of plant. This item was not supported due to concern at the potential confusion arising for duty holders from having two sets of regulations that deal specifically with *Legionella*.

It should be noted that the requirements for hazard identification, risk assessment and risk control that would be required under the *Occupational Health and Safety Act 1985* would necessarily replicate, to a large degree, those that will be brought into place via the RMP requirements, to be implemented under the *Building Act 1993*. Thus, adoption of an *Occupational Health and Safety Act* based requirement would have the potential to increase significantly the compliance costs involved with documentation and record-keeping, without providing any apparent means of improving benefit outcomes.

9.2. Cooling tower systems not identified and registered

The full cost to government and industry of establishing and maintaining a registration system for cooling tower systems has been estimated as $855,000 in year 1 and $631,250 in subsequent years (representing a Present Value of $4.86 million over ten years). However, the Legionella Working Party reached the view that significant benefits would be attached to the registration of cooling tower systems. In particular, it believed that the costs associated with managing outbreaks and investigating potential sources of Legionnaires' disease would be reduced by approximately one third.

A second, and probably more significant, benefit is associated with registration. Due to the contribution that a register will make to the timely identification of outbreak sources, the ability to identify exposed populations and so ensure early identification and treatment of symptoms will also be greatly improved. This will lead to significant improvements in treatment outcomes and reductions in treatment costs, as the effectiveness of treatment for Legionnaires' disease depends crucially on the timeliness with which treatment is begun. Similarly, output losses due to days of work missed will also be reduced.

It is not considered possible to quantify this effect. However, it is noted that the annual costs of medical treatment and lost output associated with Legionnaires' disease are currently thought to be around $6.4 million. Hence, a reduction of 10% in these costs would more than compensate for the ongoing costs of the register, even before consideration of the intangible benefits due to reduced pain and suffering.

[23] Legionnaires' Disease: Managing the Health Risk Associated with Cooling Towers: Findings and Recommendations of the Department of Human Services Legionella Working Party. Public Health Division, Department of Human Services, Government of Victoria, June 2000.

9.3. Registration of cooling tower systems by local government

An alternative form of registration would see local governments, rather than the State Government, take responsibility for keeping registers of cooling tower systems. The key potential benefit of this option would be that local government may be better placed to ensure a high level of compliance, through its better knowledge of locations and local businesses. However, this option was not favoured as the costs associated with maintaining up to 78 different cooling tower system registers could be expected to be considerably higher than those attaching to a single, central register. Moreover, outbreak investigation would often involve interrogating more than one register in order to identify potential sources of infection and may therefore suffer from reduced effectiveness.

9.4. An ongoing program of inspection and audit by the Department of Human Services

This option would involve the DHS, through Regional Environmental Health Officers or a centrally located group, providing an initial inspection, followed by annual audits of each cooling tower system in Victoria. Such an option would entail considerable costs. If each audit of a cooling tower system required as little as two hours input - as has been estimated for the "paper audits" of RMPs - the total cost would approximate $450,000 per annum. This would appear to be the minimum possible cost for this option. More likely, a four hour audit which involved inspection and verification of the actual operation of the system would be required. This would double the likely cost to around $900,000 per annum.

Such an option is not considered likely to provide offsetting benefits given the existence of the general RMP requirements. The audit provisions in relation to RMPs, combined with the annual registration requirements, allow government (via the Building Control Commission and DHS) to ensure that independent auditing of the existence, adequacy and implementation of an RMP is undertaken, without requiring that government undertake this task. This is considered consistent with the general approach of encouraging cooling tower system owners and managers to take responsibility for their systems and to represent a least cost means of ensuring the requisite quality control.

9.5. Mandatory reporting and recording of all test results and/or non-complying test results

It was proposed to the working party that maintenance contractors forward test results to DHS and that the details be recorded on the state register. Moreover, it was suggested that if all sampling outcomes were reported, remedial action could be taken immediately in the case of positive results for *Legionella*.

Even assuming fully electronic data transfer, such a system would be expected to be relatively costly to implement, requiring the employment of additional staff to record and review the information submitted. Against this, the benefits of such a system are not obvious. While non-compliance would be immediately brought to the attention of DHS, this approach could be seen as risking the undermining of the overall thrust of the current proposals toward requiring owners and managers to take a high degree of responsibility for minimising *Legionella* risk and adopting positive and pro-active strategies to this end.

9.6. Making the maintenance contractor responsible for the sampling and testing of the cooling tower system

This option was rejected because of concern that it would tend to shift responsibility away from owners and managers, contrary to the general intent of the regulatory package.

The cost implications of this alternative, vis-à-vis those of the proposed requirement are less than certain. On the one hand, the assumed hourly rate for collection and submission of samples for testing by cooling tower owners and managers is lower than that normally charged by maintenance contractors, reflecting the fact that this is not necessarily a highly skilled task. On the other hand, it may be that maintenance contractors would, by combining this task with other tasks, be in a position to carry out this task with a smaller input of time. This could offset the higher hourly cost that has been assumed.

It is believed that the difference in cost is unlikely to be great and that, on balance, the option of retaining responsibility for the task with the owner or manager is preferable in terms of its congruence with the overall approach adopted in this regulatory package.

9.7. Develop standards for companies providing the servicing and testing of cooling tower systems

This option would seek to ensure that maintenance standards were met by regulating the qualifications of companies able to provide these services. However, the working party took the view that the current approach of setting performance standards for cooling tower systems provided a more direct, and thus preferable, means of regulating outcomes. Setting of performance standards is consistent with the approach of devolving responsibility for performance to owners and managers, rather than to third parties such as maintenance contractors. There may also have been concerns in terms of the justification of any such restrictions in relation to the National Competition Policy. Moreover, the costs of establishing and maintaining an accreditation system for maintenance contracts would be relatively large. The annual ongoing cost of $631,250 for establishing and maintaining the register of cooling tower systems could probably be considered as a "lower bound" estimate in this regard, since an accreditation scheme would need to involve the assessment and checking of qualifications.

9.8. "On the spot" fines for contraventions of the regulations

This option is not supported because it would constitute a reactive approach, focused on individual breaches of the standards, rather than a proactive, risk management based approach. Moreover, it is considered that the fines would need to be of considerable size in order to have a significant effect as a deterrent to poor practice. This is unlikely to be practicable, due to concerns of principle related to the imposition of large penalties in a manner other than through the court system.

An additional concern is that a system of *ad hoc* penalties of this sort could undermine the proposed "partnership" approach, which envisages that the DHS would seek to assist owners and managers in improving practices and outcomes.

9.9. Mandatory monthly testing for *Legionella*

Mandatory monthly testing is not considered appropriate as it necessarily entails considerable costs which are not likely to be warranted by the expected benefits. The analysis of the RMP requirements undertaken above estimates that *Legionella* testing will be undertaken on average on a two-monthly basis and that this will entail cost with a present value of $11.4 million over ten years. Thus, it is estimated that requiring monthly testing would double this cost to $22.8 million. This cost would not be justified by offsetting benefits unless monthly testing could be shown to have an extremely substantial impact in reducing the incidence of Legionnaires' disease. This is not considered plausible.

Instead of a simple, prescriptive requirement, the guidelines for developing RMPs, to be issued by the DHS, will emphasise an approach based on an assessment of risk factors. Consistent with the broader approach of these guidelines, the frequency of recommended *Legionella* testing should, according to the guidelines, be determined in relation to judgements about the extent of a number of major risk factors. This may mean that *Legionella* testing is conducted monthly or even more frequently in some situations, but is conducted with much less frequency in others. It is important to recognise that the extent of the *Legionella* risk can vary considerably from cooling tower system to cooling tower system, and that the imposition of an arbitrary testing frequency would not recognise this diversity of risk levels.

In addition, there is concern that the specification of mandatory monthly testing could have a counter-productive impact on other compliance efforts through its potential to provide a false sense of security. It must be noted that *Legionella* infection can occur quickly and the absence of *Legionella* at the time of a given monthly test cannot guarantee its absence during the course of the ensuing month. Thus, it is considered preferable that *Legionella* testing be treated as an indicator of system performance only, to be used in conjunction with other indicators.

10. National Competition Policy Statement

The National Competition Policy agreements require that all new legislation must be assessed to determine whether it restricts competition. New legislation should restrict competition only if there is a nett benefit to society in so doing *and* if that benefit cannot be achieved in any way other than by restricting competition. It is considered that the proposed regulations do not contain any restrictions on competition.

11. Conclusion

Section 9, above, has set out the range of alternatives considered by the Legionella Working Party and the reasons for the rejection of each. Section 8 summarises the expected performance of the proposed package of reforms, of which the *Health (Legionella) Regulations 2001* form an integral part. Section 8 indicates that the proposed reforms meet accepted benchmarks for regulatory effectiveness and thus represent a proportionate response to the risks proposed by Legionnaires' disease. Given this analysis, and the crucial importance of the proposed regulations within the larger package of reforms, it is proposed to make the *Health (Legionella) Regulations 2001*.

Appendix 1 Notice Required Under Subordinate Legislation Act 1994

Subordinate Legislation Act 1994
Proposed Health (*Legionella*) Regulations 2001

Notice is given as required by section 11 of the *Subordinate Legislation Act 1994* of the proposed making of the *Health (Legionella) Regulations 2001*.

The objectives of the regulations, proposed to be made under the *Health Act 1958*, are to –

(a) prescribe procedures for the maintenance and testing of cooling tower systems and warm water systems; and
(b) require owners and persons who have the management or control of cooling tower systems and warm water systems to keep records on the maintenance and testing of those systems and to make those records available for inspection by an authorised officer on request; and
(c) enable the Secretary of the Department of Human Services to –
    (i) substitute different procedures in different circumstances; and
    (ii) require additional procedures to be undertaken when a system is suspected or implicated in the spread of the prescribed infectious disease, legionellosis.

A Regulatory Impact Statement has been prepared in accordance with the *Subordinate Legislation Act 1994*. The statement examines the costs and benefits of the proposed regulations and possible alternatives. The results of the statement are that the proposed regulations are the most efficient method of achieving the objectives.

Written submissions are invited from any interested industry or community group and from the public in relation to any matter relevant to the proposed regulations and will be received up to 28 days from the date of publication of this notice.

A copy of the Regulatory Impact Statement, including the proposed regulations, is available from, and submissions should be lodged with -

Manager, Environmental Health Unit
Public Health Division
Department of Human Services
Level 17, 120 Spencer Street
Melbourne VIC 3000

Telephone: 1800 248 898
Fax: 03 9637 4507

Hon John Thwaites MP
Minister for Health

The Regulatory Impact Statement and proposed regulations may also be viewed and downloaded at the *Legionella* Risk Management Project Website at
www.dhs.vic.gov.au/phd
and submissions may be forwarded by email to
lrmp@dhs.vic.gov.au

NOTE: All submissions received will be treated as public documents.

Appendix 2 Proposed Health *(Legionella)* Regulations 2001

Statutory Rules 2001

S.R. No.
Health Act 1958

The Governor in Council makes the following Regulations:

Dated:

Responsible Minister:
JOHN THWAITES
Minister for Health

Clerk of the Executive Council

Part 1-Preliminary

1. Objectives

The objectives of these Regulations are to-

(a) prescribe procedures for the maintenance and testing of cooling tower systems and warm water systems; and
(b) require owners and persons who have the management or control of cooling tower systems and warm water systems to keep records on the maintenance and testing of those systems and to make those records available for inspection by an authorised officer on request; and
(c) enable the Secretary to the Department of Human Services to-
  (i) substitute different procedures in certain circumstances; and
  (ii) require additional procedures to be undertaken when a system is suspected or implicated in the spread of the prescribed infectious disease, legionellosis.

2. Authorising provisions

These Regulations are made under sections 146, 390 and 391 of the ***Health Act 1958***.

3. Commencement

These Regulations come into operation on 1 March 2001.

4. Revocation

In the Health (Infectious Diseases) Regulations 1990 [1], Division 3 of Part 5 is **revoked**.

5. Definitions

In these Regulations-

"biocide" means a physical or chemical agent capable of killing micro-organisms, including *Legionella*;

"clean" means to render free from visible sludge, foam, slime (including algae and fungi), rust, scale, dirt, and any deposit or accumulation of impurities or other foreign material;

"disinfect" means to carry out a process which-

(a) is intended to kill or remove pathogenic micro-organisms, including *Legionella*; and
(b) in the case of a cooling tower system, consists of dosing the water of a system with-
  (i) a chlorine-based compound, equivalent to at least 10 mg/L of free chlorine for at least one hour, while maintaining the pH of the water between 7.0 and 7.6; or
  (ii) a bromine-based compound, equivalent to at least 20 mg/L of free bromine for at least one hour, while maintaining the pH of the water between 7.0 and 8.5;

"heterotrophic colony count" means an estimate of the number of viable units of bacteria per millilitre of water made using the pour plate, spread plate or membrane filter test (also known as the total bacterial count, total plate count or viable bacterial count test) method;

"Legionella" means bacteria belonging to the genus *Legionella***;**

"responsible person" means the person who owns, manages or controls the cooling tower system or warm water system;

"warm water system" means a piped water system, including any thermostatic mixing valve, which is designed to supply water at a temperature of between 30°C and 60°C.

6. Meaning of "cooling tower"

(1) In these Regulations, a "cooling tower" is a device for lowering -
  (a) the temperature of recirculated water by bringing the water into contact with fan forced or fan induced atmospheric air; or
  (b) the temperature of water, a refrigerant or other fluid in a pipe or other container by bringing recirculated water and fan forced or fan induced atmospheric air into contact with the pipe or container.

(2) An evaporative air cooler or evaporative air conditioner is not a cooling tower.

7. Meaning of "cooling tower system"

In these Regulations, a "cooling tower system" is-

(a) a cooling tower or a number of interconnected cooling towers that use the same recirculating water; and
(b) any machinery that is used to operate the tower or towers; and
(c) any associated tanks, pipes, valves, pumps or controls.

Part 2 – Maintenance and Testing of Cooling Tower Systems

8. Maintenance

The responsible person must ensure that any cooling tower system that the responsible person owns, manages or controls is maintained and tested in the manner set out in this Part, unless the system is shut down, or is otherwise not in use, and is completely drained of water.

9. Water quality and treatment

(1) The responsible person must ensure that the water of the cooling tower system is maintained in a clean condition.

Penalty: 20 penalty units.

(2) The responsible person must ensure that the water of the cooling tower system is continuously treated with-
(a) one or more biocides to effectively control the growth of microorganisms, including *Legionella*; and
(b) chemicals or other agents to minimise scale formation, corrosion and fouling.

Penalty: 20 penalty units.

10. Disinfection, cleaning and re-disinfection

The responsible person must ensure that a chlorine-compatible bio-dispersant is added to the recirculating water of the cooling tower system, and that the system is then disinfected, cleaned and re-disinfected–

(a) immediately prior to initial start up following commissioning, or any shut down period of greater than one month; and
(b) at intervals not exceeding 6 months.

Penalty: 20 penalty units.

11. Routine inspections and testing

(1) The responsible person must ensure that the cooling tower system is inspected at least once each month to check that the system is operating without defects.

Penalty: 10 penalty units.

(2) The responsible person must ensure that at least once each month a sample of the recirculating water of the cooling tower system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count.

Penalty: 20 penalty units.

12. High heterotrophic colony count detected in cooling tower system

(1) Within 24 hours of receiving a report that any sample of water taken from the cooling tower system has a heterotrophic colony count exceeding 100,000 colony forming units per millilitre, the responsible person must ensure that the following procedure is implemented-
(a) the water of the system must be manually treated with additional quantities of biocide, or with an alternative biocide.
(b) the water treatment program, tower operation and maintenance program of the system must be reviewed; and
(c) any faults must be corrected and any changes necessary to prevent a re-occurrence of those faults must be implemented

Penalty: 20 penalty units.

(2) Between 2 and 4 days after the water has been treated under sub-regulation (1), the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count.

Penalty: 20 penalty units.

(3) Within 24 hours of receiving a report that a sample taken in accordance with sub-regulation (2) has a heterotrophic colony count exceeding 100,000 colony forming units per millilitre, the responsible person must ensure that the water of the cooling tower system is disinfected, cleaned and re-disinfected.

Penalty: 20 penalty units.

(4) Between 2 and 4 days after the water has been re-disinfected under sub-regulation (3), the responsible person must ensure that a further sample of the recirculating water of the cooling tower system is taken and is delivered to a laboratory for testing and reporting on for heterotrophic colony count.

Penalty: 20 penalty units.

(5) If, after following the procedure in sub-regulations (1), (2), (3) and (4) the heterotrophic colony count still exceeds 100,000 colony forming units per millilitre, the responsible person must-
(a) ensure that the steps in sub-regulations (3) and (4) are repeated until the heterotrophic colony count does not exceed 100,000 colony forming units per millilitre in 2 consecutive water samples taken approximately one week apart; or
(b) close the cooling tower system until the problem has been remedied.

Penalty: 60 penalty units.

13. Legionella detected in cooling tower system

(1) Within 24 hours of receiving a report that *Legionella* has been detected in a water sample taken from a cooling tower system that is not associated with any suspected or known case of legionellosis, the responsible person must ensure that the following procedure is implemented-
(a) the cooling tower system must be disinfected; and
(b) the water treatment program, tower operation and maintenance program of the system must be reviewed; and
(c) any faults must be corrected and any changes necessary to prevent a re-occurrence of those faults must be implemented.

Penalty: 100 penalty units.

(2) Between 2 and 4 days after the disinfection required by sub-regulation (1) (a) has been completed, the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*.

Penalty: 20 penalty units.

(3) Within 24 hours of receiving a report that *Legionella* has been detected in a sample taken in accordance with sub-regulation (2), the responsible person must ensure that the water of the cooling tower system is disinfected, cleaned and re-disinfected.

Penalty: 20 penalty units.

(4) Between 2 and 4 days after the disinfection required by sub-regulation (3) has been completed, the responsible person must ensure that a further sample of the recirculating water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*.

Penalty: 20 penalty units.

(5) If, after following the procedure in sub-regulations (1), (2), (3) and (4) *Legionella* is still detected, the responsible person must-
(a) ensure that the steps in sub-regulations (3) and (4) are repeated until *Legionella* is not detected in 2 consecutive water samples taken approximately one week apart; or
(b) close the cooling tower system until the problem has been remedied.

Penalty: 100 penalty units.

Part 3–Maintenance and Testing of Warm Water Systems

14. Application

(1) This Part does not apply to a warm water system serving a single dwelling exclusively.
(2) Regulations 17, 18 and 19 do not apply to thermostatic mixing valves.

15. Maintenance

The responsible person must ensure that any warm water system that the responsible person owns, manages or controls is maintained and tested in the manner set out in this Part, unless the system is shut down, or is otherwise not in use, and is completely drained of water.

16. Start up procedures

The responsible person must ensure that the warm water system is disinfected by heat or chlorination and cleaned immediately prior to initial start up following commissioning, or any shut down period of greater than one month.

Penalty: 10 penalty units.

17. Routine disinfection

The responsible person must ensure that the warm water system is disinfected by one or more of the following methods-
(a) at least once each month by heat or chlorination; or
(b) continuously by means of automatic low level chlorination; or
(c) continuously by means of ultra-violet light treatment; or
(d) a method approved in writing by the Secretary.

Penalty: 20 penalty units.

18. Routine testing

Where the method of disinfection of a warm water system is by ultra-violet light treatment or a method approved under regulation 17(d), the responsible person must ensure that a sample of the water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*-
(a) at intervals not exceeding one month for a period of 12 months; and
(b) if Legionella is not detected in any sample taken and delivered to a laboratory for testing during the previous 12 months, at intervals not exceeding 3 months for so long as *Legionella* remains undetected in the system; and
(c) if *Legionella* is detected in any sample taken and delivered to a laboratory for testing during the previous 12 months, and the procedure under regulation 22 or 25 has been followed, then according to the intervals specified in paragraph (a).

Penalty: 20 penalty units.

19. Additional testing for premises where health or welfare services are provided

(1) Where a warm water system is in premises where health or welfare services are provided, the responsible person must ensure that samples of the water are taken from different outlets of the system and delivered to a laboratory for testing and reporting on for *Legionella*-

(a) where the method of disinfection is by heat or chlorination or low level chlorination under regulation 17(a) or (b)-

(i) at intervals not exceeding 3 months for a period of 12 months; and

(ii) if Legionella is not detected in any sample taken and delivered to a laboratory for testing during the previous 12 months, at intervals not exceeding 6 months for so long as *Legionella* remains undetected in the system; and

(iii) if *Legionella* is detected in any sample taken and delivered to a laboratory for testing during the previous 12 months, and the procedure under regulation 22 or 25 has been followed, then according to the intervals specified in sub-paragraph (i);

(b) where the method of disinfection is by ultra-violet light treatment or by a method approved under regulation 17(d), according to the intervals specified in regulation 18.

Penalty: 20 penalty units.

(2) If the system is disinfected at least each month, the samples must be taken just prior to the disinfection.

20. Warm water outlets

(1) The responsible person must ensure that at least once during each week all outlets of the warm water system not in use for 7 days or more are flushed at full flow.

Penalty: 20 penalty units.

(2) The period of flushing referred to in sub-regulation (1) must be sufficient to remove all stagnant water leading to the outlet, and until the temperature at which the system is set is reached at the outlet.

21. Thermostatic mixing valves

The responsible person must ensure that all thermostatic mixing valves of warm water systems are cleaned and maintained at least once in each calendar year.

Penalty: 10 penalty units.

22. Legionella detected in warm water systems

(1) Within 24 hours of receiving a report that *Legionella* has been detected in a water sample taken from a warm water system that is not associated with any suspected or known case of legionellosis, the responsible person must ensure that the following procedure is implemented-

(a) the warm water system must be disinfected by heat or chlorination;

(b) the warm water system operation, maintenance program and any water treatment must be reviewed; and

(c) any faults must be corrected and any changes necessary to prevent a re-occurrence of those faults must be implemented.

Penalty: 100 penalty units.

(2) Between 2 and 4 days after the disinfection required by sub-regulation (1) (a) has been completed, the responsible person must ensure that a further sample of the water of the system is taken and is delivered to a laboratory for testing and reporting on for *Legionella*.

Penalty: 20 penalty units.

(3) If, after following the procedure in sub-regulations (1) and (2), *Legionella* is still detected, the responsible person must-

(a) ensure that the steps in those sub-regulations are repeated until *Legionella* is no longer detected in 2 consecutive water samples taken approximately one week apart; or
(b) close the warm water system until the problem has been remedied.

Penalty: 100 penalty units.

Part 4 – General Provisions

23. Records

(1) The responsible person must-
(a) keep a maintenance log book in respect of each cooling tower system or warm water system that is owned, managed or controlled by the responsible person that records details of-
(i) all maintenance activities undertaken in relation to the system; and
(ii) all microbiological test results of samples taken from the system; and
(iii) any approval issued under regulation 24 in respect of the system; and

(b) keep the maintenance log book up to date and on the premises where the cooling tower system or warm water system is located.

Penalty: 20 penalty units.

(2) The responsible person must produce the maintenance log book and any other records relevant to sub-regulation (1) for inspection on the request of an authorised officer.

Penalty: 20 penalty units.

24. Secretary may approve a different method of maintenance and testing

(1) A person may apply to the Secretary for approval to use a method of maintaining and testing-
(a) a cooling tower system that is different from the method specified in Part 2;
(b) a warm water system that is different from the method specified in Part 3.

(2) The Secretary may approve the use of the different method if the Secretary is of the opinion-
(a) that the use of the method will achieve results that are at least equivalent to the results that would be achieved using the method specified in Part 2 or 3 (as the case may be); or
(b) that it is not practicable for the method specified in Part 2 or 3 (as the case may be) to be used in the circumstances applying to the system in respect of which the application is made.

(3) In approving the use of a different method the Secretary may impose any conditions in relation to the use of the system or the method that the Secretary considers to be appropriate.

(4) If the Secretary approves the use of a different method, the responsible person must ensure that any condition imposed by the Secretary in approving the use of the method is complied with while the method is being used.

Penalty: 100 penalty units.

(5) If the Secretary approves the use of a different method, the responsible person need not comply with Part 2 or 3 (as the case may be) while the method is being used.

25. Water system suspected or implicated as the source of infection

In any instance where the Secretary has informed the responsible person that the cooling tower system or warm water system is suspected or implicated as the source of infection in a case or an outbreak of legionellosis, that person must ensure that-

(a) a water sample from the system is promptly taken and delivered to a laboratory for testing and reporting on for *Legionella*; and

(b) the system is decontaminated in accordance with any reasonable directions given to that person by the Secretary.

Penalty: 100 penalty units.

Endnotes

[1] Reg 4: S.R. No. 85/1990. Reprinted to S.R. No. 232/1993. Subsequently amended by S.R. Nos 142/1994, 93/1996, 57/1998, 133/1998 and 108/1999.

Benefits of *Legionella* Package

Benefits of *Legionella* package, Scenario 1: 80% of cases attributable to cooling towers, " regulations 50% effective in reducing cooling-tower related cases.

Benefit Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	PV
Cases avoided	120	124	128	132	136	140	144	148	152	156	
Hospital cost savings	$1,916,340	$1,980,218	$2,044,096	$2,107,974	$2171852	$2,235,730	$2,299,608	$2363486	$2,427,364	$2491,242	$15,995,366.30
Other medical savings	$60,000	$62,000	$64,000	$66,000	$68,000	$70,000	$72,000	$74,000	$76,000	$78,000	$500,809.87
Output losses avoided	$600,000	$620,000	$640,000	$660,000	$680,000	$700,000	$720,000	$740,000	$760,000	$780,000	$5,008,098.66
		$2,576,460									
Present Value of benefits											$21,504,274.83

Assumptions

1. Medical cost savings are based on an average cost of hospitalisation of $16,810. Hospitalisations are 95 per cent of the number of cases avoided annually, which rise from 120 to 160 over the life of the regulations.
2. Output loss data based on annual average product of $50,000 per capita and an average 5 week absence from work, with no make-up of lost product by employers. This simplifies the likely reality of partial make up of production losses counteracted by further losses due to upstream and downstream effects.

Costs of *Legionella* package: Set Out by Regulatory Instrument

Cost Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	PV
Health (Legionella) Regulations 2001											
(a.) Cooling Towers											
Cleaning/disinfection after shutdowns	$862,500	$862,500	$862,500	$862,500	$862,500	$862,500	$862,500	$862,500	$862,500	$862,500	$6,348,075
Monthly testing for HCC	$1,671,000	$1,617,000	$1,591,000	$1,591,000	$1,591,000	$1,591,000	$1,591,000	$1,591,000	$1,591,000	$1,591,000	$11,808,510
Remedying high HCC readings	$396,000	$126,000	$-	$-	$-	$-	$-	$-	$-	$-	$485,724
Remedying detected Legionella.	$697,500	$348,750	$186,000	$186,000	$186,000	$186,000	$186,000	$186,000	$186,000	$186,000	$1,996,370
(b.) Warm water systems											
Start-up requirements	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$2,800	$20,608
Disinfection	$15,600	$15,600	$15,600	$15,600	$15,600	$15,600	$15,600	$15,600	$15,600	$15,600	$114,817
Water testing	$304,000	$76,000	$76,000	$76,000	$76,000	$76,000	$76,000	$76,000	$76,000	$76,000	$774,461
Flushing unused outlets	$312,000	$312,000	$312,000	$312,000	$312,000	$312,000	$312,000	$312,000	$312,000	$312,000	$2,296,347
Thermostatic mixing valves	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$716,645	-$5,274,570
Record keeping	$146,250	$146,250	$146,250	$146,250	$146,250	$146,250	$146,250	$146,250	$146,250	$146,250	$1,076,413
Total (Health Regulations)											$19,646,757
Building Act & Regulations											
Registration of cooling towers	$855,000	$631,250	$631,250	$631,250	$631,250	$631,250	$631,250	$631,250	$631,250	$631,250	$4,857,140
Formulation of Risk Management Plans	$ -	$1,512,500	$65,625	$65,625	$65,625	$65,625	$65,625	$65,625	$65,625	$65,625	$1,708,809
Review/updating of RMPs	$ -	$-	$570,000	$570,000	$570,000	$570,000	$570,000	$570,000	$570,000	$570,000	$3,150,216
Annual audit of RMPs	$ -	$-	$900,000	$900,000	$900,000	$900,000	$900,000	$900,000	$900,000	$900,000	$4,974,025
Legionella Testing	$1,075,000	$1,037,500	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$1,020,000	$7,574,751
Maintenance of records.	$562,500	$562,500	$562,500	$562,500	$562,500	$562,500	$562,500	$562,500	$562,500	$562,500	$4,140,049
											$26,404,989
Other (non-regulated)											
Additional tech. Assistance (DHS)	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$1,840,022
Random inspections	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$2,208,026
Total Year 1 costs (PV)	$6,733,505	$7,084,005	$6,774,880								
Total PV of Costs											$50,099,794