TASKFORCE MEMBERS

Councillor Jim Soorley	Lord Mayor of Brisbane (*Chair of the Taskforce*)
L. Peter Ryan	Australian Dental Association
Dr John Pearn	Australian Medical Association
Susan Wareham	Australian Medical Association
Dr Paul Wood	Queensland Health
Dr John Scott	Queensland Health
Laurence Walsh	School of Dentistry, University of Queensland
Kevin Balanda	Medical School, University of Queensland
Dr Fred Clutterbuck	Australian College of Nutrition & Environmental Medicine
Dr J. Barry Ryan	Australian Society of Environmental Medicine
Ralph Ash	Caboolture Shire Council
Cr John Nugent	Ipswich City Council
Peter Barwise	Logan City Council
Soma Somasekaran	Pine Rivers Shire Council
Dr Peter Houston	Redcliffe City Council
Colleen South	Queensland Federation of P&F Association
Debra Kennedy	Queensland Federation of P&F Association
Henry Osiecki	Member of the Public

Ex-officio Members:

Pauline Peel	Acting Divisional Manager, Community and Economic Development - Brisbane City Council
Garth Bellingham	Manager, Water Utility - Brisbane City Council
Ian Christesen	Acting Manager, Community Health and Safety - Brisbane City Council
John Martin	Health Planning Officer, Community Health and Safety - Brisbane City Council (*Executive Officer of the Taskforce*)
Eileen Watterton	Project Officer, Community Health and Safety - Brisbane City Council.

Former Ex-officio Members:

Jude Munro	Former Manager, Department of Recreation and Health - Brisbane City Council
Gary Law	Former Manager, Brisbane Water - Brisbane City Council
Michael Whittaker	Former Director, Community Health Branch - Brisbane City Council

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CHAPTER 1: EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Lord Mayor's Taskforce on Fluoridation was established in January 1997 in response to debate in the media and the political arena about whether Brisbane's water supply should be fluoridated.

The Taskforce agreed Terms of Reference (Chapter 2), and set a work program to report to the Lord Mayor with conclusions by October 1997. During the course of its deliberations the Taskforce considered the spectrum of issues arising from fluoridation under the following broad headings:

- History and Legal Issues (Chapter 4)
- Ethical Considerations (Chapter 5)
- Dental Costs and Benefits (Chapter 6)
- Human Health Effects (Chapter 7)
- Environmental Impact (Chapter 8)
- Consideration of Economic Cost/Benefit Analysis (Chapter 9)
- Public Consultation (Chapter 10)
- Assessment of Benefits and Risks (Chapter 11)

1.2 LEGISLATION

The Taskforce considered the legislative position of water fluoridation which is governed by the ***Fluoridation of Public Water Supplies Act 1963 (and Regulation 1964),*** as amended. This enabling legislation authorises local governments in Queensland to decide whether or not to fluoridate public water supplies under its control. The Taskforce obtained legal advice that Brisbane City Council is not obliged to conduct a public poll in order to decide whether to fluoridate. However, if Council did decide to conduct a poll, it would be bound by the majority verdict.

1.3 ETHICAL FRAMEWORK

The Taskforce agreed an ethical framework for considering the different issues and options arising from water fluoridation, and trying to reach the best decision possible, based on the available evidence. The framework was based on a recent paper, 'Fluoridation of Public Water Supply: Ethical Consideration' prepared by the University of Auckland in 1990 (Appendix 3).

1.4 EFFECTIVENESS OF WATER FLUORIDATION

Hundreds of research studies in many different countries have examined the effectiveness of water fluoridation over the past 50 years. There is also an enormous volume of literature on the subject, much of it propagandist by the two sides of the argument. It was neither feasible nor sensible for this inquiry to try to examine all the evidence. An attempt to do so would have risked becoming bogged down in the mass of conflicting and often contradictory detail. However, the Taskforce did try to identify key representative studies, and particularly those omnibus studies which summarised a body of evidence. The Taskforce unanimously agreed that the weight of evidence clearly demonstrated that fluoridated water had a beneficial effect in reducing dental caries, including an effect over and above the benefits from other discretionary sources of fluoride, e.g. fluoridated toothpaste, which are in such common use.

Taskforce opinion, however, was sharply divided on the extent of the dental benefits which fluoridated water alone could produce. In the 1950s, when DMFT (decayed, missing, filled teeth index) rates for, for example, 12 year olds in Brisbane might have averaged 10-12 affected teeth, the introduction of fluoridated water could be predicted to save half or more of those teeth within a few years of introduction.

However, the reductions in dental decay in both fluoridated and unfluoridated communities since the 1960s have been remarkable, with the result that the latest DMFT (1995) figure for 12 year olds in Queensland stands at 1.37 affected teeth (compared with 5.51 in 1976), slightly higher than the average for Australia as a whole. Dental experts and supporters of fluoridation on the Taskforce argued that recent studies showed that reductions of 15-40% in decay rates could still be attributed to fluoridated water alone. Opponents pointed to the complex and subjective nature of dental statistics and argued that dental caries rates in Queensland were now so low that percentage reductions, representing a small proportion of a single tooth surface, were inherently unreliable and not statistically significant.

1.5 HUMAN HEALTH EFFECTS

The review of the human health effects of fluoridation commissioned by the Taskforce concluded that there was no reliable scientific evidence proving a causal association between water fluoridation and many of the adverse health effects which have been linked to it. However, the ambiguous scientific evidence in relation to an increased risk of hip fractures, was a concern to a majority of Taskforce members. There may also be potential risks for some groups who consume particularly large quantities of water, e.g.

sportspersons, outdoor workers etc, and special arrangements would be required for kidney dialysis patients.

Many Taskforce members were profoundly concerned about the impact that water fluoridation might have on the total intake level of fluoride by babies and young children, and also the lifetime effects of the accumulation of fluoride in the body. Expert opinion on these issues was ambivalent. In 1991, the NHMRC Working Group called for a multi-disciplinary group to investigate total fluoride intake in Australia, and examine the differences between fluoridated and unfluoridated areas. Many members of the Taskforce were dismayed that apparently, this research has still not been carried out. There can be no doubt that the absence of contemporary Australian research in respect of these important and legitimate concerns, whether as a result of lack of will or lack of resources, represented a serious impediment to the pro-fluoridation case.

1.6 ENVIRONMENTAL IMPACT

The majority of Taskforce members generally accepted the findings of Dr Miller's limited study of the potential impact of a fluoridated water supply on the local Brisbane environment. Dr Miller's review concluded that some sensitive plant and animal species could be affected by the advent of fluoridation, particularly in drought/low flow conditions. The Taskforce accepted Dr Miller's recommendation that further studies would be required.

1.7 ECONOMIC COST/BENEFIT ANALYSIS

An examination of the literature on recent fluoridation cost/benefit analyses showed that the process was inherently complex because of the variety of different assumptions which have to be taken into account. The Taskforce was aware from the study by *White et al. (1989)* that research studies generally have failed to incorporate important factors, such as the declining prevalence of dental caries in recent decades.

However, the Taskforce accepted that cost/benefit analyses of fluoridation invariably show a positive economic case for fluoridation, though opponents of fluoridation argued that the risks to health have never been fully accounted for in the equation.

The Taskforce unanimously decided that it would not be practical to commission a full cost/benefit analysis for Brisbane. Besides, it was agreed that the economic cost of fluoridation was not a decisive factor in reaching a decision on the issue.

1.8 TASKFORCE ASSESSMENT OF THE BENEFITS AND RISKS OF WATER FLUORIDATION

In weighing up all the benefits and risks of water fluoridation, a small majority of Taskforce members (52%) indicated that they were currently opposed to fluoridation of Brisbane's water supply. This contrasted with a significant majority of members who stated that they had been in support of fluoridation when the Taskforce began. The views of 'committed' supporters and opponents of fluoridation on the Taskforce did not change as a result of the Taskforce process. However, a significant proportion of 'uncommitted' members shifted position from strong support to opposition.

It was clear from members' responses to a questionnaire at the end of the Taskforce process that the arguments in support of fluoridation had failed to convince a majority of Taskforce members in relation to a number of areas of concern.

CHAPTER 2: INTRODUCTION AND TERMS OF REFERENCE

The fluoridation of a public water supply is a highly complex and contentious subject which is still capable of arousing deep emotions and antipathies in spite of the fact that, as a public health measure aimed at reducing dental decay, it has now been around for more than 50 years.

All the capital cities of Australia, with the exception of Brisbane, were fluoridated during the 1960s and 1970s. Some of the reasons for Brisbane's resistance to fluoridation seem to have been lost in the mists of time. Although the issue has been raised and debated periodically in Brisbane over the last 30 years, the strength of public opinion and political will has never been sufficiently strong to bring about its introduction. Prior to the last Council elections in March 1997, the issue was again raised in the press and threatened to become a political football during the election campaign. The Lord Mayor decided that an issue concerning the health of the whole community was too important to politicise, and that a Taskforce should be established to weigh up all the available evidence and report back to him with conclusions.

2.1 TERMS OF REFERENCE:

The Terms of Reference of the Taskforce were as follows:

- To collect expert information on fluorides and fluoridation, e.g. types of fluoride, levels of safety and toxicity, etc.

- To define the costs and benefits to human health in Brisbane of dental caries, fluoridation and non fluoridation of Brisbane's water supply.

- To identify practical measures to support individuals or classes of individuals, who have particular health issues arising from fluoridation.

- To identify the legal issues associated with fluoridation and non-fluoridation of water as a public health measure.

- To identify the ethical issues associated with fluoridation.

- To identify community views and concerns about fluoridation within the City of Brisbane.

- To develop a comprehensive range of options and conduct a cost benefit analysis, specifically the effectiveness, technical aspects and costs of fluoridation options including distribution.

- To liaise with Brisbane Water's bulk water customers, specifically, relevant surrounding local authorities on the findings and recommendations of the Committee, through the auspices of Brisbane Water.

- To identify a work program and timetable to report by October 1997.

CHAPTER 3: METHODOLOGY

The Lord Mayor's Taskforce on Fluoridation agreed to a proposed methodology for tackling the issues arising from fluoridation of the water supply, including Terms of Reference, Work Program (Appendix 13), a framework for weighing the benefits and risks, and the formation of a Taskforce Sub-group.

3.1 TERMS OF REFERENCE

Draft Terms of Reference were provided to the Taskforce and were agreed after discussion at Meeting 1, 12 February 1997. The Terms of Reference were designed to provide a broad framework for the Taskforce to work within. (Chapter 2 refers).

3.2 WORK PROGRAM

A Work Program was devised following the identification of relevant issues. This was revised as necessary throughout the course of the Taskforce's deliberations. Reasons for changes in the Work Program have included the need for further discussion on relevant papers, e.g. the paper on 'Dental Risks and Benefits', or to fit with the availability of invited experts, such as, Dr Colquhoun and Dr Diesendorf. The work program was agreed at Meeting 2, 26 February 1997.

3.3 TASKFORCE MEMBERSHIP

The Taskforce was chaired by Brisbane City Council's Lord Mayor, Councillor Soorley and was comprised of 17 members from various professional and community bodies, as well as 5 Council officers to provide support and secretariat. The Taskforce membership was designed to provide a balance of opinion and expertise by including representatives from professions who have a interest in fluoridating the water supply, professionals who may hold a different view, other local governments who would be affected, and the general public.

The following organisations were invited to join the Taskforce:

- Australian Dental Association
- Australian Medical Association
- University of Queensland (School of Dentistry & Medical School)
- Queensland Federation of Parents and Friends Association
- Australian Society Environmental Medicine

- Australian College of Nutrition & Environmental Medicine

There are five local authorities who purchase their water from the City of Brisbane who also have a vested interest in the decision about whether to fluoridate Brisbane's water supply. Representatives from the following bulk water customers were invited to join the Taskforce:

- Logan City Council
- Ipswich City Council
- Redcliffe City Council
- Caboolture Shire Council
- Pine Rivers Shire Council

Taskforce officials received some complaints initially that the numerical balance of the Taskforce membership favoured those health professions and organisations that support fluoridation. However, half the members of the Taskforce were representatives of local governments and other organisations who were regarded as broadly neutral on the issue of fluoridation.

3.4 TASKFORCE SUB-GROUP

Due to the volume of literature pertaining to water fluoridation, a need was identified for a small group to review some of the more complex issues and report back to the Taskforce. The purpose of the Sub-group was to research, analyse and summarise studies and literature representative of the large body of research on water fluoridation. The Taskforce agreed to the establishment of the Sub-group at Meeting 4, 26 March 1997. The Sub-group held three meetings and a summary of their discussions is contained in Chapters 5 and 6.

3.5 ETHICS PAPER

An ethical framework to guide the work of the Taskforce, described in a paper by the University of Auckland, *Fluoridation of Public Water Supply: Ethical Consideration*, was considered by the Taskforce and accepted in part at Meeting 3, 12 March 1997. This aspect is described in detail in Chapter 5.

3.6 TASKFORCE PROCESS

The issue of the 'process' that the Taskforce should use to reach conclusions was raised on a number of occasions at Taskforce meetings. The Taskforce meetings themselves formed an integral part of the decision making process. These meetings have provided a

forum for the identification of relevant issues, discussion of these topics and suggestions for further discussion/clarification.

It was agreed at Meeting 4, 26 March 1997 that the Taskforce would produce a final report summarising areas of agreement and disagreement, attempt to weigh up the probability and seriousness of the risks and benefits of water fluoridation and other options, and present its conclusions to the Lord Mayor.

Some of the major enquiries into water fluoridation in the last 40 years, e.g. the *Lord Jauncey Report, Scotland (1981)* or the *ACT Legislative Assembly Inquiry (1989 - 91)*, have attempted to analyse the whole body of evidence relating to fluoridation, both scientific and lay opinion. These inquiries have taken years to complete and it can be argued that, such is the volume and complexity of evidence and opinion, any attempt to cover the whole field would be likely to fail to some extent. This report does not attempt to debate every aspect in minute detail or adjudicate point by point on the evidence. Instead, the report hopes to capture and reflect the dynamic nature of the Taskforce process itself.

3.7 KEY PAPERS

The field of water fluoridation contains an enormous volume of reports and studies. The major papers identified initially by the Taskforce as important background material and of particular relevance were:

- *The Effectiveness of Water Fluoridation* (NHMRC, 1991);
- *Inquiry into Water Fluoridation in the ACT* (Legislative Assembly ACT, 1991);
- *Report of the Committee of Inquiry into the Fluoridation of Victorian Water Supplies* (Legislative Assembly, 1980);
- Tasmanian Royal Commission, 1968
- *Water Fluoridation in New Zealand* (PHC, 1994);
- *Fluoride in Australia: A Case to Answer* (Varney, 1986).

Other key reports/papers referred to regularly in discussions to date have included:

- *The National Oral Health Survey* (Dept of Health, Housing, Local Government and Community Services, 1988);
- *Caries experience among children in fluoridated Townsville and unfluoridated Brisbane* (Slade, et al, 1996)
- *Fluoridation of Public Water Supply: Ethical Consideration* (Dr D. Robinson et al, 1990);
- *Fluorides and Oral Health* (WHO, 1994);

- *Trace Elements in Human Nutrition and Health* (WHO, 1996);
- *Fluoride Content of Infant Formulae in Australia* (Silva & Reynolds, 1996);
- *The Metabolism and Toxicity of Fluoride* (Whitford, 1996);
- *The Brisbane Statistical Division Survey of Adult Dental Health* (UQ, 1984);
- *The Mystery of Declining Tooth Decay* (Diesendorf, 1986); and
- *Is there a Dental Benefit from Water Fluoride?* (Colquhoun, 1994).

3.8 LITERATURE SEARCHES

Relevant literature was identified through searches of local Council, University and Dental School libraries. These have been included in the Bibliography. CD-ROM searches were also undertaken utilising the following databases:

- Medline
- Biological Abstracts

3.9 INTERNET SEARCHES

A trawl of material on the Internet was a useful process to see what information the general public was being exposed to, and to identify points that would be utilised by the various groups involved in the debate. However, much of the content was propagandist, emotive and unscientific.

3.10 EXPERT SUBMISSIONS FROM TASKFORCE MEMBERS

Submissions were provided by organisations represented by Taskforce members. Several of these presented polarised views, while others called for more information and public education on the actual costs, benefits and risks. Submissions were received from the following groups:

- The Public Health Association of Australia
- The Australian Medical Association
- The Australian Dental Association
- Logan City Council
- Ipswich City Council
- Queensland Health
- The Australian College of Nutrition and Environmental Medicine
- The Federation of P&F Associations Queensland

3.11 COMMUNITY CONSULTATION

The Taskforce agreed that the most important and relevant views on the issue of water fluoridation were those of the communities affected. The Taskforce recognised the need to invite and gauge public opinion on this issue, and did so via the mechanisms of a telephone survey, a request for written public submissions, and a public meeting in the City Hall. Details of the outcomes are contained in Chapter 10 and Appendices 14 - 16.

3.12 TECHNICAL ASPECTS

The technical aspects relating to the fluoridation of a water supply, and removal of fluoride from the water supply were also considered. (Appendices 8 and 9).

3.13 ONGOING INFORMATION PROVISION

National and state-wide statistics were provided as necessary by Queensland's Department of Health. Much of the literature required by the Taskforce to aid the decision-making process was accessed via University of Queensland resources, particularly the Dental and Medical Schools.

3.14 COMMISSIONED PAPERS

The Taskforce identified a number of specific issues that would require expert advice and commissioned consultants to prepare reports on:

3.14.1 Paper 6: Dental Costs and Benefits of Water Fluoridation

A member of the Taskforce, Associate Prof Dr Laurence Walsh *(BDSc, PhD, DDSc, FFOPRCPA*) from the School of Dentistry, University of Queensland was commissioned to prepare an expert paper on 'Dental Costs and Benefits'.

3.14.2 Paper 7: Non-Dental Human Health Effects of Water Fluoridation

Prof Ken Donald (*MBBS. PhD, FRCPA, MRCPath, FRACMA, FRACS*) and Dr Penelope Webb (*MA, DPhil*), both from the Department of Social and Preventive Medicine, University of Queensland were commissioned to review other (non-dental) human health effects.

3.14.3 Paper 10: Environmental Impact of Fluoride

Dr Greg Miller, Director of Envirotest (an environmental science based company) was commissioned to carry out a review of the potential environmental impacts of water fluoridation.

3.14.4 Dr Ken Armstrong (B.Sc, M.Com, MBBS, FRACP) from the Community Child Health Service was commissioned to revisit the evidence of the effects of fluoride on babies and young children, and to present his findings in layman's language, where possible.

3.14.5 Background Papers

Taskforce officials drafted brief background papers relating to:

Paper 1: History and Legal Issues
Paper 2: Understanding Fluoride
Paper 4: Fluoride Options - Trends in Australia and Internationally
Paper 5: Report on Public and Community Views (Summary)
Paper 8: Considerations Associated with the Dosing of Fluoride into the Brisbane Region Water Supply
Paper 9: Study of Fluoride Removal Options
Paper 11: Cost Benefit Analysis of Fluoridation Options

These papers are listed as appendices (page 92). All appendices listed in this report have been printed as a separate document.

3.15 LIMITATIONS OF THE REVIEW

There are a number of limitations to this review that are important to acknowledge.

There is a vast volume of literature available on the issue of fluoridation and its effects and benefits, including literally hundreds of scientific studies. The Taskforce attempted to identify and consider key representative examples of important findings, taking account of both sides of the argument.

It was recognised that computerised databases such as Medline do not cover all the scientific literature, e.g. some studies published in non-English languages were not included. The literature in these databases may also be subject to a degree of professional bias.

The dental statistics relating specifically to Brisbane were limited and dated. Research data was available from the 1995 studies undertaken by the University of Adelaide, including the study comparing Brisbane and Townsville children. The most comprehensive source of relevant dental research data was from the 1987 National Oral Health Survey, and no comprehensive review has been undertaken since then.

Local authorities traditionally have limited resources to commit to such an issue. This study was an investigation only and should not be compared with a Royal Commission e.g. the 1968 Tasmanian Royal Commission study into fluoridation.

3.16 INVITED EXPERTS

The Taskforce recognised that the commissioned studies relating to 'Dental Costs and Benefits' (Appendix 6), and 'Non-dental Human Health Effects' (Appendix 7) were prepared by dental and medical experts who would be presumed to favour water fluoridation as a public health measure. In order to ensure a balanced argument, the Taskforce also invited two noted opponents of fluoridation, Prof Mark Diesendorf and Dr John Colquhoun to give presentations to the Taskforce. Dr Colquhoun also participated in the public meeting.

CHAPTER 4: HISTORY, ISSUES AND LEGISLATION

4.1 ORIGINS:

The fluoridation debate has a long history back to the early 1900s and has been characterised by an extreme polarisation of views between those supporting and those opposed. There are few other issues which have such a long and continuous history of antagonism and where it can be said that the two sides are as far apart today as they have ever been. This may be due in part to the unique nature of fluoridation as a public health measure which aims to directly affect the health (dental) of the whole population without requiring any conscious effort or decision making on the part of individuals.

A complete history of the fluoridation debate and its many issues would probably occupy several textbooks, and that is not the intention of this report. However, an overview of the history and issues is necessary to gain an appreciation of the complexities and difficulties inherent in this contentious subject.

The first water fluoridation trials began in the US in Grand Rapids, Michigan in 1945 following a series of studies in the 1930s, particularly in Colorado, which had identified that brown staining (dental fluorosis) on the teeth of local residents was due to the naturally high level of fluoride in the water supply. As well as producing staining, the high levels of fluoride were also associated with lower levels of dental decay than other communities with low levels of fluoride [85].

The work of Dr Trendley Dean in the US in the 1930s and 1940s established a 'minimum threshold' of 1 part per million of fluoride in water, a level calculated to provide optimum benefit in reducing dental caries while also minimising the risks of dental fluorosis. As a result of the efforts of a small number of zealous dental supporters of fluoridation, the practice rapidly spread in the US during the 1940s - 60s until some 62% of the US population are currently served by fluoridated water supplies [85].

4.2 NATURE OF FLUORIDE:

Fluorine is the 13th most abundant element on earth and a member of a group of elements termed the 'halogens' which also include chlorine, bromine and iodine. All of these elements readily combine with metals to form salts. Fluorine is the most electro-negative and reactive of all elements and consequently is rarely found in its elemental state.

Fluorine readily reacts with metallic elements to form a wide variety of ionic fluoride salts,

some strongly alkali or acid. Fluoride occurs naturally in seawater in concentrations ranging from 0.8 to 1.4 parts per million (ppm), as well as in soil and the air. Naturally occurring fluoride concentrations in drinking water depend on type of soil or rock through which the water drains. These concentrations vary from 0.1 - 0.5ppm to levels of 1-10 ppm[42]. (For a more detailed description of the physical and chemical properties of fluoride salts, see Chapters 2 and 3 of Appendix 10).

4.3 TOXICITY OF FLUORIDES:

The physical and chemical properties of the various compounds of fluorine vary considerably, and the toxic properties range from extremely toxic to completely non-toxic. Fluoride salts are widely used as insecticides and poisons for rodents. In concentrated form they act as very powerful inhibitors of the enzymes which produce the energy requirements of living cells. At doses in excess of 2 grams this effect could also be fatal in humans.

The fluoride salts commonly used in fluoridating public water supplies are sodium fluoride; sodium fluorosilicate; and fluorosilicic acid. These are primarily by-products of the phosphate fertiliser industry. The properties of these compounds are described in more detail in Appendix 2.

A number of other fluoride salts have been tested for water fluoridation, including ammonium and magnesium silicofluoride, potassium fluoride, hydrofluoric acid and calcium fluoride (fluorspar) but each has undesirable characteristics that prevents widespread use (e.g. calcium fluoride is less toxic than sodium fluoride but is difficult to dissolve in water).

The National Health and Medical Research Council (NHMRC) study in 1991 'The Effectiveness of Water Fluoridation' [21] examined, inter alia, the possible toxicity of fluoridated water and the appropriate safety margins. The study included a guide to the probable dose-response relationship for fluoride toxicity and this is shown as a table in Appendix 2 (paragraph 3.4).

There are no definitive answers in the scientific literature regarding an optimal dose of fluoride intake in children or adults. More research has been done for children than adults. The figures below show the most commonly quoted limits for a 14kg and 22kg child (approx age 3-6 years), and a 70kg adult.

- The probable toxic dose (PTD) of a substance is defined as 'the minimum dose that could cause toxic signs and symptoms, including death, and that should trigger immediate therapeutic intervention and hospitalisation'. (*Whitford (1996) - The*

Metabolism and Toxicity of Fluoride).

- PTD of fluoride is considered to be 5mg/kg body weight[139].

- To avoid dental fluorosis the level recommended is less than 0.1mgF/kg body weight[107]. The World Health Organisation states that 'dental mottling may be taken as a definitive sign of toxicity' [56].

- Total intake: it is suggested that the useful upper limit for total fluoride intake in children is 0.05 - 0.07mg/kg body weight. More recent reports have suggested a lower threshold of 0.03 - 0.1 mgF/kg of body weight. This includes dietary and discretionary sources[42].

- Patients who undergo renal dialysis may be at increased risk of side effects, ranging from gastrointestinal upsets to skeletal fluorosis, as impaired kidneys may be unable to clear fluoride from the system. (Appendix 7).

- To produce skeletal fluorosis, the intake of fluoride must be chronic (ie over many years). There are disagreements in the literature about the amount required to produce this condition, but it seems to vary depending on nutritional status.

Amount of fluoride to be ingested from all sources to create various conditions:

Condition	**Dose** mg/kg BW/day	**Amount to be ingested to reach dose**		
		14kg child	**22kg child**	**70kg adult**
Probable Toxic Dose (PTD)	5	70mg	110mg	300mg
Recommended limit - children	0.05-0.07	0.7-0.98mg	1.1-1.54mg	n/a
Recommended limit - children (lower level)	0.03	0.42mg	0.66mg	n/a
Dental Fluorosis	0.1	1.4mg	2.2mg	n/a
Skeletal Fluorosis	chronic	0.7 → 3ppm depending on nutritional status		

The first and most obvious effect of excess ingestion of fluoride is dental fluorosis, a mottling of the teeth which can range from mild (so that only dentists would be likely to detect it) to severe mottling causing complete discolouration, pitting and possible tooth deformation. Mild dental fluorosis has been reported to occur at concentrations of fluoride above 0.6 ppm. Chronic intake of more than 6 ppm results in severe mottling of tooth enamel (Chapter 6 refers).

4.4 RECOMMENDED SAFE LEVELS OF FLUORIDE:

Observational studies in the 1930s identified fluoride concentrations of 1ppm (or 1mg per litre) as the optimum level for caries prevention while minimising the risk of dental fluorosis. The US Public Health Service (USPHS) review of drinking water standards in 1991, and periodic reviews by NHMRC, have confirmed optimal levels between 0.7 and 1.2 ppm, dependant on average daily air temperature (and consequential variation in consumption of water). [21]

However, the WHO has reviewed the USPHS guidelines on fluoride concentration in the light of concerns emanating from Hong Kong in the 1970s and 1980s about excessive levels of dental fluorosis. Hong Kong first fluoridated in 1961 and has adjusted the fluoride concentration of its water supply several times because of climatic considerations. The WHO has stated that the USPHS recommended concentrations are too high for tropical and subtropical climates and have instead recommended a maximum level of 0.5ppm, or half the optimal fluoride concentration[42].

Fluoride from drinking water is only one source of total daily intake. The other main sources are dietary, in the form of foods and drinks which have a natural level of fluoride in them or where the food/drink has been prepared using fluoridated water. Other sources include toothpaste, fluoride tablets and drops, and dental applications of fluoride. Fluoride in fluoridated drinking water accounts for approximately one quarter of the average daily intake in young children and approximately half total intake in adults. [21]

4.5 FLUORIDATION IN AUSTRALIA:

World War 2 triggered a greater interest in dental health in Australia and elsewhere because of the large number of potential recruits who were found to be unfit for service because of their level of dental decay. The post war rationale for water fluoridation in Australia rested on the poor dental health of Australian children, where an average 12 year old might have a decayed, missing of filled tooth (DMF index) for every year of his/her life, i.e. as many as 10 -12 affected teeth at age 12[31].

Fluoridation in Australia began in the small Tasmanian town of Beaconsfield in 1953[31]. During the 1950s and 60s, State legislation was enacted across Australia to authorise State health authorities or local governments to introduce water fluoridation. The earliest capital cities to be fluoridated were Canberra (1964) and Hobart (1964), followed by Perth (1968) and Sydney (1968). Adelaide (1971) and Darwin (1972) followed, and the last major population centre to be fluoridated was Melbourne in 1977.

Brisbane is the only capital city which remains unfluoridated and Queensland has by far the lowest percentage of the population consuming artificially fluoridated water, at around 5%. Australia now has one of the highest proportions of the population using fluoridated water in the world, estimated in 1990 at 65-70%. The Queensland Government has consistently adopted the policy that water fluoridation is a local authority decision. The following Queensland towns/districts have artificially fluoridated water supplies:

- Townsville/Thuringowa, Gatton, Biloela, Moranbah, Mareeba and Dalby.

Although the states of New South Wales (82%) and Victoria (71%) are heavily fluoridated, there are a number of large communities which have resisted or rejected water fluoridation including the north coast of NSW, and Geelong, Bendigo, Ballarat, Mildura and Warrnambool (Victoria). It is widely acknowledged, even by supporters of fluoridation, that support for the measure appears to have decreased considerably since the 1950s and 60s. This has been due in part to the very significant decline in dental decay in recent decades in both fluoridated and unfluoridated communities, coupled with an increasing emphasis on other aspects of health, e.g. diet and smoking; and also as a result of increasingly well organised and sophisticated community opposition to water fluoridation[31].

4.6 FLUORIDATION INTERNATIONALLY:

In considering the trends in water fluoridation worldwide, a number of factors have to be borne in mind:

- water fluoridation tends to be associated with more developed countries which have a reliable and centralised water supply system;
- the constitutional and legal position relating to water fluoridation varies from country to country;
- the level of government responsibility for public water supplies also varies;
- some countries have large areas which have naturally high levels of fluoride[42].

The World Health Organisation (WHO) has consistently supported water fluoridation since the early 1950s as an effective, safe and inexpensive preventive measure which also has

the virtue of requiring no active participation on the part of the persons benefited. However, WHO also recommend that - 'to determine when it is appropriate to fluoridate is a matter that requires the prior determination of prevailing fluoride intake from all sources including drinking water, food and the general environment'[42].

Following the rapid expansion of water fluoridation from the 1940s to 1960s, particularly in the US, Canada, Australia and New Zealand, even the most ardent proponent of fluoridation would probably admit that there has been little growth in recent decades. Some significant trends are listed below:-

- **USA:** The US has set a national target of extending fluoridated water supplies to 75% of the population by the year 2000. Some 62% of the population is presently covered, and achieving that objective appears unlikely in the face of concerted and vigorous opposition from a range of well organised interest groups. These groups represent concerns about health risks, civil liberties and the environment. The media exerts a powerful influence on decisions at local level, and it appears to be easier to campaign successfully on the negative aspects of fluoridation than the positive[16].

- **South America:** Fluoridation has been fairly widespread in Central and South America with 10% of the population receiving fluoridated supplies in 1968.[57]

- **Europe:** Only a small proportion of the European population (<5%) are served by fluoridated water supplies, mainly in Ireland (>60%) and the UK (10%).[57] A number of European countries have moved away from fluoridation in recent decades. The Scandinavian countries have shifted from a pro-fluoridation stance pre-1960, to one of leaving decisions about fluoridation to local communities, while also pointing to declining caries levels and advocating reliance on other methods to tackle the remaining problem, i.e. mouthrinsing, tablets, toothpaste, etc. Holland also seems to have decided that decreasing levels of caries means that the scale of the problem no longer warrants water fluoridation. France and Switzerland have opted for fluoridated salt while in the UK, only 10% of the population is covered in spite of enabling legislation and government approval. Water fluoridation appears to be non-existent in Germany, Italy and a number of other European countries.

- **Asia:** Fluoridation of public water supplies is not widespread in Asia. A number of prominent countries have banned water fluoridation, including Japan [57] and Korea, generally on the basis that water supplies should remain as pure as possible. China has experimented with water fluoridation in the past but appears to have discontinued pilot schemes during the 1980s. Some parts of India and China have

high levels of fluorosis, including skeletal fluorosis, because of very high natural levels of fluoride in water supplies.

4.7 LEGISLATIVE ISSUES:

Fluoridation in Queensland is governed by the ***Fluoridation of Public Water Supplies Act 1963*** [26], and ***Fluoridation of Public Water Supplies Regulation 1964*** [27], as amended. Brisbane City Council currently supplies water to its own residents and those of neighbouring Ipswich, Logan City, Redcliffe, and parts of Pine Rivers Shire and Caboolture Shire. The current design of the water supply system means that if Council decided to fluoridate its supply, this would result in the residents of those other areas also receiving a fluoridated water supply. A decision by BCC to fluoridate Brisbane's public water supply could give rise to a number of issues of interpretation of the legislation, as outlined below

Section 4(1A) of the *Fluoridation Act* authorises a local government to add fluorine to any public water supply under its control. However, Section 4(1A) also states that a local government **shall not** fluoridate if a majority at a poll vote against fluoridation. Legal advice is that Council is not obliged to conduct a poll to decide to fluoridate Brisbane's water supply. However, if Council decided to fluoridate without holding a poll, it is possible that State Government may seek to amend the Fluoridation legislation to require a poll to be held. If BCC did hold a poll and a majority of voters were against fluoridation, Council cannot proceed to fluoridate.

Section 5 of the *Fluoridation Act* provides for indemnity by State Treasury in respect of 'all costs and expenses properly incurred by [local government]'. The indemnity does not appear to cover actual damages awarded against Council, only its legal costs and expenses. The indemnity is rather limited and only arises where the State Treasurer 'is satisfied that the alleged cause of action or other proceeding created no legal liability whatsoever in the local government'. Accordingly, legal advice is that the net effect of Section 5 is that indemnity is offered to Council only in respect of the costs of defending frivolous or vexatious litigation, and would not affect Council's liability to its residents for damages caused to them by the addition of fluoride if Council's liability was proven.

The *Fluoridation Regulation* controls the addition of fluorine to public water supplies and provides detailed provisions about the following aspects:-

- Local government must notify the Chief Health Officer of a decision to fluoridate;
- Minimum and maximum concentrations of fluoride;
- Use of trained staff;

- Analysis of treated water as prescribed;
- Keeping of accurate records;
- Various other requirements concerning the keeping of fluoride.

4.8 LEGAL POSITION INTERNATIONALLY:

In the US, legal challenges against fluoridation have become commonplace. One survey found that in the five years up to 1984 there had been 255 challenges to fluoridation programs. As a result, 36% of these programs were terminated and 14% delayed or curtailed. A review of referenda in the 1980s found that 63% of 163 community fluoridation referenda failed to pass decisions to fluoridate.

In the United Kingdom a long and costly legal case was fought in Scotland against fluoridation in the 1980s *(McColl v. Strathclyde Regional Council, 1983)*[12] The court sat on 201 days making it the longest and costliest case in Scottish legal history. Exhaustive evidence was heard from leading experts worldwide on both sides of the argument. The judge, Lord Jauncey, found fluoridation to be safe and beneficial, and found no evidence to support the claim that fluoridation caused cancer. However, the judge upheld that part of the case which claimed that fluoridation was ultra vires, relating to a legislative interpretation of the limitations of a water authority's responsibilities to provide a supply of 'wholesome' water.

In New Zealand, a test case on water fluoridation taken to the Privy Council in 1964 confirmed that the power of local authorities to supply 'pure water' has implicit in it a power to add fluoride to the water.

A number of countries have legislation making fluoridation compulsory, including Ireland, Greece and Bulgaria. There are other countries where water fluoridation is illegal or has been discontinued for various reasons, including:

- Belgium (experimental treatment plant was discontinued);
- Netherlands (Supreme Court of Justice ruled in 1973 that the Water Supply Act was not an acceptable legal basis for water fluoridation);
- Japan (water fluoridation is not permitted);
- Germany (addition of fluoride to foodstuffs is illegal and there is no water fluoridation);
- Sweden (a special fluoride Commission opposed legislation permitting fluoridation);
- China (had water fluoridation at two sites but discontinued during the 1980s).

A number of other countries allow fluoridation of table salt, including France, Germany,

Spain, Mexico, and Switzerland. [42]

CHAPTER 5: ETHICAL CONSIDERATIONS

5.1 BACKGROUND AND ISSUES:

The decision whether or not to fluoridate a public water supply raises a number of issues of an ethical and moral nature, including such questions as whether fluoridation represents mass medication with an uncontrolled dose, and whether it is an infringement of the rights of the individual. Equally it can be argued that a failure to fluoridate deprives those in the community at most risk of dental decay of a health benefit. Taskforce members opposing fluoridation advanced arguments that it constituted mass medication, inter alia:

- intended to produce an improvement in dental health, therefore a medication;
- administered without consent, therefore contrary to Nuremberg Tribunal standards;
- morally wrong because everyone is compelled to drink it .

Those supporting fluoridation were equally adamant that fluoride was a naturally occurring substance, and simply represents an adjustment to the natural level of fluoride in the water, comparable to the addition of vitamins or minerals to food.

It was clear to the Taskforce that there were no simple, 'black and white' answers to these questions, and that some form of ethical framework was required to weigh up conflicting risks and benefits; and which would also take account of the sometimes conflicting rights of individuals and communities. A paper prepared by the University of Auckland in 1990, ***'Fluoridation of Public Water Supply: Ethical Consideration'*** [44] was recommended to the Taskforce for consideration. The paper explores the ethical aspects of fluoridation but makes no attempt to favour one side or the other.

5.2 SUMMARY OF ETHICAL CONSIDERATION PAPER - TASKFORCE PAPER 3 (Appendix 3)

The paper makes the fundamental point that there is no single, consistent, universally agreed set of moral principles, and sets out the following framework:

Basic Argument: The basic argument in favour of fluoridation is that the state ought to act to achieve fundamental benefits for its citizens. The paper explores two main areas of ethical concern about fluoridation:-

- **the Safety Objection**: can a decision to fluoridate be ethical if fluoridation may have harmful effects?
- **the Compulsion Objection**: is the state justified in compelling people to consume

fluoridated water?

5.2.1 Safety Objection:

Those who make this objection might typically argue that fluoridation may not have beneficial effects, and may even be harmful. Therefore, it is morally unacceptable to subject people to possible harm where there are no clear benefits.
To assess the safety objection the following is required:

- **factual information** is required about effects of fluoridation
- how well **supported by evidence** is the factual information?
- **assess the probability** of the effects occurring
- assess the **degree of benefit or harm** (utility) of each effect

The following points follow on from this:

- Decision whether to fluoridate will be a ***'decision under uncertainty'***
- It is not unethical to make a decision under uncertainty (complete certainty about the effects of fluoridation will be impossible to achieve, because of limited evidence, etc)
- Obligation to make the best decision you can, given the evidence available

This leads to the principle of 'Maximising Expected Utility' which means taking that course of action which has the greatest total expected benefit. A number of factors are necessary to apply this principle:

- consideration of all possible options
- examination of possible outcomes or consequences
- each outcome assigned a probability value and utility value
- multiply to produce 'expected utility'

However, the application of this principle cannot be done mathematically or mechanically, and the final choice of the most ethically justified option must be one for informed judgment.

The paper goes on to question whether 'maximising expected utility' is truly ethical, given that it permits a trade-off of (possible) harm for some in return for (probable) benefits for others. The example of mass immunisation programs is often cited as an example of where the state seeks to act for the public good in ways which involve some small risk to individuals.

5.2.2 Compulsion Objection:

Those who make this objection might argue as follows:

- water fluoridation removes freedom of choice from individuals
- morally unjustified for state to use force, even if there are benefits

The paper examines what kind of compulsion is involved in fluoridation, since it could be argued that individuals could use filters or bottled water to remove the fluoride. The paper concludes that the presence of fluoride in food and drink manufactured using the local fluoridated water supply effectively means that some compulsion is involved. Individual autonomy and parental rights are important but **not absolute**, and comparisons are drawn with traffic restrictions and food safety regulations as examples where individual freedom has to be limited for the common good.

The paper considers '*Mill's Principle*' - that the state is morally justified in interfering with the liberty of an individual only if this is necessary to prevent harm to others. In analysing whether '*Mill's Principle*' should apply to fluoridation, the paper concludes:

- fluoridation does not just confer a benefit, it also prevents a harm;
- it can be argued that the state has a role in promoting dental health;
- individuals alone do not bear cost of poor dental health, the community also suffers;
- '*Mill's Principle*' only applies to responsible adults, not children.

If it is accepted that the state has an obligation to protect and promote welfare of citizens, it may sometimes be necessary to curtail individual liberty. If this view of the state is accepted, Mill's Principle will be rejected.

5.3 CONCLUSIONS:

The 'Ethical Consideration' paper concluded that the state has an obligation to protect the welfare of its citizens, and may be justified in interfering with individual liberty in order to promote a fundamental benefit like health. However, self-determination and the right of parents to choose for their children, were values which should not be lightly overridden.

Fluoridation could only be ethically justified if it was sufficiently superior to alternatives to outweigh the disadvantages of compulsion.

5.4 TASKFORCE DISCUSSION:

The Taskforce discussed whether the principles outlined above provided a logical and practical framework to reach a decision about fluoridation. Members were concerned that ethical considerations should apply to all aspects of fluoridation, e.g. the environmental impact, and not just human health. Application of the principles should also apply to the alternatives to water fluoridation; and there was a need to apply a heavier weighting to more serious health risks. In weighing up risks and benefits, members favoured a descriptive approach, e.g. 'likely/unlikely' or 'high/low' probability, rather than some mathematical formula.

The Taskforce submitted the NZ study to the Department of Philosophy at the University of Queensland, requesting the Department to review the paper for its completeness in addressing all the ethical issues involved in making a decision about water fluoridation. The Department replied that it was satisfied that the paper was a clear and comprehensive examination of all the relevant issues. Although some of the philosophical principles involved were developed during the last century, they were still appropriate and relevant to a complex modern health issue like fluoridation.

SUMMARY:

5.5 AREAS OF AGREEMENT:

Taskforce members unanimously agreed that an ethical framework of the kind detailed in the New Zealand study was necessary to underpin their consideration of the issues and achieve a consistent approach. The Taskforce agreed to adopt the basic principle of 'maximising expected utility' as a reasonable, sensible and balanced approach.

5.6 AREAS OF DISAGREEMENT:

Some members expressed concern that the Auckland paper had been prepared in a country that was heavily committed to fluoridation as an official public health measure, and that it had been used to justify decisions to fluoridate or continue fluoridation. On balance, however, the Taskforce was satisfied that the paper represented a balanced view. In relation to whether the state has a right to fluoridate, a small minority of members refused to accept that the state had the right to impose a measure like fluoridation.

5.7 TASKFORCE SUB-GROUP

Two of the public submissions to the Taskforce supporting fluoridation took an unusually balanced and even-handed approach to the fluoridation debate, and both touched on the dilemma of the human/ethical considerations and their relationship to scientific evidence. (Submissions from Dr B. Homan, a dentist and member of the 1991 NHMRC Working Group; and from the School of Public Health, Queensland University of Technology). The submissions emphasised the importance of providing the public with reliable information and listening to the public's views. Other comments included:

- Water fluoridation cannot be considered in isolation. It is also necessary to consider the impact of other forms of fluoride, and the context of declining rates of dental decay.

- water fluoridation is a social as well as a public health decision.

- facts alone will not convince people that fluoridation is to their advantage.

- scientific arguments are not the only ones which apply - there are also ethical, environmental and cultural aspects to the decision-making process.

The Taskforce Sub-group (paragraph 3.4 refers) discussed these issues, and a majority of sub-group members decided that social/cultural/ethical issues should carry more weight than scientific evidence. These discussions were reported back to the Taskforce.

CHAPTER 6: DENTAL BENEFITS AND COSTS

6.1 BACKGROUND AND ISSUES:

The effectiveness of water fluoridation in reducing levels of dental caries is a crucial issue in any decision whether or not to fluoridate a public water supply. The framework for decision making adopted by the Taskforce (Chapter 5) recognised that fluoridation inevitably involved a degree of compulsion and should only be sanctioned as a public health measure if it was sufficiently superior to alternatives to outweigh the disadvantages of that compulsion.

The dental benefits and risks of fluoridation give rise to consideration of a range of issues:

- extent of the dental caries problem in Brisbane;
- the level of effectiveness of fluoridated water in reducing dental decay;
- the effectiveness of other decay-reduction dental techniques;
- risks of dental and skeletal fluorosis;
- margins of safety/toxicity;
- concern about total intake of fluoride - effects on infants/young children;
- doubts about the methodology and accuracy of some fluoridation research studies;
- appropriate concentration of fluoride for a subtropical climate;
- who benefits most from water fluoridation - children, adults, or lower socio-economic groups?
- acceptance/rejection of water fluoridation in other countries.

The very significant reduction in levels of dental caries generally in the developed world in recent decades, and the ready availability of a variety of discretionary sources of fluoride have called into question both the need for and effectiveness of water fluoridation.

The Taskforce commissioned one of its members, Associate Professor Laurence Walsh, a reader in Preventive Dentistry and Gerodontics at the University of Queensland, to prepare an expert paper on 'Dental Costs and Benefits' in order to inform Taskforce deliberations (Appendix 6). Dr Walsh is one of Australia's leading experts in the field and supports the introduction of fluoride to Brisbane's water supply. He has a strong research interest in the occurrence and management of dental decay in the Brisbane population. The Taskforce recognised Dr Walsh's position as an advocate of water fluoridation, and therefore invited Dr John Colquhoun, University of Auckland, New Zealand, a strong opponent of fluoridation, to present his case to the Taskforce.

6.2 THE NATURE OF DENTAL CARIES:

Although the prevalence of dental caries has decreased in recent decades, it remains the main reason for tooth loss in Brisbane and Australia, and reducing dental decay remains an important goal for dental public health services.

Dental caries is an infectious bacterial disease involving the operation of four factors, namely, bacterial plaque, fermentable carbohydrates, a susceptible tooth surface, and time. However, other factors such as salivary flow rate and buffer capacity, and the salivary concentration of fluoride, influence the rate of progression of the disease.

Dental decay results from a process of mineral loss (demineralisation) from tooth enamel as a result of attack by acids in dental plaque produced by the combination of bacteria and dietary sugars. This process can operate in reverse and teeth can undergo repair (remineralisation) by taking minerals, including fluoride, from the saliva into the tooth surface. When fluoride ions are incorporated into remineralising enamel, fluorapatite is formed rather than normal hydroxyapatite. This has important implications for changes elicited by subsequent exposure to acid, since fluorapatite is conspicuously the less soluble of the two minerals (Ref: dePaola, 1991). In addition to direct effects of fluoride ions on mineral components of enamel, fluoride influences the biological behaviour of plaque bacteria, reducing their acid production and decay potential. (Ref: Hamilton, 1990; Van Loveren, 1990). (Appendix 6 refers).

In caries-susceptible individuals, the balance between periods of enamel mineral loss and repair favours decay formation, whereas in caries-free individuals, the balance favours decay repair. Clinically, the earliest stage of caries development on a tooth is a ‘white spot’ lesion with a smooth apparently intact outer surface. This is followed by a change in surface texture but without cavitation. Subsequently, as decay extends into the underlying dentine, obvious cavitation occurs, and the changes are no longer reversible. At this point, the removal of decayed tooth structure is required to prevent infection and exposure of the dental pulp, and a filling is inserted to replace missing tooth structure. Early intervention permits chemical treatment of early lesions using low dose fluoride therapies

6.3 EFFECTS OF FLUORIDE ON DENTAL CARIES:

The principal benefit of fluoride in caries prevention derives from the presence of small quantities of fluoride in saliva and plaque fluid over extended periods. Fluoride appears to inhibit the development of caries via a number of mechanisms. When present in saliva and oral fluids, fluoride is taken up by dental plaque and becomes concentrated in plaque fluid where it inhibits acid production by plaque bacteria and thereby slows the rate of demineralization. In addition, fluoride ions interact with enamel mineral, resulting in both increased repair and reduced damage.

The most important effect of fluoride is on demineralised areas of enamel where it promotes remineralisation. Freely available fluoride ions are incorporated into the remineralising enamel where they replace carbonate ions, giving fluorapatite. This is chemically more stable than normal enamel, which is hydroxyapatite. When enamel is demineralised by an acid attack, the presence of fluoride in saliva and plaque fluids also enhances reprecipitation of calcium and phosphate. Finally, fluoride ions reduce the extent of acid production by harmful bacteria. (Appendix 6)

6.4 TASKFORCE SUB-GROUP REVIEW OF REASONS FOR DECLINING TOOTH DECAY

An important and controversial study of the decline in tooth decay by Prof Mark Diesendorf titled *'The Mystery of Declining Tooth Decay'* [78], published in 1986, was identified by both pro and anti-fluoridation experts on the Taskforce as of particular relevance. The study was examined in more detail by a Taskforce Sub-group consisting of Dr L. Walsh, Dr F. Clutterbuck, Ms C. South and Mr J. Martin.

Prof Diesendorf's paper makes the following key points in relation to the steep decline in dental decay since the 1960s:

- large reductions in caries in unfluoridated and fluoridated communities;
- the start of the decline predates water fluoridation and fluoridated toothpastes, therefore other factors must be involved;
- other causes for the decline include diet, immunity, cyclical changes;
- lack of longitudinal, blind studies and proper control groups in many early fluoridation studies;
- studies indicate benefits beyond the maximum obtainable from fluoridated water and fluoridated toothpaste;
- benefits of fluoridation overestimated - differences in caries levels between Queensland and fluoridated States are marginal.

Broad agreement was reached by the two sides of the debate on the following aspects:

- there have been large reductions in dental caries in both fluoridated and unfluoridated communities in the developed world since the 1960s;

- many early fluoridation research studies had flawed methodologies and their findings have proved to be unreliable;

- factors other than fluoride (water or other sources) have contributed to the decline (Dr Clutterbuck favoured changes in diet, general health, and immunity as contributing factors, while Dr Walsh referred to an increase in anti-bacterial agents).

Dr Clutterbuck and Dr Walsh disagreed on the extent of the benefits from water fluoridation - Dr Clutterbuck agreed with Prof Diesendorf (Chapter 7 refers) that the benefits were marginal, had been exaggerated by the pro-fluoridationists, and were not worth either the risks to health or the negative aspects of imposing fluoridation on a section of the population. Dr Walsh acknowledged that the absolute benefits of fluoridation, in terms of numbers of teeth saved, had declined in recent decades but still considered that the benefits were significant, particularly for adults.

6.5 EXTENT OF CARIES PROBLEM IN BRISBANE AND AUSTRALIA:

Reviews of the prevalence of dental caries in several industrialised countries have revealed that substantial reductions in dental caries (in the order of 30-50 %) in 5 and 12 year old children occurred during the 1970s and into the 1980s. These reductions occurred in both fluoridated and unfluoridated countries, including Australia, Denmark, Finland, Netherlands, New Zealand, Norway, Sweden, United Kingdom and the United States (Ref: Renson, 1986).

Measurements of dental caries in populations are often expressed in terms of teeth affected, by a summation of decayed (D), missing (M) and filled (F) teeth or tooth surfaces: the DMF (Decayed, Missing & Filled) Indices. The DMFT Index expresses the sum of DMF teeth (T) per person, while the DMFS Index scores the DMF tooth surfaces (S). The maximum possible DMFT score is 32, if molars are included; and the maximum DMFS score, when the third molars are disregarded, is 128. The DMF Indices are indices for permanent teeth, whereas in primary (deciduous) dentition, the comparable index is called def (where e = exfoliated, lost). (Appendix 6).

An assessment of the nature and extent of the dental decay problem in Brisbane is a key component in attempting to weigh up the benefits and risks of water fluoridation. If the decay problem is serious and substantial, the argument for water fluoridation is strengthened, and vice versa if the current problem is less serious.

In considering this matter, the Taskforce encountered a major obstacle. The Taskforce's dental expert, Dr Walsh, advised that only two properly controlled and randomised studies

had been undertaken for Brisbane in the recent past - the National Oral Health Survey 1987[234] and the Brisbane Survey of Adult Dental Health 1984[244]. The limitations of these studies were obvious to the Taskforce, in that the data was more than a decade old, while dental caries is a dynamic and changing disease. The Taskforce was aware from both international and Australian studies that caries rates have continued to decline during the past decade.

6.6 NATIONAL ORAL HEALTH SURVEY (NOHS, 1987), AND BRISBANE DENTAL STUDY (BDS, 1984):

The Taskforce considered the following key points from the NOHS in relation to the state of dental health in Brisbane and Queensland:

- Expenditure on dentistry in 1987 represented 4.9 % of health care costs and some 0.38 % of Gross Domestic Product (GDP).

- Dental caries was responsible for the total loss of teeth in the large majority (70 %) of individuals who were edentulous (i.e. completely without teeth). In Brisbane, this group constituted some 53 % of the population over 65 years of age.

- Dental caries in the deciduous dentition in 5-9 year old children was more severe in Brisbane than in some other fluoridated state capitals (dmft of 2.6 in Brisbane, 1.4 in Melbourne and Perth, 1.2 in Sydney, and 1.0 in Hobart and Canberra). [Ref NOHS p.40 Table 18]

- At the age of 10-14 years, *69 %* of individuals in Brisbane were affected by caries. By the age of 20, *over 90 %* of individuals had been affected by caries, and this increased to 98% in the 25-29 year old age group. (However, these statistics are more than a decade old and more recent figures show significant improvements in children's teeth in Queensland (e.g. the 1993 figures from the Australian Institute of Health and Welfare (AIHW) Research Unit shows that 48% of 12 year old children in Queensland had no caries experience)).

- Dental caries in the permanent dentition in adolescents (10-14 years of age, and 15-19 years of age) was higher in Brisbane than in some other fluoridated state capitals. However, as the table below shows, Brisbane rates were lower for 10-14 year olds than Adelaide and only 0.2 higher than Melbourne which are both fluoridated. [Ref NOHS p.45 Table 20]

DMFT rates (NOHS, 1987 p.45 Table 20)

	Brisbane	Sydney	Canberra	Hobart	Perth	Adelaide	Melbourne
Age 10-14	2.3	1.4	1.1	1.0	1.8	2.4	2.1
Age 15-19	5.3	2.8	3.2	3.4	4.4	4.8	5.0

The DMFT rate for 12 year olds in Queensland had reduced to 1.37 affected teeth by 1995 (AIWH Report).

- The above figures show that dental caries was a significant problem in adults in Brisbane in the 1980s. In the 35-44 year old age group, the mean DMFT was 19.5 teeth (out of a possible maximum of 32 teeth). Of this total of 19.5, some 7.3 were from extractions due to dental caries. However, obtaining accurate dental statistics for adults in Australia has been acknowledged as a problem because of the difficulties in obtaining a stable, consistent, and reliable sample, and few such studies have been carried out[21].

- At an international level (using the WHO scale), dental caries in Queensland was 'low' for 12 year olds, 'moderate' for 15-19 year olds, and 'high to very high' for 35-45 year olds. These ratings were the same as Australia as a whole.

- There was a large unmet need for dental treatment due to dental caries in Brisbane. The proportion of individuals in Brisbane requiring fillings were as follows: 10-14 years, 24 %; 15-19 years, 40 %; 35-44 years, 52 %; 65+ years, 23 %.

- In the elderly in Brisbane (ages 65 years and over), on average 17.6 teeth had been lost due to caries, and all individuals had undergone extractions because of caries. However, there have been significant improvements in adult dental health in the last decade, e.g. the number of natural teeth in people aged 65 and over in Australia in 1994 was 62.1% more than it was in people 65 and over in 1989 (Ref: Australia's Health 1996, AIHW, p79).

The findings from the National Oral Health Survey relating to Brisbane confirmed results obtained three years previously in the Brisbane Statistical Division (BSD) survey of adult dental health, conducted in 1984 (Powell & McEniery, 1987, 1988 a-c).

The BSD survey was undertaken in May-June 1984, and involved examination of 1504 individuals aged 15 years and above. Mean DMF scores were very similar to those in the NOHSA survey. Major findings from the BSD study were:

- Mean DMF scores increased with age: 15-19 years: 6.18; 20-24 years: 10.57; 25-29 years: 15.79; 30-34 years, 18.08; 35-44 years: 20.38; 56-64 years: 26.16; and 65+ years: 28.68.

- Dental caries was the major reason for tooth loss.

- Most (but not all) individuals (94.8 %) brushed their teeth; the average number of times per day was 2.0 .

- Occupation and level of education exerted a strong influence on attitudes and behaviour. More individuals who were university graduates or from professional groups attended the dentist for preventive care, while toothache was the major reason for attendance in retired persons (70.5 %), the unemployed (40.0 %), housewives (54.7 %), and individuals whose highest level of education was primary school (64.3 %) or Grade 10 (42.9 %).

- In general, caries was more severe in females than in males, and edentulism (total tooth loss) was consistently higher in females.

- Very few individuals had not experienced dental caries. In males, in the 15-19 year age group, only 10 % of individuals were caries-free, while in the 20-24 year and higher age groups, no individuals were caries free. A similar pattern was seen in females, however only 5 % were caries-free in the 15-19 year age group.

- With regard to the frequency distribution of caries, there were clear shifts with age. There was a clear high caries risk tail to the frequency distribution of caries in all age groups. While many individuals required restorations (fillings) for caries (generally only one or two), some individuals required multiple fillings of both simple (one surface) and complex (multi-surface) types.

- The lower socio-economic groups were identified as being particularly at-risk from severe caries. The study suggested that substantial improvements in dental health would be obtained if this issue were addressed.

6.7 EFFECTIVENESS OF WATER FLUORIDATION:

The Taskforce considered the issue of water fluoridation effectiveness from two perspectives:

- the degree to which water fluoridation could contribute to a reduction in dental

caries and consequently a reduction in dental treatment; and

- the performance of water fluoridation in comparison with other dental health programs. The latter will be covered later in this chapter.

The issue of 'effectiveness' was one that sharply divided the Taskforce. Since water fluoridation was first introduced in the US after the war, literally hundreds of studies have been carried out to calculate its effectiveness. For example, the results of a total of 95 fluoridation studies conducted in 20 different countries was reviewed by *Murray et al (1991)*[83], and showed a range of reductions between 20 - 90%. Most studies until about 1980 showed very significant differences in caries rates between fluoridated and unfluoridated communities, indicating a range of reductions attributed to water fluoridation of typically between 50-90%. Effectiveness varied depending on a host of other variables, e.g. between deciduous and permanent teeth, between different age groups, and depending on the length of exposure to fluoride[15]. It is widely acknowledged that the quality of studies from about 1980 onwards has been better than earlier studies[83].

However, these early studies have had some very prominent critics, as will be illustrated later by Dr Colquhoun's presentation. Strong criticism has been levelled at the methodologies of these studies, particularly in relation to sampling methods and the lack of 'blind' studies (i.e. where the researcher does not know whether the subject resides in a fluoridated or un-fluoridated community). These criticisms appear to have been vindicated by the widespread acceptance over the last decade that pre-1980 studies were flawed or suffered serious limitations[83].

Studies of water fluoridation effectiveness conducted since the 1980s have generally adopted more rigorous methodologies and have also had to take account of confounding factors which did not exist with earlier studies, namely the increasing and now ubiquitous availability of a variety of other sources of fluoride. As well as fluoridated toothpaste, which first became available in Australia in the late 1960s and now accounts for more than 95% of toothpaste sales, other discretionary sources include topical applications such as gels and varnishes, fluoride tablets and drops, fluoride mouthrinses, as well as background fluoride in the form of foods and drinks which have used fluoridated water during manufacture (the 'halo' effect).

A wide range of Australian and international studies were re-analysed by the 1991 NHMRC review of water fluoridation which concluded that water fluoridation had accounted for a 60% reduction in the mean number of DMF teeth in 1977[21]. However, more recent studies of fluoridation effectiveness have acknowledged that the percentage reductions in caries attributable to water fluoridation were no longer of the same magnitude as earlier studies

because of the impact of other fluoride sources, and perhaps other lesser known factors[74]. A number of omnibus studies have indicated a reduced range of effectiveness between 20-40%[21, 74]. Some experts have concluded that it is no longer possible to give a valid estimate of the effectiveness of water fluoridation alone because so many different factors affect the outcome, particularly the caries prevalence in the population under consideration[75].

The above factors presented the Taskforce with a recurring dilemma in trying to calculate separately the effectiveness of fluoridated water :

- there were no accurate, up-to-date figures of dental decay rates in Brisbane;
- dental decay rates have been falling in Brisbane for several decades, as elsewhere in Australia;
- even if current caries data did exist, it would be extremely difficult to separately identify benefits attributable to water fluoridation alone;
- the skewed nature of the distribution of dental caries (e.g. 23% of children have 72% of the dental decay problem - Appendix 6, p9) meant that statistical averages of reductions can be misleading.

6.8 DENTAL RISKS OF WATER FLUORIDATION:

Two well recognised risks do arise from excess intake of fluoride, in the form of dental and skeletal fluorosis. Dental fluorosis is a specific disturbance of tooth formation caused by excessive intake of fluoride taken during formative period of the dentition. Clinically, dental fluorosis is characterised by lustreless, opaque white patches in the enamel which may become striated, mottled and/or pitted in more severe forms. The severity of fluorosis is generally graded as - questionable; very mild; mild; moderate; and severe. (Appendix 6)

A more complete description of these conditions, and the dose levels likely to produce them, is contained in Chapter 7 Human Health Effects. Taskforce discussion on the causes and risks of fluorosis is outlined later in this chapter.

6.9 OTHER FLUORIDE OPTIONS:

There are a number of dental strategies and programs which may be used in the prevention of dental caries, as well as water fluoridation. These include the following procedures :

- those designed to reduce the decay potential of dental plaque, e.g. toothbrushing, anti-bacterial mouthwashes, reduction in sugar intake, etc;
- those designed to increase the resistance of tooth structure to caries attack, e.g.

water fluoridation, topical gels and varnishes, sealants, etc; and

- those designed to augment salivary factors, e.g. chewing gums.

The efficacy of some of these techniques can be improved by using them in combination, e.g. toothbrushing combined with the use of mouthrinses at school.

Section 5 of Dr Walsh's 'Costs and Benefits' paper (Appendix 6) presents a comprehensive comparison of ten different fluoride options in terms of practicality, likely compliance, cost and efficacy. Dr Walsh concluded that all strategies have particular advantages and disadvantages. Overall, he rated water fluoridation as the best option, though a number of other strategies, including topical applications and toothbrushing, also rated highly.

6.10 PRESENTATION BY DR COLQUHOUN:

Dr John Colquhoun from the University of Auckland is a world-renowned opponent of water fluoridation. His evidence to the Taskforce was particularly interesting because of his background as a senior dentist (he had been Principal Dental Officer for Auckland). Dr Colquhoun had been a strong advocate and supporter of fluoridation as recently as the early 1980s.

Dr Colquhoun outlined the evidence that had changed his opinion about fluoridation, including the following points:

- initial concerns in New Zealand were raised by falling decay rates in both fluoridated and unfluoridated areas, and later confirmed by similar findings in other countries[171];

- studies in Auckland and elsewhere in NZ found little or no relationship between water fluoridation and levels of tooth decay[171];

- some studies, e.g. Prof Teotia in India, had found that tooth decay rates increased with higher intake of fluoride ('Fluoride' magazine volume 27, p301-308, 1994);

- examination of decay rates for 5 year olds in NZ from 1930-1990 showed that declining caries levels appeared to predate both water fluoridation and the availability of discretionary sources of fluoride[171] (point also made by Prof Diesendorf);

- reasons for caries decline were not fully understood, however, Dr Colquhoun believed that post war improvements in diet, particularly increased consumption of

fruit, vegetables and cheese (latter known to have anti-caries properties) were important elements;

- Dr Colquhoun has accused pro-fluoridation researchers of both conscious and unconscious bias in the choice of fluoridated and unfluoridated communities for comparison purposes, and also referred to a lack of 'blind' studies;

- diagnosis of tooth decay involved a very subjective exercise of judgement, and researchers were usually pro-fluoridation;

- the principal decay-prevention action of fluoride has been shown to be topical (i.e. on the surface of teeth) rather than systemic, as was previously thought. Consequently, therefore there was limited benefit from actually swallowing fluoridated water;

- Dr Colquhoun was also concerned about potential harm, particularly the effects of long term ingestion of fluoride. He referred to Sweden's rejection of fluoridation on the recommendation of a special Fluoride Commission, which included amongst its reasons 'The combined and long-term environmental effects of fluoride are insufficiently known' (*Report of Swedish Fluoride Commission, SOU Stockholm, 1981*). He also informed the Taskforce that he had raised the question of possible damage to bones before the first studies linking fluoride to hip fractures were conducted.

Many of the points made by Dr Colquhoun were also made by Professor Diesendorf. (Chapter 7).

Dr Colquhoun went on to outline the following arguments against water fluoridation:

- the 1987 National Oral Health Survey showed decay rates in un-fluoridated Brisbane similar to those in fluoridated Adelaide and Melbourne. These comparisons correlated with Dr Colquhoun's assessment of fluoridated and un-fluoridated communities in New Zealand and elsewhere, which also appeared to show negligible benefits for fluoridation.

- reference was made to the many countries in Asia where water fluoridation was banned, and to those European countries such as Belgium, Holland, Germany, Sweden, Denmark, Finland, Hungary, etc., where fluoridation experiments were conducted but water fluoridation has ultimately been rejected.

- Dr Colquhoun was convinced that there was no such thing as a 'safe' level of fluoride - the only 'safe' dose was the lowest that you can get. Dr Colquhoun considered that it was illogical to believe that fluoride could affect teeth without affecting any other parts of the body.

6.11 TASKFORCE DISCUSSION:

6.11.1. Effectiveness of Water Fluoridation

The Taskforce debated the issue of the effectiveness of water fluoridation at some length. Taskforce members were satisfied that the weight of evidence from the large number of studies in many different countries pointed overwhelmingly to a protective effect from water fluoridation. As outlined earlier however, there were sharp differences of opinion about the extent of the benefits.

6.11.2 Townsville v Brisbane Study:

The complexity of the 'effectiveness' issue can be illustrated by reference to the study carried out by the Dental Statistics and Research Unit of the University of Adelaide in 1995 [28], which the Taskforce discussed. The study examined the differences in caries experience of large samples of children aged 5-12 years who were lifetime residents either of non-fluoridated Brisbane or Townsville, fluoridated since 1965.

The study concluded that caries rates were significantly lower in Townsville children than Brisbane, and in permanent dentition a percentage reduction ranging from 20-65% was calculated. The figure of 65% appeared in newspaper headlines in Brisbane earlier this year. A closer examination of the study, however, revealed a number of difficulties which the researchers identified. The study does attempt to obtain an age-standardised distribution of decay experience between the two cities, and to control for a number of different variables including - different socio-economic groups, frequency of toothbrushing, use of fluoride supplements, and lifetime residency. The study acknowledged, however, that other factors, such as dietary differences, possible differences in levels of bacteria, or differences in dental services and treatment methods between the two communities had not been taken into account, even though they may have been relevant.

The Townsville v Brisbane study concluded that lifetime residents of fluoridated Townsville had lower levels of caries experience than lifetime residents of Brisbane, both for the permanent dentition and the primary dentition. In terms of affected

teeth, the average difference between all the children in the Brisbane and Townsville samples was an excess of 0.23 of a single affected tooth surface in the Brisbane sample. The study stated that these findings were consistent with other recent studies in Western Australia and New South Wales. The study concluded that 'a difference of 0.25 DMFS probably constitutes a minor effect at the level of an individual patient in the age range studied here. Nonetheless, it is axiomatic that community water fluoridation is not an intervention applied to individual patients and therefore it is appropriate to interpret the practical significance at a population level'[28].

In considering the Townsville v Brisbane study, the Taskforce was aware that averages can be very misleading in relation to dental caries, since it has been estimated that 20% of the population have 70% of the problem. For example, it was known from other studies that a large proportion of children in both Townsville and Brisbane (50% +) would have no caries experience at age 12, such is the decline in dental decay. What the Townsville v Brisbane study appeared to indicate, but did not say overtly, was that for the large majority of children in the two communities, there appeared to be little statistical difference in levels of decay. However, for that small minority of children who were particularly at risk, the levels of decay in Brisbane were higher.

6.11.3. Cause of Dental Fluorosis

The Taskforce debated the causes of dental fluorosis and the likelihood of an increase in fluorosis levels as result of the introduction of water fluoridation. Studies of naturally fluoridated communities by Dean in the 1940s acknowledged that water fluoridated at the optimal level of 1ppm would produce mainly mild dental fluorosis in a small proportion of children. A 'community index' of fluorosis was devised which indicated that when the water fluoride level was in the 1.6-1.8 ppm range, the prevalence and severity of fluorosis was at the threshold of a public health problem. This level of fluoride intake in young children equates to 0.75 - 1.00 mg per day. Intake from water fluoridation alone for children in an area fluoridated at 1ppm, would be approximately 0.5 mg per day.

Dental experts on the Taskforce argued that most dental fluorosis was caused by ingestion of toothpaste by young children, and pointed to recent data from Ireland[162] which showed no evidence of excessive fluoride intake in fluoridated communities where fluoride toothpastes are widely used, and no problems with fluorosis attributed to fluoridation. Other members of the Taskforce argued that the incidence of dental fluorosis was increasing and that logic demanded that water fluoridation

must add to the problem. In his presentation to the Taskforce, Dr Colquhoun referred to a survey of dental fluorosis in Auckland which reported significantly higher levels of dental fluorosis in fluoridated areas compared to non-fluoridated areas. Dr Colquhoun said that these findings correlated with studies in other countries including the US[171].

In his review of the scientific literature for the Taskforce, Dr Armstrong concluded that children will be at some increased likelihood of developing dental fluorosis if the water supply is fluoridated. The precise increase in rates of cosmetic dental fluorosis cannot be estimated, but is likely to be in the range of 0% - 10% (Appendix 20).

6.11.4 Total Intake of Fluoride: Babies and Children

The prevalence of dental fluorosis in Australia has increased in both optimally fluoridated and non-fluoridated areas[107]. In the literature, this has been attributed to an increase in the fluoride level of food and beverages through processing with fluoridated water, ingestion of fluoridated toothpaste, and the inappropriate use of fluoride supplements. A major source of fluoride in infancy is infant formula which has been implicated in a number of studies as a risk factor for fluorosis[107]. A number of Taskforce members expressed particular concern about this issue.

Intake of fluoride by infants depends mainly on whether they are fed breast milk or formula. Human breast milk contains only a trace of fluoride, unless water fluoride concentrations are very high (e.g. 9 ppm - Opinya *et al.*, 1991) and provides less than 0.01 mg/day. At 6 months of age, when most infants begin to eat a mixed diet, average intakes range from 0.2-0.5 mg/day, depending on the concentration of fluoride in the drinking water (Ophaug *et al*., 1980 a). The range for 2 year old children is only slightly higher, and also depends strongly on the drinking water fluoride concentration (Ophaug *et al*., 1980 b, 1985 a). Average intakes of fluoride in children of 1.2 mg/day, 1.8 mg/day, and 2.2 mg/day have been reported (SanFilippo & Battistone, 1971); Singer *et al*., 1980; Taves, 1983). However, there is considerable variation among individuals in such studies. A recent longitudinal study in New Zealand compared the total fluoride intake of 3-4 year old children living in fluoridated and non-fluoridated communities (Guha-Chowdhury *et al*., 1996). The mean fluoride intake from foods and drinks alone in low-fluoride areas was 0.15- 0.06 mg/day, and 0.36 - 0.17 mg/day in fluoridated communities. When the contribution of toothpaste was included, the mean fluoride intake rose to 0.49 mg/day in non-fluoridated areas and 0.68 mg/day in fluoridated areas. A number of studies of the average intake of fluoride by children from food and drink have been

conducted in North America, and these are summarised in Dr Walsh's paper (Appendix 6).

In his review of the literature, Dr Armstrong commented that there is no current epidemiological data concerning Brisbane children's actual fluid intake. However, he made estimates based on current intakes recommended to parents by Community Child Health Services. He concluded that infants using infant formulae mixed with fluoridated water, and given the recommended amount of formulae per day, could be ingesting fluoride at above the recommended levels of 0.07mg/kg per day. Recognition of this risk had led one major manufacturer (Nestlé) to transfer all manufacture of their infant formula to a plant with an unfluoridated water supply. Dr Armstrong's overall conclusion, however, was that fluoridation was unlikely to have a significant impact on toddlers total fluoride consumption since there was little discretionary use of water as a thirst quencher in infancy when alternatives exist.

Overall, the published data indicates that *dietary* fluoride intake in areas in North America where the drinking water concentration is 1.0 ppm has remained relatively stable during the last 50 years. However, due to the 'halo' effect, it has probably increased in many areas where the water is not fluoridated (Whitford, 1994). However, Dr Colquhoun emphasised the point that levels of dental fluorosis were increasing and that the intake of fluoride by infants in infant formula made up with fluoridated water was massively greater than the level in breast milk.

6.11.5 Margins of Safety

There are no definitive limits in the scientific literature concerning safe and unsafe doses of fluoride. Responses can vary considerably between individuals depending on a range of factors, including age, body weight, nutritional status, etc. Chapter 4 presents some basic information about fluoride toxicity.

The Taskforce were aware from the literature that chronic fluoride intake of 1-2ppm can lead to dental fluorosis, while intake of 4 ppm could lead to skeletal fluorosis (though some reports have indicated that skeletal fluorosis can occur in people exposed to fluoride levels as low as 0.7ppm)[21]. People with impaired renal function were at greater risk of developing skeletal fluorosis and cases have been reported in patients exposed to levels between 1.7 and 2.6ppm (ref p107 NHMRC 1991). The Taskforce debated whether the safety margins between an optimal dose for caries reduction, e.g. 0.7ppm for Brisbane, and a dose with known health risks, was sufficiently wide. Some Taskforce members opined that it was common medical practice to require a 10:1 safety margin. Medical opinion on the Taskforce

considered that a 4:1 ratio was a sufficient safety margin for fluoridating water. The Taskforce also viewed a recent UK (Channel 4) documentary on the risks of water fluoridation in which a scientist referred to the need for a 100:1 safety margin. Many Taskforce members remained concerned that the margin of safety was insufficient.

6.11.6 Fluoride Concentration in Drinking Water

The United States Public Health Service (USPHS) produced guidelines in the 1960s for the concentration of fluoride in drinking water, taking account of differences in climate and the fact that people in hot climates drink more water than those in cooler areas. These guidelines became widely used and would recommend for Brisbane that the appropriate level of fluoride in the water supply should be 0.7ppm.

The Taskforce heard that Hong Kong has adjusted the fluoride concentration of its drinking water several times since fluoridation started in 1961 because of unacceptably high levels of dental fluorosis in children. The concentration was reduced in several stages down to 0.5ppm. In view of this, WHO now recommend that the level of 1ppm should be regarded as an absolute upper limit for cold climates, and that 0.5ppm should be the limit for tropical and subtropical climates. Supporters of fluoridation on the Taskforce indicated their acceptance of the need for a lower limit. However, the lower concentration would also have an impact on the effectiveness of the fluoridated water in terms of caries reduction. The 1991 NHMRC review considered the impact of a halving of fluoride concentration and concluded that a best estimate might be an increase in dental caries of 10-15%. However, lack of data meant that NHMRC had to acknowledge that the reduction in effectiveness could range from a small to a substantially higher effect[21].

6.11.7 Reduction in Prevalence of Dental Caries

There have been a number of references to the reduction in dental caries in the developed world over the past three decades. Dental experts on the Taskforce suggested that the decline had reached a plateau during the 1980s. The Taskforce debated the meaning of the dental statistics and whether decay rates were still falling, as recent figures continued to indicate. The Taskforce agreed that although dental caries rates were still reducing in the 1990s, the rate of decline, and relative amount of decline over time, had fallen during the last decade. Some members suggested that the rate of decline might be expected to decrease since caries rates were now at such a low level.

6.11.8 Interstate Comparisons

Some Taskforce members questioned whether Brisbane's oral health was as bad as the 'Dental Costs & Benefits' (Appendix 6) paper suggested, or indeed any worse than many of the other fluoridated States. This led to debate about the accuracy and reliability of Interstate dental comparisons, and about where Queensland stood in relation to national goals and targets for dental health.

An examination of the NOHS figures showed a number of ambiguities, with Queensland preforming better in some aspects than others in comparison with other States. The Taskforce recognised that there were differences in the quality of statistical recording between States, and that dental statistics were not specifically intended to be used to make comparisons between fluoridated and unfluoridated areas.

6.11.9 Benefits of Water Fluoridation

Discussion amongst pro-fluoridation members of the Taskforce revealed differences of emphasis about which group would benefit most from water fluoridation. Dental opinion argued that the balance of benefit had shifted away from children, (where it was accepted that decay figures in Queensland were relatively low compared to Australia as a whole and internationally) and towards adults. Adults now had most of the decay problem. Medical opinion on the Taskforce, however, continued to emphasise the needs of children

SUMMARY

6.12 AREAS OF AGREEMENT:

The Taskforce reached general agreement on a number of points:

6.12.1 Caries Reduction Effect

Following analysis and discussion of the research evidence, most Taskforce members were in agreement that water fluoridation did produce some reduction in dental caries. However, there were sharp divisions between supporters and opponents concerning the extent of the benefits, and the statistical methods used to isolate and quantify those effects.

6.12.2 Trends in Dental Decay - Australia and Worldwide

The Taskforce agreed that there has been a substantial decline in levels of dental

caries during the last three decades. This trend has occurred in both fluoridated and unfluoridated communities. Members also agreed that the decline was continuing, though the rate of decline has reduced since the mid-1980s.

6.12.3 Factors Involved in Reduction in Caries

Taskforce members were generally agreed that factors other than water fluoridation and other discretionary sources of fluoride must be involved in the decline in dental caries in recent decades. Expert opinion was agreed that diet and nutrition, improvements in dental hygiene, improvements in dental services and techniques, and the use of antibiotics were all relevant factors.

6.12.4 Benefits Mainly Topical:

The Taskforce agreed that most of the caries prevention effect of fluoridated water was topical, i.e. it results from the effects of fluoride at the surface of the teeth rather than systemically (via the bloodstream), as used to be thought. Consequently, there was limited value from actually swallowing the water.

6.12.5 Excessive Ingestion Causes Dental Fluorosis

Excessive ingestion of fluorides by children under the age of six can lead to dental fluorosis. The extent of the damage to teeth depends on the level of fluoride intake, and the length of time these levels are maintained.

6.12.6 Fluorosis Not Simply a Cosmetic Problem

WHO stated that dental mottling is a definitive sign of fluoride toxicity[56]. The Taskforce agreed that any level of dental fluorosis in children was undesirable.

6.12.7 Inadequacy of Dental Statistics

Expert opinion on the Taskforce considered that the only reliable dental studies relating to Brisbane were the 1987 National Oral Health Survey Australia (NOHS), and the 1984 Brisbane Adult Dental Survey. These statistics were now more than 10 years old. Most fluoridation studies have been carried out on children because they represent more stable sample populations, and because of the availability of the school dental health service. Most Taskforce members agreed that both the quality and quantity of dental statistics were inadequate, particularly in respect of adult dental health; and noted that the 1991 NHMRC report had pointed to a need

to urgently upgrade the monitoring of dental health. Correspondence between the Taskforce and both the Australian Dental Association and NHMRC has indicated that these improvements have not yet been implemented.

6.12.8 Some Fluoridation Studies Unsound:

Taskforce members were generally agreed that the literature showed that many fluoridation studies prior to 1980 had employed unsound methodologies or had omitted relevant factors. More recent studies had employed more rigorous and defensible methods.

6.13 AREAS OF DISAGREEMENT:

To a lesser or greater degree, Taskforce members disagreed on the following points:

6.13.1 Extent of Effectiveness of Water Fluoridation

Proponents of fluoridation argued that it remains the most effective and socially equitable method of reducing dental caries, citing recent omnibus studies showing reductions attributable to water fluoridation averaging between 20-40%. The limited statistical evidence available indicated that average DMFT levels for 12 year olds in Queensland have dropped from 5.51 to 1.37 during the last 20 years. Opponents on the Taskforce argued that the dental benefits were now minimal, equating to a small proportion of one tooth surface per child.

6.13.2 Cause of Dental Fluorosis

Supporters of fluoridation argued that recent research showed that most dental fluorosis in children was caused by ingestion of fluoridated toothpaste or inappropriate use of fluoride supplements. A number of Taskforce members, however, were convinced that water fluoridation would both cause and exacerbate the problem.

6.13.3 Safety Margin for Ingestion of Fluoride:

A significant number of Taskforce members remained concerned that the safety margin between a supposed safe dose of fluoride and a potentially toxic dose was not wide enough.

6.13.4 Interpretation of Dental Statistics:

A number of Taskforce members considered that the use of percentages to record the effectiveness of water fluoridation was misleading, in the light of relatively low and declining levels of decay.

6.14 FURTHER RESEARCH:

Taskforce members were unanimously agreed that more Australian research on the effects of water fluoridation and improved monitoring of dental health were both required. The majority of the Taskforce found it surprising that the concern about the lack of research in Australia expressed in the 1991 NHMRC Report [21] (Section 8), and the call for an effective monitoring and research program in relation to Australia's water fluoridation policy, appeared to have gone largely unheeded. Evidence presented to the Taskforce suggested that the same inadequacies criticised by NHMRC still persist, namely:

- more Australian research required on the degree of effectiveness of water fluoridation, in view of the dynamic, changing nature of dental disease.

- Australian studies of the dental decay problem in adults was particularly necessary.

- more accurate and reliable dental monitoring required to assess the scale of the caries problem and determine whether the decline in decay rates is continuing.

- monitoring and research in Australia required in respect of total intake of fluoride and the lifetime effects of accumulation in the body. Further research was also required to examine safe levels of fluoride intake and whether the margins of safety were sufficiently wide, particularly for babies and young children.

- more Australian research required on what constitutes a chronic safe or toxic dose of fluoride for different age groups in the population, and an appropriate margin of safety between the two.

CHAPTER 7: HUMAN HEALTH EFFECTS

7.1 BACKGROUND AND ISSUES

The links between the dental benefits of water fluoridation and concern that fluoridated water might also have adverse health effects date back to the earliest studies of naturally fluoridated communities in the USA in the early part of this century, when researchers observed that persons with dental fluorosis also had fewer dental caries. Controversy about alleged adverse health effects of fluoride have continued to dominate the fluoride debate ever since .

There is no dispute that fluoride in concentration is a highly toxic substance. However, the key question is whether there are any health risks from fluoridated water at the concentration of 1 part per million (ppm), the optimal dose for the fluoridation of domestic water supplies. This is the dose calculated to provide the maximum benefit to teeth while also keeping dental fluorosis levels to a minimum. Since fluoride builds up in teeth and bones, the question of the cumulative effect over a lifetime is also a crucial issue.

The possibility of adverse health effects from water fluoridation has been extensively examined since fluoridation systems were first introduced in the US in the 1940s. Although there has been little or no scientific evidence to support some of these concerns, more recent studies in relation to hip fractures and cancer have given rise to particular concern. Excessive ingestion of fluoride does produce two common and relatively well understood conditions - dental fluorosis and skeletal fluorosis. These 'dental' effects were discussed in Chapter 6. Water fluoridation has also been linked with a wide variety of other health conditions including:

- hip fractures: allegedly caused by the bone-weakening effects of a build up of fluoride in the bones;
- cancer: mainly related to osteosarcoma (bone cancer);
- renal and gastrointestinal disease: kidney dialysis patients present a particular concern;
- allergic reaction: some people complain of particular sensitivity to fluoridated water;
- sudden infant death syndrome (SIDS);
- reproductive effects and fertility;
- genetic defects;
- thyroid and brain function;
- cardiovascular disease

7.2 EXCESSIVE INTAKE OF FLUORIDE: INFANTS AND CHILDREN:

Water fluoridation gives rise to particular concerns in relation to the total daily intake of fluoride for babies and young children and the consequent risks of dental fluorosis. The amount of fluoride in infant formula constituted with fluoridated water was another particular concern. These effects have also been examined in Chapter 6.

7.3 SUMMARY OF TASKFORCE PAPERS - (I) Non-Dental Human Health Effects of Water Fluoridation (Appendix 7); and (ii) Dental Costs and Benefits of Water Fluoridation (Appendix 6):

The Taskforce commissioned two specialist papers in relation to (I) dental benefits and risks (Chapter 6) and (ii) other non-dental, human health effects. Prof Ken Donald and Dr Penelope Webb from the Department of Social and Preventive Medicine at University of Queensland examined the human health effects of fluoridation. There are elements of overlap between the two in relation to human health, particularly in relation to issues of fluoride toxicity, e.g. skeletal fluorosis and excessive intake of fluoride.

7.4 METHODOLOGY:

The Webb/Donald study reviewed only that literature which the authors considered to have a sound scientific basis. Two main issues were considered in evaluating the scientific evidence. First, if there appeared to be an association between an exposure and ill health, was this association real? Or could it be an artifact, due to chance, bias or confounding? Certain types of study allow the possibilities of confounding to be ruled out with a greater or lesser degree of certainty. The review included both original articles and recent reviews published in peer-reviewed scientific journals as well as reports from reputable agencies around the world, including Australia. For the purpose of analysis, the literature was classified under three broad categories:

1. Studies where there was no evidence at all to support an association between fluoride and health. This group would include both well-conducted studies that do not find any association and a large literature of personal opinion, hypothesis and speculation that was not based on scientific fact

2. Studies where there was a suggestion of a statistical association between fluoride and health, but the possibility that this association could be an artifact due to chance, bias or confounding could not be excluded.

3. Studies where there was not only a statistically significant association between fluoride exposure and health, but it was also possible to rule out both bias and confounding as possible explanations for this

7.5 HEALTH CONDITIONS (Appendix 7 refers):

7.5.1 Osteoporosis and Hip Fracture:

A series of studies, mostly conducted in the USA, the UK and Canada, have addressed the question of whether fluoride affects the risk of fracture of the hip. In summary, of 17 ecological studies (i.e. studies of groups or populations), six reported no association with hip fracture, two a significant decrease in risk and nine an increased risk of fracture, although this was not statistically significant in three studies.

None of the studies provided strong evidence of an association, at the levels of fluoride used for artificial fluoridation, that cannot be explained by chance, bias or confounding. In summary, there was no evidence that could be classed as level 3 and be used reliably to evaluate causality.

7.5.2 Cancer:

There were upwards of 50 published reports of studies looking at the association between water fluoridation and cancer. The majority of these studies reported no significant association between fluoride and cancer rates thus providing no evidence that fluoridation was a cause of cancer. One study from the US reported a statistically significant positive association in 1977. However, in this type of study it was impossible to rule out confounding as a possible explanation for any association seen. Furthermore, the study has been heavily criticised in the literature for the way in which the analysis was performed, and re-analyses of the same data have consistently shown no association.

Using the classification above, all of this evidence would be classed as level 1 or possibly level 2 and, in the absence of any stronger data there was, therefore, no scientific evidence on which to base an evaluation of causality. There have also been several studies looking at the specific association between fluoride and the risk of osteosarcoma. Again the majority of these were conducted at the population level and found no association between water fluoride levels and either osteosarcoma or bone cancer rates generally. Three further studies considered individuals with and without bone cancer, and could, therefore, be considered to

provide stronger evidence for an evaluation of causality. Of these, the two largest and most recent studies found no consistent association between osteosarcoma and fluoride. The earliest study was very small and reported a significant protective effect associated with fluoride.

In summary, the majority of the data would be classed as level 1 and there was none of level 3 which would be required to provide any reliable evidence of causality. There was, therefore, no scientific evidence to support claims that water fluoridation causes osteosarcoma.

7.5.3 Skeletal Fluorosis:

Approximately 50% of ingested fluoride is excreted by the kidneys within 24 hours, a small amount is stored in the teeth, and the rest is mainly deposited in the skeleton. Exposure to high levels of fluoride can lead to skeletal fluorosis. This condition produces pain, stiffness and immobility in joints and can lead to more serious neurological disorders. There have been no reports of skeletal fluorosis attributable to water fluoridation in Australia and, overseas, most reports have been linked to sustained high levels of exposure in areas where water fluoride levels are naturally very high or in workers who are occupationally exposed to fluoride. However, no systematic research on skeletal fluorosis has been carried out in Australia, and NHMRC have acknowledged that it would not be surprising if there were undetected cases[21].

The review concluded however, that it was possible that certain individuals, for instance patients under going dialysis for renal disease, might have a slightly increased risk of skeletal fluorosis.

7.5.4 Dental Fluorosis

Dental fluorosis is a specific disturbance of tooth formation caused by excessive intake of fluoride during the formative period of the dentition. The manifestations depend upon the peak concentrations achieved in the blood following exposure to fluoride (usually by ingestion), the duration of exposure and the age of the subject. Clinically, dental fluorosis is characterized by *lustreless, opaque white patches in the enamel* which may become striated, mottled and/or pitted in more severe forms. The opaque areas may become stained yellow to dark brown. The severity of fluorosis is graded from very mild to severe.

The critical period for developing fluorosis is during the maturation period of tooth

enamel, which for the cosmetically important maxillary (upper) anterior teeth is the *second and third year of life*[137]. Fluorosis is considered probable following intakes of 0.1 mg F/kg body weight during infancy (Forsman, 1977). More recent reports have suggested a lower threshold: 0.03-0.10 mg F/kg body weight has been suggested as borderline, at least for European children. *(Fejerskov et al., 1987; Baelum et al., 1987)*.

In communities receiving artificially fluoridated water prior to the widespread use of fluoride toothpaste, most fluorosis was of the questionable or very mild variety. No treatment was considered necessary for either questionable or very mild fluorosis, as patients were usually unaware of both from a cosmetic standpoint. Mild and moderate fluorosis were more common in situations where toothpaste was swallowed, tablets ingested, or water levels contained high naturally occurring levels of fluoride. These conditions can be rectified cosmetically by enamel microabrasion.

7.5.5 Renal and Gastrointestinal Effects:

The kidney is a site for potential toxicity because this organ is exposed to relatively high concentrations of fluoride as approximately 50% of ingested fluoride is cleared from the body by the kidneys. The study found no evidence to suggest that water fluoridation was associated with an increased risk of renal disease.

Water used by kidney dialysis patients for haemodialysis after purification by reverse osmosis, has been reported to contain significantly higher levels of fluoride than commercially prepared peritoneal dialysis fluid (Bello *et al*., 1990). The authors suggested that the common usage of reverse osmosis to purify water for dialysis meant that in areas with fluoridated water, dialysis patients might, inadvertently, be exposed to too much fluoride. In the US, an outbreak of acute illness occurred in 12 of 15 patients treated in one dialysis room, compared with no cases in 17 patients treated in the second room at the same unit. The cases had unusually high serum fluoride levels and the cause of this was traced to a temporary deionisation system (Arnow *et al*., 1994).

7.5.6 Allergy:

Cases of asthma have been reported in adults exposed to fluoride in an occupational setting (Kongerud et al., 1994), and in children living near an aluminium smelter and exposed to air containing fluoride. However, there appeared to be no confirmed cases of allergic reactions following water fluoridation.

Consumption of tea, which contains high levels of fluoride, was not commonly associated with allergic reaction. Nevertheless, a small proportion of the public were convinced that they have suffered an allergic reaction caused by fluoride in the water.

7.5.7 Sudden Infant Death Syndrome (SIDS):

A number of studies have examined whether water fluoridation might be linked with a higher level of SIDS. Although a comparison of SIDS rates in the Australian capitals (Walker, 1992) claimed that Hobart with the longest history of fluoridation had the highest rates, followed by Canberra, while the rates were lowest in Melbourne which was non-fluoridated, there are likely to be many other differences between these cities that could explain the variation in SIDS rates. In conclusion, the study found no scientific evidence to suggest that fluoridation might increase the risk of SIDS.

7.5.8 Reproductive Effects and Fertility:

A single study has attempted to relate fertility to exposure to fluoride in humans. (Freni *et al.* (1994)). A few occupational studies have suggested that workers in certain industries, who are exposed to fluorides amongst other potentially hazardous compounds, experienced a range of adverse health effects including reduced testosterone levels in men and menstrual irregularities and spontaneous abortion in women. In all of these studies it was impossible to ascribe an effect to fluoride with any certainty because of the parallel exposure to a range of other compounds. In conclusion, the review found no reliable evidence to support an association between exposure to fluoridated water and any adverse reproductive effects.

7.5.9 Genetic Defects:

A number of small studies have suggested an association between fluoride and congenital malformation or Down syndrome. Earlier studies had suggested a link but have since been shown to be flawed, and more recent studies have not supported this hypothesis (IARC, 1982; NHMRC, 1985; PHC, 1993). The review concluded that there was no strong scientific evidence to support such an association.

7.5.10 Thyroid and Brain Function:

In a study of 26 adolescents aged 13-15 consuming water containing fluoride at 3 ppm, a level higher than in fluoridated water, there was no effect on thyroid function (Baum et al., 1981). Other studies have considered thyroid function in patients treated with high doses of fluoride. In one study of patients treated for osteoporosis with 60mg of Sodium Fluoride per day, some patients experienced joint pain and gastrointestinal effects but no changes in renal, bone marrow or thyroid function (Hasling et al., 1987). Exposure to fluoride in patients treated for osteoporosis would be considerably greater than that associated with consumption of fluoridated water.

Studies in animals have reported both the presence and absence of adverse effects of high levels of fluoride on thyroid function. A review of fluorine and thyroid function concluded that the published data did not support the view that fluoridated water had an adverse effect on the thyroid (Burgi et al., 1984). Another concern expressed is that fluoridated water may be associated with Alzheimer's disease because of contamination with aluminium. However, on the basis of current evidence, aluminium exposure has not been clearly established as a causal factor in the development of Alzheimer's disease. There is an alleged link between fluoride intake and both brain function impairment and a protective effect. The scientific findings, however, are not consistent.

7.5.11 Other Conditions:

There is an alleged link between fluoridated water consumption and a number of other adverse health effects including ageing, immune system damage, and magnesium/calcium deficiency. However, the review could find no reliable scientific evidence of an increased risk of these conditions.

7.5.12 Cardiovascular Disease:

A number of studies have shown conflicting results in relation to a possible beneficial link between fluoride and the incidence of cardiovascular disease. Some studies have shown an apparent decrease in the prevalence of cardiovascular disease in areas with higher fluoride levels, while others have shown no link. There is insufficient evidence to establish a causal link.

7.6 PRESENTATION BY PROF MARK DIESENDORF, UNIVERSITY OF

TECHNOLOGY, SYDNEY

The majority of Taskforce members recognised that there are always limitations to a literature review in covering the range of opinion on the effects of fluoridation, and invited a noted critic of fluoridation, Prof Mark Diesendorf, Director of the Institute of Sustainable Futures, University of Technology Sydney, to present his views. Prof Diesendorf has published a number of articles questioning aspects of fluoridation. Prof Diesendorf highlighted the following aspects:

- The causes of decline in dental caries (Chapter 6 also refers)
- Weak and misleading conclusions from the 1991 NHMRC report
- Health hazards and 'at risk' groups
- Negligible benefits of water fluoridation
- Ethical concerns about fluoridation

Prof Diesendorf made the following points:-

Decline in dental caries:

- the rate of dental caries has been declining for several decades in both fluoridated and unfluoridated communities;
- consequently, the effectiveness of water fluoridation has also declined with the advent of other sources of fluoride;
- the start of the decline in caries predated water fluoridation and other fluoride products, therefore other factors must have been involved;
- many early fluoridation studies were flawed - lack of longitudinal, blind studies and proper control groups;
- the benefits of fluoridation have been exaggerated - the differences in caries levels between Queensland and the fluoridated states were marginal or non-existent;

NHMRC Report (1991):

- Prof Diesendorf referred to misleading and weak admissions made in the Executive Summary of the NHMRC (1991) report. He considered that the majority of people on the Working Group represented professional bodies, like the ADA, that support fluoridation. The NHMRC report acknowledged concern about the possibility of adverse medical effects, and called for more research, while also continuing to support fluoridation;

- concerning skeletal fluorosis, the 1991 report stated 'The working group could find

no evidence within Australia of skeletal fluorosis'. Prof Diesendorf made the point that the report also acknowledged that Australian research has not been done (NHMRC, Section 6.4). In relation to dental fluorosis, NHMRC had also acknowledged that there were no published studies in Australia of the levels of fluorosis or its association with fluoride vehicles (NHMRC Section 6.2.3). However, Dr Diesendorf considered that there was data available from several other countries including India, the Middle East, and the United States which showed that skeletal fluorosis was a problem where fluoride concentrations were as low as 0.7 - 2.5ppm.

High risk groups:

- Prof Diesendorf's primary concerns were (I) dental fluorosis in children; (ii) skeletal fluorosis in older people; (iii) hip fractures; and (iv) hypersensitivity. He considered there were 4 particular high risk groups:
  - infants fed on milk formula made with fluoridated water;
  - outdoor workers and athletes (high water consumption because of subtropical climate);
  - people with diabetes;
  - people with kidney problems.

(I) Dental Fluorosis:

Prof Diesendorf advised that infants fed on milk formula made up with fluoridated water could be receiving between 1.2- 1.8 mg of fluoride per day. This was four times the level recommended by NHMRC and two hundred times the level found in breast milk. Prof Diesendorf was concerned that fluoride was absorbed more easily into children's bones.

(ii) Hip Fractures:

Prof Diesendorf made a number of points in relation to the evidence about hip fractures:-

- a number of major studies from the USA, UK and France had found a positive correlation between exposure to fluoridated water and increased levels of hip fractures;
- other studies which did not find a correlation had been poorly designed;
- studies have shown evidence of higher rates of hip fractures in osteoporosis patients who receive fluoride treatment to increase bone mass. Prof Diesendorf considered that these results were consistent with water fluoridation findings, since the higher doses of fluoride given in the short-term

to osteoporosis patients could be equated to the lower doses of water fluoridation over longer periods.

(iii) Negligible benefits of water fluoridation:

Prof Diesendorf made the following points:-

- used School Dental Service graphs (Tooth Decay in Australian Capital Cities 1977-1987) to illustrate his point that there had been significant and similar reductions in dental caries in Brisbane, Hobart and Melbourne during that decade; and that it was not possible to separate the influence of water fluoridation from other sources of fluoride.
- the National Oral Health Survey (1987) data on average tooth decay amongst 10-14 year olds showed that Brisbane had similar DIMFT figures to Adelaide, Melbourne and Perth (where 'I' stands for 'indicated for extraction').
- the average reduction in caries between fluoridated and non-fluoridated communities amounted to approximately a half tooth (extraction or filling).
- comparisons of DMFT rates in 12-13 year olds in the major cities of New Zealand in 1984 and 1987 showed unfluoridated Christchurch as having the lowest decay rates. This was a study of all children, i.e. a full population study.

Many of the above arguments were also put forward by Dr Colquhoun in his presentation to the Taskforce (Chapter 6).

(iv) Ethical concerns about fluoridation:

Prof Diesendorf posed a number of questions:-

- Is mass medication, which is difficult and expensive to avoid, right or wrong?
- Is medication with an uncontrolled dose right or wrong?
- Is it right or wrong for professionals to claim that fluoridation reduces tooth decay by 40-70%, when the actual benefit is so small that it cannot be measured by the traditional indices of tooth decay?
- Is it right or wrong for society to impose health risks upon some people for the possibility of giving tiny benefits to the same or other people?
- Is it right or wrong for professionals to mislead people that fluoride has to be swallowed, when fluoride has no nutritional value, and any dental benefit is obtained from its direct action at the surface of teeth?

7.7 TASKFORCE DISCUSSION:

In relation to the two most serious health conditions which have been linked to fluoride, osteosarcoma (bone cancer) and hip fractures, the Webb/Donald study concluded that (I) there was no sound scientific evidence to prove that water fluoridation at the optimal dose caused higher levels of cancer; and (ii) that it was not possible to state conclusively that fluoridation will not affect rates of hip fracture, though the weight of evidence was against such an association. The study also concluded that renal dialysis patients did present special risks if exposed to fluoridated water, and that special precautions would be required. In respect of other alleged risks, the study concluded that there was no scientific evidence of causal links. The causes and risks of dental and skeletal fluorosis have been dealt with separately in Chapter 6.

Taskforce members discussed a number of points arising from the Webb/Donald study, and about the alleged risks to human health raised in the presentations by Prof Diesendorf and Dr Colquhoun:

7.7.1 Degree of Risk:

The scientific studies listed in the Webb/Donald literature review were mainly American, obtained via Medline on the Internet. Some Taskforce members argued that Medline contained mainly US research and that many non-English language studies would be missing, e.g. the recent study on hip fractures by the University of Bordeaux. The latter study concluded that the risk of hip fracture was significantly higher in areas of higher water fluoride concentration, and was not included in Paper 7.

As with many other aspects of fluoridation, the evidence relating to some health risks such as hip fractures, or the lifetime effects of ingestion, was ambiguous, and invariably the literature called for better data or more research. Many Taskforce members found difficulty in trying to pinpoint the degree of risk, or judge between the opposite and competing views of the experts on both sides.

Although the Webb/Donald review concluded that for many of the alleged risks, there was no evidence of a causal link with fluoridated water, that the risk of increases in hip fracture appeared to be low, or that the data was not reliable enough to prove a link with bone cancer, a number of Taskforce members remained unconvinced. Concern about conflicting evidence led to debate about the soundness and scientific standing of different types of evidence presented to the Taskforce. Some supporters of fluoridation suggested that much of the evidence put forward by the anti-fluoridation side was not scientifically sound because it had not been published in ‘reputable’, peer-reviewed journals, Opponents of fluoridation

responded that many early fluoridation studies which had once been accepted as sound, had subsequently been judged to be flawed. They also alleged that a number of reputable anti-fluoridation studies have been refused publication because of professional bias. Taskforce members were agreed, however, that they had a responsibility to distinguish reliable information from propaganda, to consider a range of expert opinion, and not dismiss lay opinion simply because the author was not a scientist.

During the course of his presentation to the Taskforce, Prof Diesendorf referred to known physiological changes caused by fluoride, including:

- damage to ameloblasts (enamel-forming cells);
- inhibition and activation of enzymes;
- genetic damage in the form of mutation and chromosome damage to mammalian cells in vitro.

The Chair sought clarification from the medical/dental experts on the Taskforce as to whether they agreed with Prof Diesendorf. Dr Walsh responded that there was scientific evidence of these effects with large doses of fluoride. However, the key question was the dose response.

7.7.2 Dose Response:

Given that fluoride was acknowledged as a toxic substance in 'high' doses, the issue of what constituted a safe level or a toxic dose loomed large in Taskforce discussion about health effects, as it had during the consideration of dental benefits and risks. Many of the research studies linking fluoride with cancer, genetic damage, brain function, etc, had been conducted using large doses of fluoride, usually on animals. Consequently, it was not appropriate to directly compare those results with the much lower doses of fluoride provided by water fluoridation. Nevertheless, some Taskforce members were concerned that the build-up of fluoride in the body over many years could begin to approach, and mirror the effects of dosages identified with harmful effects in short term experiments. Taskforce members were also aware that it is extremely difficult to isolate a single causative agent in the environment as responsible for specific adverse health effects, particularly in the presence of other potential causative agents.

7.7.3 Hip Fractures:

The Taskforce discussed the rather ambiguous scientific data on the links between fluoridated water and increased rates of hip fractures. A recent University of Bordeaux study had concluded that more hip fractures had occurred in populations exposed to fluoridated water at 1ppm compared to those at 0.2 or 0.4ppm. Proponents of fluoridation responded that some other studies showed a decrease in hip fractures with increased fluoride levels, and also pointed to the fact that high doses of fluoride were used to treat patients suffering from osteoporosis. Opponents argued that those studies which did not show a link were small scale and had used small towns, whereas large population studies were required to show a clear picture. Opponents referred to the New England Journal of Medicine which found that although fluoride increased bone mass, it also changed bone structure making it more fragile.

7.7.4 Cancer Risk:

In his presentation to the Taskforce, Prof Diesendorf referred to US Cancer Registers which showed an increase in bone cancer in fluoridated areas. Supporters of fluoridation on the Taskforce questioned the link to cancer and pointed to the complexities of the disease which often requires both an initiator and a promoter of disease, as well as other factors. Although there was evidence in the laboratory to suggest that fluoride can promote cancer growth, it was argued that this did not mean that fluoridated water caused increases in cancer.

7.7.5 Research Standards:

Comment was made by Dr Colquhoun that the very rigorous standards applied by the Webb/Donald study had not been applied to many of the published studies showing benefits to teeth from fluoridation. Taskforce members were already aware that the methods used in many early fluoridation studies have been criticised by experts on both sides of the argument. However, it should be emphasised that Prof Donald and Dr Webb were only looking at human health effects and not the dental effects of fluoridation.

7.7.6 International Situation:

A number of Taskforce members were clearly concerned that many European countries - modern, democratic and similar to Australia in many ways - had experimented with water fluoridation but had abandoned it. There was considerable discussion about the reasons for this, which seemed to be as much socio-political as scientific. The literature indicated that some of these European countries (e.g.

the Scandinavian countries, Holland) seemed to have taken the view that caries levels were low and declining, and that other methods of applying fluoride were more appropriate in tackling the remaining problem[156]. WHO figures suggested that the caries experience of 12 year olds in Queensland was similar to that of Sweden, Finland and Denmark (all unfluoridated), and slightly lower than New Zealand (fluoridated) [240].

7.7.7 Total Intake:

A number of Taskforce members expressed particular concern about increasing levels of fluoride in the environment (both natural and the 'halo' effect), and particularly the risks of excessive intake by infants and young children (also discussed in Ch 6). Dr Colquhoun had expressed particular concern about infants getting a large dose of fluoride so early in life, given that the lifetime effects of accumulated ingestion were poorly researched and largely unknown. In his commissioned study for the Taskforce, Dr Armstrong also pointed to the risks of excessive intake of fluoride from infant formula mixed with fluoridated water (Appendix 20, page 9). Supporters of fluoridation argued that there was weighted evidence that ingestion of fluoridated toothpaste was the main cause of excessive intake in children. They argued that parents and children could be educated to use a smaller amount of toothpaste, and a lower concentration of fluoridated toothpaste. Opponents replied that society could never control the behaviour of young children. However, it could control whether the public water supply was fluoridated.

SUMMARY

7.8 AREAS OF AGREEMENT:

The Taskforce reached general agreement on the following points:

- High doses of fluoride were toxic and have been linked with a number of potentially adverse human health risks, e.g. osteosarcoma, genetic damage;
- Evidence of a causal link between increased numbers of hip fractures and water fluoridation was ambiguous and difficult to quantify;
- The lifetime effects of the build-up of fluoride in the body were not fully understood;
- Fluoridated toothpaste and other discretionary sources of fluoride were associated with higher levels of dental fluorosis, and more public education was required;
- There was a need for more research in relation to a number of alleged health risks.;
- The rate of dental decay has been declining for several decades in both fluoridated and unfluoridated communities.

7.9 AREAS OF DISAGREEMENT:

Following discussion, Taskforce members disagreed on the following issues:

- Members supporting and opposing fluoridation were profoundly divided on the level of health risk associated with water fluoridation. Supporters asserted that no serious health risks had been proven in more than 50 years, while opponents argued that stronger evidence of risk has emerged in recent years, particularly in relation to hip fractures and osteosarcoma, and that there has been a lack of research into lifetime effects.

- Pro and anti-fluoridation members were also split on the risks of low dose, long-term exposure to fluoridated water. Proponents were convinced that fluoridated water had proved to be completely safe for over 50 years. Opponents were equally convinced that there was some evidence of risks.

- The appropriate margin of safety between a safe and toxic dose was disputed, as it had been in relation to dental and skeletal fluorosis (Ch 6).

7.10 FURTHER RESEARCH:

The 1991 NHMRC Working Group expressed considerable concern about the fact that it could not point to a single Australian study which had monitored adequately the impact of possible adverse consequences of fluoridation (NHMRC 1991, Section 8). The Working Group criticised the fact that, although Australia had opted heavily for fluoridation compared to many other countries, it had not contributed the corresponding research. The pro-fluoridation case had relied almost entirely on international studies. In the context of Brisbane's particular subtropical climate, and the decline in dental decay in the last 20 years, the lack of current Brisbane data was acknowledged by a majority of Taskforce members as detrimental to the pro-fluoridation argument. The NHMRC report had called for improvements in a number of areas:

- more Australian research on the effectiveness of water fluoridation, in the context of the dynamic nature of dental disease;
- more monitoring of total fluoride intake and its effect on health and ecology;
- studies of toxicity of fluoride in the form of dental and skeletal fluorosis;
- improved economic analyses

The Taskforce were aware from the literature, and also from correspondence with NHMRC and Queensland ADA, that the inadequacies highlighted by NHMRC have not been

adequately addressed during the intervening years, e.g. the National Oral Health Survey 1987, which ideally should be updated annually, has not been repeated.

Against this background, most Taskforce members were broadly agreed on the need for more and continuing research in relation to possible adverse health effects of long term ingestion of fluoride, particularly the issue of total intake by infants and young children, and the levels of build-up of fluoride in the body.

CHAPTER 8: ENVIRONMENTAL IMPACT OF FLUORIDE

8.1 BACKGROUND AND ISSUES

The environmental impact of fluoride has never been fully considered in Australia in the debate about whether or not to fluoridate a public water supply. Consideration does need to be given to the impact of fluoride on the biological (plants and animals) and the physical environment (waterways, soil and air) of a community.

It was clear to the Taskforce that there has been limited research undertaken which shows any potential impact (both benefits or risks) of fluoride in the environment, especially when fluoride has been artificially introduced.

The majority of studies that have been conducted were on the impact of industrial fluoride. It has been surmised that the effects of industrial fluoride would be similar to sodium fluoride (the form most widely used to fluoridate drinking water supplies).

There appeared to be few studies/research available on a community's ecosystem, prior to and after the introduction of fluoride.

Limited information/research was available on the effect of fluoride in a sub-tropical climate. The only study undertaken for the Brisbane area concerned the effect of industrial (hydrogen) fluoride. Brisbane is a sub-tropical environment and there is limited information available on the effect of fluoride within a sub-tropical environment.

The Taskforce commissioned Dr Greg Miller from Envirotest (an environmental science based company) to carry out a review of the potential environmental impacts of water fluoridation. The study covered the following:

- identification of key issues from relevant studies/papers;
- an analysis of the findings of those studies/papers with particular reference to the chemical nature of fluoride compounds and the possible impact on Brisbane's environment;
- an assessment of the quality and reliability of those findings; and
- recommendations in relation to the impact of fluoridated water on the environment.

8.2 SUMMARY OF PAPER 10: ENVIRONMENTAL IMPACT OF FLUORIDE

Dr Miller approached the issue from an eco-toxicology viewpoint and considered the following issues:

- properties of fluoride
- levels of fluoride in the environment (biological and physical)
- effects of fluoride on plants and animals
- assessment of potential impacts on Brisbane's environment and
- characterisation of risks.

There was an existing natural level of fluoride in plants and animals. Plants take up fluoride from air, soil and water and accumulate it in the leaves. The natural fluoride content of vegetation was in the range of 1 and 10 ppm. Fluoride was taken up by animals and stored mainly in the skeletal or exoskeletal parts of the body.

Fluoride is a chemical element and the introduction of any fluoride will produce a toxic response in the environment. Some species of animals and plants would adapt to the introduction of additional fluoride. However, fluoride would affect some species and at different stages of their life cycle e.g. an adult form of a species may be more sensitive that the juvenile (e.g. rainbow trout).

The introduction of fluoride to the environment would present a relative (increased) risk to livestock, some terrestrial and agricultural plants, sensitive freshwater plants and animals, and freshwater creeks (especially under low flow conditions) found in the Brisbane area.

The study summarised the relative risks for plant and animal classes in terms of a hazard ranking of likely species sensitivity from 0 - 3 (negligible, low, medium and high). Exposure related to the likely presence of fluoride in plant or animals' habitat at concentrations that could effect sensitive species. The table below refers:

Relative Risk Scores for Plants and Animals of Brisbane Area

		Hazard		Exposure	Risk
Plants					
Marine		1	x	1	1
Freshwater		(1)	x	1-2	(1-2)
Terrestrial		2	x	1	2-4
Agricultural		2	x	1-2	2-4
Animals					
Birds		1	x	1	1
Terrestrial	Livestock	2	x	1	2
	Other Mammals	1-2	x	1	1-2
	Invertebrates	(1)	x	1-2	(1-2)
	Insects	1-2	x	1	1-2
Freshwater	Fish	1-2	x	1-2	1-4
	Crustaceans	1	x	1-2	1-2
	Macroinvertebrates	(1)	x	1-2	(1-2)
Marine	Fish	1	x	1	1
	Crustaceans	1	x	1	1
	Molluscs (bivalves)	2	x	1	2
	Benthic Invertebrates	1-2	x	1	1-2

* ( ) high degree of uncertainty.

** 1-3 = Low Risk; 4-6 = Medium Risk; 7-9 = High Risk.

As outlined in the above table, the relative risks for livestock and possibly domestic animals (relative risk: 2), some freshwater animals (relative risk: 1-2) and freshwater plants (relative risk: 1-2) are considered low on a scale of 0-9. There is a higher level risk for terrestrial and agricultural plants (relative risk: 2-4).

Some species of freshwater fish would be at an increased risk (1-4) due to Brisbane's climatic conditions. For example, the evaporation of water in summer (drought) would cause fluoride concentration to accumulate in the dry conditions, potentially exceeding the Australian Water Quality Guidelines for irrigation (1 mg/L) and livestock watering (2 mg/l). In Brisbane there would be a certain seasonal impact on the ecosystem.

8.3 REVIEW / CONCLUSION

The Review formed the following conclusions:

- During low flow and dry periods, freshwater creeks were likely to contain variable

fluoride levels of up to 1-2 mg/L compared with background levels of 0.1 mg/L.

- Estimates of environmental risks for marine, estuarine, freshwater and terrestrial classes of plants and animals have been made. These indicated that risks of effects such as fluorosis or plant injury in sensitive species were generally low at the level of fluoride proposed. Considerable uncertainty exists though for major groups or classes of organisms such as invertebrates and birds.

- Some urban vascular plants, vegetables and crops were likely to be sensitive to elevated soluble fluoride from watering or irrigation. Freshwater ecosystems were also likely to be vulnerable during low flow and drought conditions.

- Livestock would ingest higher levels of fluoride from drinking water, fluoride watered forage and local feed. It was uncertain whether intake doses would be sufficient to cause symptoms or signs of fluorosis.

- The review recommended that experimental studies and other biological assessments should be conducted on sensitive plant and animal species that reflect the region's biodiversity, prior to any decision for the release of long-term additional fluoride into Brisbane's environment.

8.4 TASKFORCE DISCUSSION:

8.4.1 A Taskforce member queried to the effect of fluoride on fisheries, especially their fertility rate.

Dr Miller responded that fisheries, especially the juvenile species, e.g. prawns, etc, would be at some risk from the introduction of fluoride. In salt water, some species of adults would be more tolerant, however, juveniles (which live in bracken water) would be more susceptible. Within a sensitive species, part of the population, that is, the 'sensitive within sensitive' part of the population, may be eliminated.

8.4.2 The effects fluoride in comparison with that of chlorine being discharged into the waterways was discussed. Chlorine was also a toxic chemical. However, when it was treated with ammonia there was a decrease in the toxicity levels. An ecological study of a freshwater area at Bulimba has revealed that the area has recovered from the effect of chlorine. Fluoride, however, has a longer term, more persistent, toxicological effect on the environment. In effect, the fluoride ion remained for a much longer period in the environment than chlorine.

8.4.3 A Taskforce member commented that Moreton Bay has been referred to as a 'disaster area' in terms of ecological damage. Moreton Bay cannot be compared to Sydney or Melbourne's bays because Moreton is a closed system that 'holds in' most of what goes into it, whereas Sydney and Melbourne are more open systems. Dr Miller commented that brine shrimp could be affected (significant inhibition of growth) at a fluoride dosage of 0.5 ppm. Dr Miller also estimated that 128 kg of fluoride effluent would flow into the bay each day. Dr Miller was asked what the effect of 128kg of fluoride effluent per day would be on the marine life in Moreton Bay.

Dr Miller explained to the Taskforce that Moreton Bay was under threat from a number of elements. A wastewater study has been commissioned on how the bay functioned and there was already concern about the west part of the bay near the wastewater discharge points (the area around Luggage Point). Sydney and Melbourne have temperate climates as well as 'open-systems', and cannot be used for comparison purposes with Moreton Bay (which has a sub-tropical climate and a 'closed system'). The eastern part of the bay flushed well and the water there was of good quality.

Dr Miller was of the opinion that there would be minimal change to the Bay within one year (with a fluoride effluent of 128 kg per day). Pollutants do take a while to flush out fully to the bay. The longer term effects, however, were uncertain and areas within a limited radius of discharge points would definitely be affected.

Some marine species (e.g. prawns) may decrease, however, there are some species of crustaceans that are tolerant to fluoride and store it in their shells.

8.4.4 Taskforce members raised the concern over the pollutants already in the bay and the current affect of existing pollutants.

The motion of water in Moreton Bay came from the western side (Luggage Point) around to Caboolture. There was already concern over a large area of sea grass (7 km x 2 km) near Pebble Beach, Deception Bay that died off each year because of pollution. From April to June each year, fish from this area were considered too toxic for human consumption. This 'toxic' area was now moving into the breeding grounds in Pummicestone Passage.

8.4.5 A Taskforce member remarked that there was insufficient knowledge about the effects of fluoride on the environment and that not enough studies have been undertaken on this issue. Dr Miller advised the Taskforce that there

were a number of world studies available but they needed to be adapted and applied to the local environment of Brisbane. The studies available focussed on specific issues e.g. the smelters at Gladstone, etc. In 1986, the University of Queensland undertook a study on the effects of hydrogen (industrial) fluoride on plant life in Brisbane.

Dr Miller concluded that there were some sensitive species that would be affected by the introduction of fluoridated water to the environment, including terrestrial and marine species. Dr Miller's personal opinion was that there would be no perceived environmental benefits from the introduction of fluoride.

8.5 AREAS OF AGREEMENT / DISAGREEMENT

Taskforce members had no specific area of disagreement, however, many members did have concern that there was insufficient research and information available on the effect of fluoride on the whole ecosystem.

It should be explained that Dr Miller's study represented a limited, small-scale review of the existing literature, allied to his specialist knowledge of the local environment of Brisbane and the existing environmental threats. As Dr Miller recommended, more definite conclusions about the environmental impact of fluoridation of Brisbane's public water supply would require that experimental studies and other biological assessments should be conducted on sensitive plant and animal species in the locality.

CHAPTER 9: CONSIDERATION OF ECONOMIC COST/BENEFIT ANALYSIS

9.1 BACKGROUND AND ISSUES

A Taskforce paper (Appendix 11) was developed to examine the various elements which would make up a cost benefit analysis on water fluoridation, the constraints involved in preparing an accurate analysis for Brisbane, and provided options for consideration by the Taskforce.

A cost/benefit analysis on water fluoridation concerned the economic considerations which should guide policy-makers in deciding whether to fluoridate, or in making economic choices between different fluoride options, e.g. fluoride tablets/drops. Literature on recent fluoridation cost/benefit analyses, primarily from the United States, showed that the process was inherently complex because of the variety of different assumptions which have to be taken into account. All studies had been criticised for omitting relevant considerations, e.g. a study by ***White et al. (1989)*** argued that researchers generally have failed to incorporate a number of important factors:

- the declining prevalence of dental caries in recent decades;
- a lack of detail concerning program costs, with some direct costs not included;
- failure to fully incorporate treatment savings.

The analyses in the literature appeared to be unanimous in showing a positive economic case for water fluoridation. Fluoridation was shown as more cost effective than other decay prevention programs, e.g. fluoride tablets/drops, topical applications, mouthrinses, etc.

Although there were doubts about the degree of effectiveness of water fluoridation, it seemed probable that fluoridation could be shown to be cost effective. However, the *'White et al'* study illustrated the difficulty in producing an accurate and widely acceptable economic assessment unless you have data about baseline caries rates and the changes in disease patterns over time.

The main constraint in producing an accurate cost/benefit analysis for Brisbane was the absence of any recent, comprehensive dental research data which would quantify the extent of the dental decay problem in Brisbane and the changes in disease over time. This data was essential to estimate the scale of the reduction in dental treatment which might result from water fluoridation, and a key element in calculating the 'benefits' side of the equation.

The above constraints cast considerable doubt on the feasibility of producing an accurate and defensible analysis for Brisbane. It was also argued that neither side in the fluoridation debate would view the economic argument as decisive in terms of the final decision.

Three options were put to the Taskforce:

(a) Do not carry out a full cost/benefit analysis, in view of the data limitations for Brisbane outlined above and the likely criticism which any study would provoke.

(b) Commission a limited study, looking at the benefits to Brisbane children only, using dental decay rates and assumptions about fluoride effectiveness from the University of Adelaide studies (1995).

(c) Commission a full population study of Brisbane using assumptions about effectiveness, demand for treatment, etc, from elsewhere, and extrapolate to Brisbane.

The Taskforce accepted the recommendation that a full cost/benefit analysis study for Brisbane should not be attempted for the following reasons:

- Lack of recent dental data for Brisbane relating to levels of decay and changes in disease pattern.
- Unable to isolate or quantify the reduction in dental treatment attributable to water fluoridation alone.
- All cost/benefit analyses on fluoridation have been criticised.
- Economic argument was not decisive in reaching a decision.

9.2 TASKFORCE DISCUSSION

Taskforce members agreed that a full cost/benefit analysis for Brisbane would be very time consuming, expensive, and might well be flawed.

Dental experts on the Taskforce estimated that the lifetime cost savings which could be obtained from a reduction of one surface filling would be approximately $300 per person. In contrast, US studies have shown that the costs of water fluoridation over the course of a lifetime were 54 cents per person. Taskforce members opposed to fluoridation acknowledged that point, but commented that any analysis would have to take into account all the other factors involved in a cost benefit analysis, including, for example, the risk (and costs) of an increase in hip fractures.

Another Taskforce member commented that the costs of water fluoridation would have to be borne immediately by Council, whereas the benefits in the longer term would accrue to State Governments and individuals. However, the Taskforce was agreed that the economic cost of water fluoridation was not a decisive factor in deciding whether or not Council should fluoridate.

Supporters of fluoridation on the Taskforce commented that the study by *White, et al - 'Issues in the Economic Evaluation of Community Water Fluoridation'*, was recent, responsible and sound. Although the paper pointed out the difficulties and complexities of cost/benefit analysis in relation to fluoridation, and revealed that most studies had deficiencies, the paper also concluded that water fluoridation 'may be one of the most cost-effective programs in health care'. However, opponents of fluoridation referred to a lack of analysis in the paper concerning the cost of adverse health effects.

9.3 AREAS OF AGREEMENT / DISAGREEMENT

The Taskforce supported the recommendation that a full cost/benefit analysis for Brisbane should not be commissioned, and that the cost/benefit discussion paper be accepted as part of the report.

CHAPTER 10: PUBLIC CONSULTATION

The Taskforce recognised the need to invite and gauge public opinion on this important and contentious issue. This was achieved through; an initial telephone survey, invitation through the media for public submissions, correspondence to the Lord Mayor, and through a public meeting.

10.1 TELEPHONE SURVEY

Four hundred residents across the four regions of Brisbane were surveyed via a telephone questionnaire. This survey was undertaken by REARK to gauge community opinion on the issue of fluoridating Brisbane's water supply. The survey represented a limited snapshot of public opinion and was carried out in February 1997, prior to the first meeting of the Taskforce. (Appendix 14)

10.1.1 Methodology

Interviewing was conducted with residents of Brisbane City Council aged 18 years or over. Results were post weighted to reflect the age and gender of the Brisbane population based on Australian Bureau of Statistics Census figures.

10.1.2 Support for Fluoridation

Approximately 62% of respondents supported the introduction of fluoride treatment into the Brisbane water supply, 22% did not support it and 16% did not know or did not care. Further analysis of responses showed support for fluoridation on the basis that there were no scientifically established side effects.

10.1.3 Reasons for Support / Non-Support

Supporters of fluoridation were asked the reasons for their support. The main factors stated were health reasons (73%) such as it is good for teeth and general health; it has been used elsewhere without any problems (22%); and other issues such as reduced dental bills and making it available for free to everyone in society. Non-supporters were asked the reasons for opposition to the introduction of fluoridation. The main reasons stated were health related (47%) such as side effects including discolouration of teeth and disliking chemicals in the water; freedom of choice (17%); and other reasons (28%) such as taste.

All respondents were also asked the advantages and disadvantages of fluoridation. The main advantages cited by supporters were health related benefits (87%) and economic or 'public-good' reasons (19%). A total of 62% of supporters did not acknowledge any disadvantages to fluoridation. Amongst non-

supporters, the main disadvantages stated were health related concerns about possible side effects and discolouration of teeth (46%); and other concerns such as freedom of choice (17%), cost (6%) and disliking chemicals (8%). A total of 48% of non-supporters acknowledged some benefits to fluoridation of the water supply while 52% said there were no benefits.

10.2 REQUEST FOR PUBLIC SUBMISSIONS

Via the press media, the public were also invited to send written public submissions expressing their opinions and providing information on the issue of fluoridating Brisbane's water supply. One hundred and ninety-two (192) replies were received. Of these 84.9% opposed fluoridation, 14.6% supported fluoridation, and 1.04% were neutral.

The one hundred and ninety-two respondents were divided into two groups. Residents (145) and non-residents (47). Four respondents, all opposed to fluoridation of water, did not provide an address. Their reasons have not been included in this summary. Their points, however, were similar to those mentioned by the other respondents.

Residents were further divided into three groups: support (25), oppose (119) and neutral (2). Non-residents were divided into two groups: support (2) and oppose (30). There were no neutral non-residents.

The following tables summarises the position of the respondents and the distribution of their residence.

TOTAL NUMBER OF SUBMISSIONS: 192

Classification	Support	Oppose	Neutral	Total
BCC Residents	25	119	2	**146 (76.04%)**
Outside BCC	2	30		**32 (16.67%)**
Overseas		10		**10 (5.21%)**
Unknown		4		**4 (2.08%)**
TOTAL	**27**	**163**	**2**	**192**
% of Total	**14.06%**	**84.90%**	**1.04%**	**100%**

A summary of the reasons provided by the respondents by residential status and

position is outlined. The submissions have been further categorised into five broad topic areas: Health, Civil Liberties, Environmental, Economic and Other.

These outlines exclude the four (4) "unknown" submissions.

Summary of Reasons

10.2.1 Residents (Total: 146)

10.2.1.1 Support (25)

Those supporting the introduction of fluoride to Brisbane's water supply most commonly stated its effectiveness in reducing caries. Several of these comments were based on the reports in the newspapers stating that Brisbane suffered up to 65% more caries than Townsville. The fact that Brisbane was the only capital not fluoridated was the second most frequent reason, followed by personal or family experience with or without fluoride. Improved dental health, cost effectiveness and social equity in public health were also cited. Three respondents stated that other options were available, one believed good oral hygiene and a healthy diet were better options and another acknowledged the problem of mass medication.

10.2.1.2 Oppose (119)

Those opposed to the introduction of fluoride to Brisbane's water supply, most commonly stated that other options were available, followed by the suggestion that good oral hygiene and a healthy diet would treat the cause of the problem, rather than just treating the symptoms. Several residents did not want their rates to go towards those who "will not take the responsibility themselves for the care of their children's teeth". Many felt it was an infringement of the right to choose, or that it constituted mass medication; and were concerned that fluoride was a cumulative poison; and that dosage at the tap was uncontrollable. One response referred to differences in fluoride concentrations of up to 500% when measured at different household taps. Other issues causing concern included: the fact that other countries have ceased usage, or have banned it; only a small amount of water is actually used for drinking; and that the "water tastes bad enough already" was a common cry.

10.2.1.3 Neutral (2)

Only one of the two neutral respondents gave reasons for their decision. The School of Public Health, QUT provided a balanced summary of the

pros and cons of the issue and offered their services in the event that Council required any health promotion/ research.

10.2.2 Non-residents (42)

10.2.2.1 Support (2)

The two non-residents who wrote supporting the introduction of fluoride were from scientific backgrounds (a dental academic and a public health unit doctor). Both stressed that advantages of fluoridation occurred throughout life, not just during childhood; the effectiveness of fluoride in reducing caries; and social equity in public health. One mentioned cost effectiveness while the other suggested that, ideally, a combination of better diet and oral hygiene was the *optimal* solution. However, for social equity, water fluoridation provided the *best* solution.

10.2.2.2 Oppose (40)

This group of 40 submissions consisted of 10 from prominent overseas anti-fluoridation activists, most of whom have a scientific background. These included: Dr John Colquhoun (Auckland, NZ), Dr John Yiamouyiannis (USA), Dr Zeigelbecker (Austria), and Hans Moolenburgh (Netherlands). Other non-resident submissions can be divided into three main groups: those from neighbouring local government areas concerned about the fluoridation of Brisbane's water affecting their food and water (or that of relatives living in Brisbane); those from the various anti-fluoridation associations around Australia; and those from various schools/associations of natural medicine. Three other submissions were from different council areas within Victoria which have rejected water fluoridation. They cite their own examples, and list the other Victorian councils which have also refused to fluoridate their water supplies (Ballarat, Bendigo, Geelong, Mildura, Warrnambool, Wodonga).

10.2.3 Submission Categories

10.2.3.1 Health

Supporters of water fluoridation most commonly cited its effectiveness in reducing caries, followed by improved dental health. One interstate 'academic' supporter referred to the reduced need for dental treatment. Several respondents for and against fluoridation stated that their opinions stemmed from concern for their young children.

Side effects were the main focus of the majority of respondents who opposed fluoridation. In relation to individual side effects, the belief that fluoride compounds are cumulative poisons was the most frequently stated reason for opposition. The cumulative effects of aluminium, lead and arsenic residues in fluoride compounds, was also mentioned by several respondents.

Of the side effects, allergy/sensitivity was the most frequently cited. Several people referred to themselves or relatives having severe reactions to fluoride toothpaste, with symptoms only ceasing when non-fluoridated toothpaste was used. Some were concerned about rising levels of sensitivity to chemicals in the population, and that fluoridation of the water may cause an increase in this problem. Several were concerned about how fluoride would react with all the other chemicals we ingest daily. Many stated that they believed it was good for teeth, but did not believe it was good for "health" in general. Of the other side effects, cancer rated second in frequency, followed by dental fluorosis, increased hip fractures, genetic damage/Downs Syndrome, reduced IQ/impaired brain functioning and gastrointestinal upsets. It was suggested by some that if there was any suspicion that fluoride may cause cancer, its use should be suspended until the issue was decided.

10.2.3.2 Civil Liberties

The fact that other options were available and that some foods contain relatively high concentrations of fluoride, were the most frequently cited reason for opposition to fluoride. Many respondents were emphatic about their right to choose what chemicals they ingest. Mass medication and infringement of the right to choose also rated highly. For the supporters of fluoridation, 7 out of 27 stated social equity in public health as a reason to fluoridate the water supply. Many opponents did not believe that social equity was a good enough reason to put the rest of the population at risk, whether the minority beneficiaries were children or lower SES groups.

One supporter of fluoridation referred to Queensland's enabling legislation as empowering the State government to indemnify any local authority for compensation claims on the grounds of injury or harm to health resulting from the consumption of fluoridated water. Seven respondents opposed to water fluoridation also referred to indemnification , suggesting that if water fluoridation was so safe, why was there a need for local authorities to be indemnified against legal action.

10.2.3.3 Environmental

Water purity was the most frequently cited "environmental" concern. Some respondents stated that the water tastes bad enough already without fluoride. The effect of fluoride on the environment and pollution of waterways, was of concern to a number of writers, followed by references to accidental poisonings that have occurred or the risk that they may occur in Brisbane. Human error was mentioned, as was fluoride poisoning of livestock in Tasmania.

10.2.3.4 Economic

Several supporters of fluoridation cited cost effectiveness compared to other options. Those opposing considered it a waste of rate-payers money as decay can be prevented in other ways, and referred to the small amount of water actually used for drinking. Other related points raised by many respondents included: people, especially children, don't drink much water; children drink too many soft drinks. A few respondents suggested other methods they felt to be more cost-effective, eg fluoride tablet provision, salt fluoridation, bottled-water fluoridation.

10.2.3.5 Other

Supporters of fluoridation suggested that because other capitals were fluoridated, Brisbane should be. However, many opponents referred to the fact that much of Europe and some Asian countries have abandoned or banned fluoridation. Personal and family experiences regarding water fluoridation were cited by both sides.

Uncertainty of dosage of fluoride was one of the most frequently cited reasons, followed by the absence of fluoridation in other countries, and the fact that it is a waste product of the aluminium/ superphosphate industries. Benefits for children only was a commonly cited misconception, although several respondents stated that *'most'* benefit goes to children. Others stated that once teeth have erupted, the effect of fluoridated water was only topical, and that there were more cost effective ways of topically applying fluoride. Some respondents stated that the benefit was only for low SES groups, and believed that it was not in the interests of the majority to fluoridate.

Several respondents opposing fluoridation compared the use of fluoridated water to the use of other reportedly "safe" products such as thalidomide, asbestos, lead, and other drugs that have been found harmful to humans

after many years of usage. One respondent commented that fail safe mechanisms often fail, and another suggested that it would be very expensive to install them.

10.3 PUBLIC MEETING

The Taskforce held a public meeting on 11 June 1997 to further discuss fluoridation issues with the public. Approximately 250 people attended the meeting which presented both sides of the debate. (Appendix 16)

The Lord Mayor opened the debate and stated that the Fluoridation Taskforce had been established to try to find consensus on this difficult issue. Professor John Pearn and Associate Professor Laurence Walsh, both Taskforce members, spoke on behalf of water fluoridation, while Dr Fred Clutterbuck (Taskforce member) and Dr John Colquhoun spoke against. Following the presentation, the audience had the opportunity to ask questions. This produced a broad range of questions highlighting the public's viewpoint both for and against water fluoridation.

10.4 LORD MAYORAL LETTERS

The Lord Mayor received letters from members of the public voicing their opinion on fluoridation. One hundred and eleven (111) letters from residents and non-residents were received, with 95.5% opposing fluoridation of public water supplies (Appendix 15)

Many writers supported Brisbane's long standing policy of not fluoridating the water supply. The general tenor of opinion in these letters was similar to the public submissions to the Taskforce.

Through these processes, a representative cross-section of opinion of the general population of Brisbane was obtained. Generally, these results revealed that written submissions indicated strong opposition to fluoridation, while the telephone survey indicated support for fluoridation at the time the survey was conducted.

CHAPTER 11: TASKFORCE ASSESSMENT OF THE BENEFITS AND RISKS OF WATER FLUORIDATION

11.1 BACKGROUND AND ISSUES:

As explained in Chapter 5 (Ethical Considerations), the Taskforce agreed to a structure for examining the issue of fluoridation, and principles for arriving at a decision which involved considering all the options, weighing up all the outcomes and consequences based on (I) the probability that a particular outcome would arise; and (ii) its degree of seriousness (or utility), and then applying rational judgement to the resulting conclusions.

In order to pull together, analyse and summarise the views of the Taskforce on such a diverse and complex subject as fluoridation, Taskforce members were asked at the end of the process to complete a detailed questionnaire (Appendix 19). The questionnaire examined their initial views and opinions prior to joining the Taskforce; the degree of influence of the Taskforce process itself; their final decision on fluoridation and the reasoning behind it; and their views on the balance of benefits and risks.

RESULTS OF THE TASKFORCE SURVEY:

11.2 STRUCTURE OF THE TASKFORCE

The rationale behind the membership of the Taskforce is outlined in Chapter 2, and a list of members is shown at the beginning of the report. The Taskforce consisted of 17 members, excluding officials and the Lord Mayor as Chairperson. The views of a number of Taskforce members were well known at the start of the inquiry, because some members had openly expressed strongly held opinions, or they represented organisations (e.g. the ADA) whose views were known. The completed questionnaires confirmed that these ‘committed’ members of the Taskforce represented 53% (9 members) of the total membership. The views of the remaining 47% (8 members), representing other local authorities affected by the fluoridation decision, and community organisations, were unknown, and prior to the questionnaire, regarded as ‘uncommitted’.

11.3 OPINION PRIOR TO JOINING THE TASKFORCE

The outcome of the survey showed that, on joining the Taskforce, 10 members supported water fluoridation, 5 opposed, and 2 were uncertain. All the medical and dental representatives strongly supported fluoridation; and the survey confirmed those

presumed to be the ‘committed’ opponents of fluoridation. The survey revealed that the remaining 8 ‘uncommitted’ members in fact consisted of 4 supporters, 2 opponents (1 ‘not strongly’ opposed), and 2 members who were uncertain.

11.4 REASON FOR SUPPORT/OPPOSITION

The medical/dental supporters of fluoridation (representing 35% of total membership) were unanimous in their reasons for supporting fluoridation, to the effect that the effectiveness of fluoridation had been proved over many years; the scientific evidence weighed in favour of the benefits rather than the risks; there were no harmful side effects of any consequence; and for reasons of social equity (i.e. the greater needs of lower socio-economic groups).

Those strongly opposed to fluoridation listed a number of common reasons for opposition:

- Objection to mass medication with an uncontrolled dose;
- Belief that the rights of individuals should be paramount;
- Concern about the toxicity of fluoride, and the possibility of long-term health effects, particularly damage to bones.

11.5 FINAL VIEWS ON FLUORIDATION

At the end of the Taskforce process, the breakdown of members views was that 9 members (53%) opposed fluoridation while 8 members (47%) supported. A comparative analysis of the shift in members opinions between the start and completion of the Taskforce process revealed a number of interesting findings:

- none of those strongly supportive or opposed at the start of the Taskforce process had altered their views in any way by the end (although those opposed to fluoridation indicated that their opposition had hardened).

- of those 8 Taskforce members regarded as ‘uncommitted’ at the start of the Taskforce process, 3 members had changed from ‘strongly support’ to ‘oppose’, while 1 member changed from ‘uncertain’ to ‘oppose’. Another member switched from ‘uncertain’ to ‘support’ for fluoridation.

- In summary, half of the ‘uncommitted’ members had changed their views to opposition to fluoridation. (One other member indicated a change from ‘very weak’ opposition to ‘very strong’).

It is interesting to note that the three former ex-officio members of the Taskforce have stated that they were all initially in support of the introduction of water fluoridation to Brisbane. However, at the end of the Taskforce process, two of the three indicated that they had changed their opinions and were now opposed.

11.6 REASONS FOR CHANGE OF OPINION

The figures above show that 6 Taskforce members (35%) underwent a significant shift of opinion during the course of the Taskforce. An analysis of the reasons given by these members provides an interesting insight into the various influences, and factors which may have affected the balance of the argument. Although these Taskforce members could not be considered representative of the public, it is interesting to speculate to what extent the factors which influenced them might also weigh heavily with the public at large. The following points summarise the views of the 6 members whose opinion changed significantly:

- one member was influenced by ‘perceived narrowness’ of view from the medical/dental professionals who seemed to only advance arguments that fluoridation was good for teeth, while dismissing any risks. The alternative views of Dr Colquhoun and Prof Diesendorf, and the presentation on environmental impact also had an influence;

- another member was influenced by the level of fluoride already in the environment. Also significant were the number of countries that had experimented with fluoridation but later rejected it;

- reference was made to the apparent manipulation of statistics by the pro-fluoride side to support its case. Also the evidence related to previously unknown side effects. The major improvements in dental health irrespective of water fluoridation was also influential;

- influenced by possible harm to consumers. Considered that fluoridation was not the best way to dispense fluoride;

- influenced by the research which showed that there were side effects from consuming fluoridated water. Had previously been led to believe there were no harmful effects. The data which showed that fluoridated areas did not always produce better dental results than unfluoridated areas was also significant;
- the member who changed from ‘uncertain’ to ‘support’ commented that there

was now clearer identification of where potential benefit lay, and of potential harm and its likelihood. Considered that the benefits of fluoridation to the community outweighed the ethical arguments about the rights of individuals.

11.7 BALANCE OF ARGUMENTS BETWEEN RISKS AND BENEFITS

Taskforce members were asked to balance the benefits of water fluoridation against the risks, while taking account of the ethical arguments about the rights of individuals and communities. The 9 members opposed to fluoridation at the end of the Taskforce advanced the following views on the balance of arguments:

- a number commented that there was a high probability of more dental fluorosis, hip fractures, and excessive intake of fluoride by children; and that the degree of risk was serious;

- some members referred to 'uncertainties' about the health risks, and that supporters of fluoridation in Australia were not willing to fund the required research;

- one member commented that 'Council does not have the right to override the right of the individual to choose for themselves and their children whether or not to ingest this toxic chemical';

- another stated: 'it appears that many of the apparent benefits in areas with fluoridation have also occurred in unfluoridated areas as a result of the introduction of fluoride toothpaste';

- 'Health, hygiene and diet are main reasons for improved dental health, not fluoridation';

- 'A 'benefit' can never be acceptable when there are risks, both proven and with some still unknown, which may lead to life-long problems either physical, emotional or mental';

- one member summarised - 'Pro-fluoridation: total focus on teeth. Anti-fluoridation: concern shown for the whole body and the environment'.

The 8 members who currently support fluoridation made the following comments about the balance of the argument:

- a number stated that reductions of 20 - 40% in dental caries were still achievable despite the decline in decay rates; and that concerns about health risks had not been substantiated;

- one supporter commented that ‘the right of choice is a minor one for the public, and should not be a major factor in forming a decision’;

- another remarked ‘I would consider the benefits to the community to outweigh ethical arguments about the rights of individuals’;

- ‘The ‘risks’ have proved so minimal that the United States Health Department after the most extensive inquiry ever held into the subject .... concluded that ‘If fluoride presents any risks to the public at the levels to which the vast majority of us are exposed, those risks are so small that they have been impossible to detect in the epidemiological studies to date. In contrast, the benefits are great and easy to detect’;

- another commented that the balance of arguments is ‘overwhelmingly in favour of the child’s right, in Brisbane, to be free from dental caries, where this is achievable by safe and effective means’.

11.8 NEED FOR MORE RESEARCH

Concerning the need for more research, Taskforce members were equally divided into 3 groups - those opponents of fluoridation (35%) who called for more research into a number of aspects of fluoridation; those supporters who considered that there was a need for ongoing scientific research and monitoring, but still considered that fluoridation was safe (30%); and the remaining third, both supporters and opponents, who thought that further research was not required, or did not express a view.

Those who called for more research, referred to the following specific areas:-

- more definitive answers on safe and toxic levels;
- the effects of chronic exposure to fluoride over a lifetime;
- those areas identified by the 1991 NHMRC Report;
- the carcinogenic effects of fluoride;
- the question of ecological damage;
- whether infant formula should be reconstituted with fluoridated water;
- the effects of fluoride on human bones (and the risk of increased fractures); brain function, and human function generally; and

- the level of skeletal fluorosis in Australia.

In relation to any issues or aspects where members were still uncertain, 5 members (30%) indicated that they still had some specific doubts. These related to aspects such as - safe and toxic dose/margin of safety; and the environmental impacts.

11.9 SUMMARY

11.9.1 Currently Oppose Fluoridation

There were five Taskforce members who opposed fluoridation prior to joining the Taskforce. On a scale of 1 to 10, where 1 is 'not at all strongly' and 10 is 'very strongly', the average level of opposition was 7.1. A total of nine Taskforce members currently oppose fluoridation. On a scale of 1 to 10, where 1 is 'not at all strongly' and 10 is 'very strongly', the average level of opposition to fluoridation is 7.8.

Five Taskforce members opposed fluoridation before and after the Taskforce. On the scale of 1 to 10, the average level of opposition was 7.1 before the Taskforce and 9.9 after the Taskforce. This indicates that during the Taskforce, members originally opposed to fluoridation became firmer in their opposition.

Three Taskforce members supported fluoridation prior to joining the Taskforce, but currently oppose fluoridation. On the scale of 1 to 10, support for fluoridation amongst these respondents was 8.3 prior to the Taskforce. On the same scale, opposition to fluoridation is now 3.7 indicating a relatively weak level of opposition. However, this represents a significant shift in opinion from support to opposition.

One Taskforce member was uncertain about fluoridation prior to joining the Taskforce and currently opposes fluoridation. On the scale of 1 to 10, the strength of their opposition is 10.

11.9.2 Currently Support Fluoridation

There were ten Taskforce members who supported fluoridation prior to joining the Taskforce. On the scale of 1 to 10, the average level of support was 9.0. A total of eight Taskforce members currently support fluoridation. On the scale of 1 to 10, the average level of support for fluoridation is now 9.1.

There were seven Taskforce members who supported fluoridation before and after the Taskforce. On the scale of 1 to 10, the average level of support was 9.4 both before and after the Taskforce. This indicates that participation in the Taskforce did not influence these members in their opinion.

One Taskforce member was uncertain about fluoridation prior to joining the Taskforce and currently supports fluoridation. On the scale of 1 to 10, the strength of their support is 7.

11.10 CONCLUSIONS

11.10.1 A significant proportion (23%) of Taskforce members shifted position from strong support for fluoridation, or in one case uncertainty, to opposition.

11.10.2 It is clear from responses that the case presented by the medical/dental experts on the Taskforce, as well as the literature supporting fluoridation, failed to convince these members about a number of areas of concern:-

- that the dental caries problem in Brisbane was sufficiently serious to require fluoridation (in the light of declining decay rates);

- that health risks were negligible, particularly in relation to increased risk of hip fracture; the possible effects of accumulation of fluoride over a lifetime of exposure; and excessive total intake by babies and young children;

- that the margin of safety between a toxic and safe dose was significantly wide;

- some commented that health professionals who supported fluoridation were not prepared to carry out research in Australia to prove that fluoridation was still effective or, more importantly, completely safe.

CHAPTER 12: TASKFORCE CONCLUSIONS

1. This report has been structured to reflect the sequence in which the Taskforce tackled the many issues arising from the fluoridation debate, and also attempts to capture the dynamic nature of Taskforce discussions and deliberations. As the report shows, Taskforce members were able to reach a consensus on a broad range of the less contentious issues. However, in relation to fundamental questions concerning the efficacy, effectiveness and safety of water fluoridation, the Taskforce was deeply divided between those who were strongly committed to water fluoridation as a public health measure, and those who remained unconvinced by the arguments that fluoridation was necessary, effective and safe.

   A small majority of Taskforce members (52%) stated that they were opposed to the fluoridation of Brisbane's water supply. A significant proportion of members (23%) who had initially been supportive of fluoridation had changed their opinion to opposition by the end of the Taskforce process.

2. The Taskforce was satisfied that the weight of scientific evidence overwhelmingly supported the decay-reduction effect of water fluoridation. However, there was considerable disagreement about the extent of the benefits and the use of percentages to express reductions in dental decay.

3. Many Taskforce members were unconvinced by assurances that serious risks to health were negligible or non-existent. In particular, there was concern about ambiguous scientific evidence of an association between water fluoridation and higher levels of hip fracture.

   The Taskforce noted that the 1991 NHMRC Working Group, which had supported fluoridation, had expressed considerable concern about the fact that it could not point to a single Australian study which had monitored adequately the impact of possible adverse consequences of fluoridation (*NHMRC 1991, Section 8*). The majority of the Taskforce was concerned that these inadequacies have still not been addressed. Many Taskforce members were also concerned that the pro-fluoridation case had relied heavily on studies from abroad which do not take account of aspects particular to Brisbane e.g. its sub-tropical climate.

4. There was also concern about the lack of scientific research on the lifetime effects of an accumulation of fluoride in the body, in spite of the 1991 NHMRC Working Group statement that 'it was imperative that public health

recommendations in the future be based on accurate knowledge of the total fluoride intake of Australians' (*NHMRC 1991, Section 8.3*). This aspect was highlighted by most Taskforce members as an area which required further scientific investigation.

5. Many Taskforce members had doubts that the available evidence proved that the dental decay problem in Brisbane was serious enough to warrant water fluoridation:

- dental decay rates have been falling for three decades in both fluoridated and unfluoridated communities.

- there was a lack of contemporary dental evidence on the scale of the problem in Brisbane, particularly in relation to adults.

- research evidence showed the complexity of trying to separately identify the benefits of water fluoridation alone, as illustrated by the recent comparison study of children in Brisbane and Townsville (*University of Adelaide*).

- dental decay rates (DMFT for 12 year olds) amongst children in Queensland (1.37 in 1995) appear to be similar to the Australian average (1.01 in 1995), as illustrated in the tables below:

DMFT rates (NOHS, 1987 p.45 Table 20)

	Brisbane	**Sydney**	**Canberra**	**Hobart**	**Perth**	**Adelaide**	**Melbourne**
Age 10-14	2.3	1.4	1.1	1.0	1.8	2.4	2.1
Age 15-19	5.3	2.8	3.2	3.4	4.4	4.8	5.0

DMFT rates (School of Dentistry, University of Adelaide, 1995)

	NSW	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**
12 year olds	0.93	1.02	1.37	0.64	1.04	0.86	0.82	0.61

National Average: 1.01

- the widespread availability and use of other sources of fluoride.

6. The Taskforce accepted that the effectiveness of water fluoridation in reducing

dental decay has declined in the last 20 years as a result of the advent of other sources of fluoride, as well as other factors. However, the Taskforce was sharply divided on the current level of effectiveness of water fluoridation, in the light of falling decay rates.

The effectiveness of water fluoridation varies with the concentration of fluoride in the water supply. At the optimal concentration for a temperate climate of 1 ppm, effectiveness in decreasing dental decay would be greater than at the 0.7 ppm level recommended by USPHS for a sub-tropical climate.

The majority of Taskforce members, however, agreed with the WHO recommendation that 0.5 ppm would be the appropriate level for a sub-tropical climate. This would further reduce the effectiveness of fluoride while also reducing the risk of dental fluorosis.

7. There was considerable concern amongst many Taskforce members that water fluoridation could increase the total intake of fluoride in excess of a safe level for babies and young children.

8. The evidence relating to what constituted a safe or a toxic dose of fluoride was uncertain and confusing. A majority of Taskforce members were concerned that the margin of safety between a safe and toxic dose may not be sufficiently wide.

9. The majority of the Taskforce accepted the findings of Dr Miller's limited study of the environmental impact of a fluoridated water supply on the Brisbane area. The majority agreed that the study had raised concerns about the possibility of adverse effects on some sensitive plant and marine species, and that further experimental studies and other biological assessments would be required to reach more definite conclusions. The majority of the Taskforce accepted that there had been little examination of the environmental effects of water fluoridation world-wide.

10. The Taskforce agreed that dental decay is not a disease which is spread equally throughout the population, and that there are clearly many individuals and groups who are more susceptible and at more risk. Water fluoridation is particularly aimed at those who do not or are unable to look after their teeth, for example, young children and those in lower socio economic groups. Although the Taskforce did not discuss the options for tackling the problem in detail, there seemed to be scope for more effective targeting of those at risk, and for obtaining the benefits of using different fluoride treatments in combination.

11. The Taskforce concluded from the evidence, and from correspondence with the ADA and NHMRC, that the recommendations of the 1991 NHMRC Working Group for an immediate increase in Australian dental public health research, and for improved dental health monitoring, have not been implemented.

    The majority of Taskforce members would not support the introduction of water fluoridation to Brisbane until the recommended Australian research has been carried out. However, if the required data gathering and research were carried out, the Taskforce could be reconvened to consider any new evidence.

APPENDICES

Appendix No

1: History and Legal Issues (Paper 1)

2: Understanding Fluoride (Paper 2)

3: Ethical Issues (Paper 3)

4: Fluoride Options - Trends in Australia and Internationally (Paper 4)

5: Report on Public and Community Views (Summary)(Paper 5)

6: Dental Costs and Benefits of Water Fluoridation (Paper 6)

7: Non-Dental Human Health Effects of Water Fluoridation (Paper 7)

8: Considerations Associated with the Dosing of Fluoride into the Brisbane Region Water Supply (Paper 8)

9: Study of Fluoride Removal Options (Paper 9)

10: Environmental Impact of Fluoride (Paper 10)

11: Cost Benefit Analysis of Fluoridation Options (Paper 11)

12: Summary Paper on Toxicity

13: Taskforce Work Program

14: Summary of Public Telephone Survey

15: Summary of Lord Mayor Letters

16: Public Meeting (Agenda; Information, Speakers)

17: Transparencies from Presentation by Dr Diesendorf

18: 'The Evidence Which Changed My Opinion About Fluoridation' - Dr J. Colquhoun

19. Taskforce Questionnaire

20. 'Likely Impact of Water Fluoridation in Brisbane on Young Babies and Young Children' - Dr K Armstrong

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