



The 1998 Sydney Water Crisis (A)

On 21 July 1998, the Sydney Water Corporation learnt that routine samples collected from the Prospect Water Filtration Plant and Potts Hill Reservoir contained low-levels of *Cryptosporidium* and *Giardia* contamination. Both parasites posed a potentially serious risk to public health. Sydney Water began investigating the incident immediately, in consultation with the New South Wales Health Department. Over the next few days, further testing revealed that several central city areas were also affected, and by Saturday 25 July, some very high readings had been recorded. Although Sydney Water believed that the situation was probably the result of cleansing the system, it was still unable to identify the exact cause or extent of the problem. That evening, Sydney Water Managing Director Chris Pollett was informed of the situation. On Sunday, the following day, as he waited for independent verification of the initial test results, further high readings were obtained. He knew that the next morning he was due to attend his regular monthly briefing with Sydney Water Chair David Hill and their Operating Licence Minister Craig Knowles, both of whom were unaware of what had transpired. Pollett had to decide what, if anything, to tell his superiors and how to manage the situation.

Sydney's water supply

In 1998, approximately 85 percent of Sydney's water was processed through the Prospect Water Filtration Plant (*Exhibit 1*). One of the largest of its kind, with the capacity to process 3,000 megalitres of water per day, it was located on a greenfields site in Sydney's west and supplied in excess of three million people. The Prospect Plant drew its water via a long pipeline from the Warragamba catchment area situated near the Blue Mountains. Water destined for the remaining areas of Sydney was siphoned off before Prospect and diverted to the Orchard Hills plant.

This case was written by Marinella Padula for Dr Allan McConnell, University of Sydney, as a basis for class discussion rather than to illustrate either effective or ineffective handling of a managerial situation.

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Once the water reached Prospect, it was filtered, disinfected and fluoridated to eliminate harmful contaminants. Chlorine was used to kill viruses and bacteria, while chlorine-resistant parasites and other matter were removed by filtration. This involved several processes, after which treated water would be passed through sand filters, typically removing 99 percent of particles in the *Cryptosporidium* and *Giardia* size-range. The Prospect Plant operators claimed that at least 99.9 percent of such particles were caught by their filters.¹

When the filters eventually became clogged, they were “backwashed” i.e. water was reversed through the system, dislodging the particles so they could be collected for disposal. The “backwash” was then separated for additional treatment before being re-released into the system. This procedure was critical to maintaining plant efficacy. If it was not performed properly, incoming water could be contaminated.

After treatment, water was channelled into one of two “clear water tanks”. While there, some sediment would usually settle in the bottom of the tanks, which required periodic cleaning. From here, water was distributed to homes and businesses via an extensive network including nearly 20,000 kms of pipes.² Water for the inner city, inner western suburbs and southern suburbs was channelled from Pipe Head to two large service reservoirs at Potts Hill and from there to pumping stations at Waterloo and Dowling Streets in Sydney. Water for the northern suburbs and Warringah was supplied by pumping stations at Prospect and West Ryde (*Exhibit 1*). During July 1998, the plant was undergoing intensive but scheduled maintenance, because water demand during winter was typically at its lowest.

Cryptosporidium* and *Giardia

Cryptosporidium and *Giardia* were two of the organisms targeted by water treatment processes. Parasitic protozoa, they reproduce inside the intestinal tract of humans and animals. Transmission can occur via a number of mechanisms including: person-to-person contact; contact with animals; ingestion of contaminated food and beverages; and intake of contaminated swimming pool or drinking water. In Australia, however, infection through contaminated water supplies was considerably less common than person-to-person transmission.

Although there are a number of *Cryptosporidium* species, only *Cryptosporidium parvum* has been found to produce disease in humans. Symptoms usually present within a week of infection and include nausea, flu-like illness and mild to severe diarrhea, which can persist for up to two weeks. People with impaired immunity (such as transplant recipients, or AIDS and cancer patients) are at particular risk of prolonged illness, even death. AIDS sufferers are especially vulnerable.

¹ McClellan, P., *Sydney Water Inquiry, Second Interim Report: Management of the Events*, NSW Premier’s Department, September 1998, p.15.

² *Ibid* p.14

Giardia produces similar gastrointestinal complaints and can also lead to serious complications. Capable of causing acute or chronic diarrhea, symptoms (including nausea and abdominal cramps) typically appear one to two weeks after infection. The disease is often mild and resolved without medical intervention but in more extreme cases, symptoms can linger for up to six weeks and even recur after the initial bout of illness. For both conditions, the severity of the illness depends of the number of organisms ingested and their virulence. Therefore, not everyone exposed to the pathogens becomes symptomatic to the same degree – indeed some do not become sick at all.

Additionally, *Cryptosporidium* and *Giardia* are not the only causes of gastroenteritis. A wide range of other viruses and bacteria, including *Salmonella*, produce extremely similar ailments. In fact, conditions are indistinguishable on the basis of symptomatology alone; laboratory testing of fecal samples is required to make a definitive diagnosis. Of samples tested in Australia at that time, only 30 percent positively identified any particular pathogen and of those, *Giardia* accounted for two to four percent.³ At the time of the 1998 crisis, *Giardia* infections could be successfully treated with appropriate medication but *Cryptosporidium* was more difficult to manage. However, compared to *Cryptosporidium*, *Giardia* was much more prevalent in the community, especially among small children.⁴

Giardia and *Cryptosporidium* were only problematic while alive and *Giardia* was usually killed via chlorination. Conversely, *Cryptosporidium* was resistant to normal chlorine treatment and filtration was the only effective means of containment. *Cryptosporidium* lives in a robust structure called an “oocyst”, while *Giardia* lives in “cysts”. Both can survive in water for several months this way. As *Giardia* can be controlled by chlorination, most disease outbreaks have been blamed on *Cryptosporidium*. The largest reported outbreak occurred in the US city of Milwaukee in 1993. It affected more than 400,000 residents and resulted in over 100 deaths.⁵ No similar waterborne outbreaks had been recorded in Australia prior to 1998.

Testing for *Giardia* and *Cryptosporidium* required large water samples because *Cryptosporidium* in particular can have a low infective dose. In addition, no reliable test existed for the routine identification of specific species of *Cryptosporidium* and many types of algae could be easily misidentified as *Cryptosporidium* or *Giardia*.

Distinguishing between live and dead organisms also required additional tests. While many testing methods were utilised by the scientific community, most had not been fully validated and there was substantial debate about the quality of different methods, their efficiency and reliability. The technically challenging and laborious process of monitoring these parasites was complicated by the fact that there were no national standards for safe

³ McClellan, P. ‘*Sydney Water Inquiry, Third Report: Assessment of the contamination events and future directions for the management of the catchment.*’ Chapter 4 NSW Premier’s Department, October 1998 p.10

⁴ McClellan, P. ‘*Sydney Water Inquiry, First Interim Report: Possible Causes of Contamination*’ NSW Premier’s Department, August 1998 p.11

⁵ Ibid.

levels in Australia and differing views as to what constituted a significant contamination incident.

Sydney Water

Sydney Water was a state-owned corporation responsible for the supply of water and disposal of sewage and wastewater within the areas of Sydney, Illawarra and the Blue Mountains. It was also responsible for the operation of systems and services required to collect, treat, distribute and dispose of water. The operation of four of Sydney Water's eleven treatment plants (including Prospect) was contracted out to private companies. Australian Water Services (AWS) jointly owned by Lend Lease Ltd and Suez Lyonnaise des Eaux and P&O, commenced operation of the Prospect Water Filtration Plant in 1996. The Sydney Water board had seven directors including David Hill (Chair) and Chris Pollett (Managing Director). Three general managers plus a media manager were responsible for the day-to-day operation of the corporation and reported to Pollett (*Exhibit 2*).

Sydney Water also owned Australian Water Technologies (AWT), a subsidiary trading arm which performed the bulk of water quality testing. Sydney Water's three principal objectives were: to be a successful business; to protect the environment; and to protect public health by supplying safe drinking water to its customers. These equally-weighted goals were laid out in Sydney Water's establishing legislation, the *Water Board Corporatisation Act 1994* (WBC Act).

The WBC Act came into effect on 1 January 1995. Sydney Water was also regulated under the *NSW State Owned Corporations Act 1989* (SOC Act) which outlined the separation of responsibilities of the shareholding Ministers, the operating licence Minister and the regulatory Ministers. The regulatory Ministers were: Andrew Refshauge, MP, Minister for Health; Pam Allan, MP, Minister for the Environment; and Richard Amery, MP, Minister for Land and Water Conservation. However, the Minister with direct oversight of Sydney Water's activities was Craig Knowles MP, Minister for Urban Affairs and Planning. He was responsible for administering the provisions of the WBC Act relating to Sydney Water's Operating Licence and reporting to Parliament on Sydney Water's operations.⁶ He did this with the assistance of the Licence Regulator, which was established to monitor Sydney Water's compliance with the Operating Licence and inform the Minister about any failure to meet operational standards or other Operating Licence requirements. The regulator also commissioned independent annual audits of the Corporation.⁷

Sydney Water's Operating Licence set out the standards to be met by the Corporation, such as achieving drinking water quality in accordance with the 1980 National Health and Medical Research Council (NH&MRC) Australian Drinking Water Guidelines (later revised in 1987 and 1996). It also defined the terms and conditions under which Sydney

⁶ McClellan, P. *'Sydney Water Inquiry, Second Interim Report: Management of the Events'* NSW Premier's Department September 1998 p.17

⁷ *Ibid* p.21.

Water was to operate, outlining the guiding principles for Sydney Water's relationships with its customers and its regulators. Where the latter were concerned, Sydney Water was required by the WBC Act to enter into Memoranda of Understanding (MoUs) with each body or statutory authority. In 1998, Sydney Water had MoUs with the NSW Environment Protection Authority, NSW Health and the Water Administration Ministerial Corporation. The *Act* described the general purpose of the MoUs as to clarify the roles and responsibilities of each organisation in order to facilitate cooperation. It did not, however, explicitly require adherence to the terms of the MoUs.⁸

In addition to the Operating Licence, Sydney Water also had a Customer Contract to which it was required to adhere. This detailed the rights and responsibilities of both Sydney Water and its customers, including the customer's right to "the supply of water, sewerage and drainage services, consultation, information and assistance, notice of interruption to supply and customer redress."⁹ This contract was legally enforceable and described the customer's right of redress if water supply did not meet the standards outlined in the Operating Licence.

NSW Health

The New South Wales Department of Health was responsible for regulating Sydney Water in relation to public health outcomes, in particular the provision of safe drinking water. Under the *Public Health Act 1991* the Minister for Health had emergency powers which enabled him/her to restrict or prevent the use of water believed to pose a threat to public health. This power was vested in the Chief Health Officer at NSW Health. The Department was also required to advise Government on drinking water standards and enter into a MoU with Sydney Water.

At the time of the 1998 incident, Dr Michael (Mick) Reid was the Director-General of NSW Health. Reporting to him was Chief Health Officer, Dr Andrew Wilson, who was responsible for the public health arm of NSW Health (*Exhibit 3*). He oversaw nine divisions including Health Protection, where Ross O'Donoghue was Acting Director. Within the Health Protection Division, Dr Jeremy McAnulty was the Medical Epidemiologist in the AIDS/Infectious Diseases Branch. Other key personnel concerned with Sydney Water were Adrian Farrant, Acting Manager of the recently established Water Unit, located within the Environmental Health Branch, and Shari Armistead, the Acting Director of Health Media.

The Memorandum of Understanding

Signed in November 1997 after two years of negotiation, the MoU between Sydney Water and NSW Health outlined the ways in which both parties were expected to cooperate. In addition to supplying water in accordance with 1996 NH&MRC standards, Sydney Water was also committed to providing NSW Health with "immediate notification of any water

⁸ McClellan, P. *'Sydney Water Inquiry, Second Interim Report: Management of the Events'* NSW Premier's Department September 1998 p.21.

⁹ *Ibid* p.20.

system event or any monitoring results which indicate the potential existence of a public health hazard.”¹⁰ In turn, NSW Health undertook to advise Sydney Water on water safety and public health issues, as well as to “develop a public water supply regulatory program for the purpose of making independent judgements on public health matters related to the Corporation’s (Sydney Water’s) activities.”¹¹ Where water safety guidelines were breached, NSW Health was responsible for assessing the problem and prescribing an appropriate remedy. However, Sydney Water was not compelled to act on advice given:

If the Department is of the opinion that it is appropriate to do so, it may provide advice on rectification action which may be taken by the Corporation. Where the Department gives any advice to the Corporation under this clause, it shall be entirely the responsibility of the Corporation to take appropriate rectification action to ensure that: the drinking water it supplies is safe to drink and meets the requirements of the Corporation’s Operating Licence...¹²

In signing the Memorandum, both parties also agreed to share information and data related to water monitoring and public health issues, as well as coordinate their responses to significant events.

Sydney Water’s Incident Management Plan

As per its statutory obligations, Sydney Water was required to devise an Incident Management Plan to ensure the effective handling of significant or major contamination events. An Interim Plan had been drawn up in June 1997 but by July 1998, a new draft plan was in place. Sydney Water began monitoring for *Cryptosporidium* and *Giardia* in 1996. This was despite the fact that the 1996 NH&MRC Guidelines did not specify acceptable levels for these parasites, nor recommend routine testing due to the complexity of the process and time involved.

Nonetheless, Sydney Water’s Incident Management Plan defined a “routine incident” as one where there were more than one, and less than 100 oocysts/cysts of *Cryptosporidium* and *Giardia* per 100 litres of raw water. In filtered water, 1 oocyst/cyst per 100 litres was regarded as a “significant incident”; more than that was considered a “major incident”. According to the Plan, an incident manager could only declare a “significant” or “major” incident in consultation with the Managing Director. The Plan also outlined some general principles for its application:

Sydney Water, in its management of the community’s daily drinking water supplies, holds a great deal of public trust. They trust us to do the job right so they can safely drink our water, and they trust us to fix any problems quickly. How we deal with such incidents – both major and minor – will reflect in the level of trust and respect we receive from our customers, the community and stakeholders. If we do the job right, then the level of trust

¹⁰ *Memorandum of Understanding between NSW Health and Sydney Water Corporation* November 11, 1997 p.4

¹¹ *Memorandum of Understanding between NSW Health and Sydney Water Corporation* November 11, 1997 p.6

¹² *Ibid.*

and support will remain high. Do it poorly and we will lose that trust very quickly..... Doing it right is simple. All it requires is quick thought and appropriate action. Think and act quickly to tell the right people that a problem exists and then think and act quickly within the response team to fix the problem. Delay is the biggest threat to maintaining public trust.¹³

The first incident

On 15 July 1998, routine water sampling was conducted by Sydney Water. On 21 July, test results showed positive low-level readings of both *Cryptosporidium* and *Giardia* in water taken from outlets at the Prospect distribution chamber and Potts Hill reservoir. As per the MoU, Sydney Water contacted the Environmental Health Branch at NSW Health later that morning, informing them of the results.

As a consequence of levels being low and not appearing to pose a significant risk to the public, NSW Health supported Sydney Water's proposal to retest at the positive sites and surrounding areas. Sydney Water commissioned the retests and reviewed the Prospect plant's records for 15 July 1998 and found them within specification. The following day, Sydney Water received a clear batch of test results from all areas except Sydney Hospital which showed a low positive reading for *Giardia*. Sydney Water ordered further testing of the hospital and areas in the vicinity as well as flushing of the local system. That afternoon, Sydney Water advised NSW Health of the results and their actions, which NSW Health endorsed.

On 23 July, hospital samples showed a higher positive result for both parasites, but surrounding areas were clear. This led Sydney Water to conclude that the incident was probably a localised event resulting from a cross-contamination within the hospital grounds. Sydney Water convened a meeting between its representatives and hospital engineers, at which they decided to empty the hospital storage tank. Sydney Water also informed NSW Health of the situation and took more samples downstream from Potts Hill.

The next day, all samples were clear except two low-positive readings obtained from Sydney Hospital and the Art Gallery. The problem was still thought to be localised, and the hospital storage tank was set to be drained again. Sydney Water also conducted resampling and water flushing in the College Street and Crown Street areas. After being informed of the latest readings, NSW Health then notified Director-General Michael Reid. On learning of the situation, he immediately informed the Minister for Health, Andrew Refshauge, who then told the Premier, Bob Carr.

Cause for concern

On Saturday 25 July, Sydney Water received more positive test results but this time they were considerably elevated. Three central Sydney sites recorded in excess of 100

¹³ c.f. McClellan, P. 'Sydney Water Inquiry, Second Interim Report: Management of the Events' NSW Premier's Department September 1998 p.26

Cryptosporidium oocysts and *Giardia* cysts per 100 litres of water.¹⁴ Sydney Water expanded its testing program to include a wider part of the distribution system. Prospect was also re-tested for the first time since 21 July. One of the high readings was obtained from the Crown Street reservoir but, even after a physical check, nothing unusual was discovered.

At 7.50 pm that evening, Sydney Water informed NSW Health of the new developments, pointing out that one of the highest-reading samples from College Street had proved difficult to process. Sydney Water postulated that cysts and oocysts could have collected over years in the biofilm lining of the pipes. These cysts/oocysts may have been dislodged by the flushing of the pipes, thereby releasing them into the system. Sydney Water also explained that first-flush water may not be entirely representative of the whole distribution system, as it may be from a dead-end section of the pipe or a hydrant where contaminated compounds can build up.¹⁵ Sydney Water and NSW Health agreed to search for possible local causes of contamination, but none were identified. Both parties also agreed to have the test results independently verified by Macquarie University.

That night, Managing Director Chris Pollett was also informed of the high readings. He contacted the General Manager of Distribution, Jeff McCarthy and the General Manager of Retail, Geoff Morris, and emphasised the need for them to follow the MoU with NSW Health and observe the usual procedures in managing the incident.

On Sunday, the following day, extremely high results were obtained from Macquarie Street (376C/3952G per 100L), College Street (170C/332G) and the Art Gallery (200C/963G) and lower levels from Crown Street Reservoir (6C/20G). Test results for the Prospect Plant, Potts Hill, Thornleigh and West Ryde were negative; however, the first positive result outside the eastern CBD (except for those at Prospect and Potts Hill) was recorded in Greenacre (0C/8G). Sydney Water immediately began a systematic scouring and flushing of the area affected by the Crown Street reservoir. Meanwhile, Sydney Water's incident management team continued investigating possible sources of contamination without success. On the basis of visual inspections and other tests, it did not appear that the integrity of the system had been breached.

Morris briefed Pollett late on Sunday morning, then again in the evening regarding the latest set of results. Pollett reiterated the need to collaborate with NSW Health but was reluctant to take further action until the Macquarie University results had been received. Pollett said: "I noted that they were getting second opinions on the high results because we were dealing with...sampling at the forefront and these things do need to be validated."¹⁶ Richard Mackender, the Water Network Manager who reported to Geoff McCarthy was similarly dubious about the accuracy of the initial Sydney Water readings: "I've never seen *Giardia* of those numbers in the system and at that point, because of that,

¹⁴ McClellan, P. 'Sydney Water Inquiry, Second Interim Report: Management of the Events' NSW Premier's Department September 1998 p.31

¹⁵ McClellan, P. 'Sydney Water Inquiry, Second Interim Report: Management of the Events' NSW Premier's Department September 1998 p.31

¹⁶ *ibid* p.32

I wasn't sure whether they were real numbers or whether they were some sort of aberration in the testing process."¹⁷ At 8.15 pm, Sydney Water received confirmation of the high readings from Macquarie University.

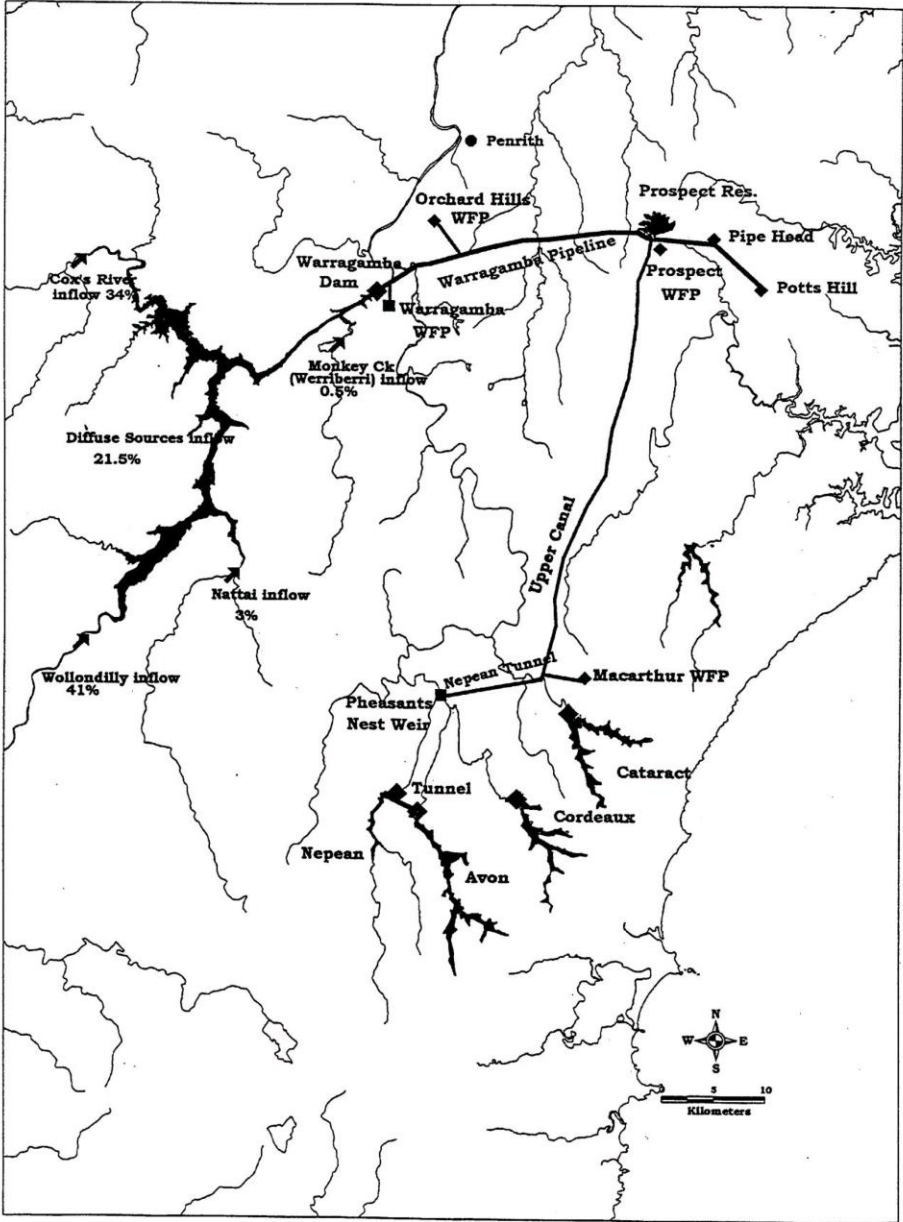
While it was unclear whether Pollett had been notified, Water Quality Coordinator Michael Keelan was aware of the result. He phoned Adrian Farrant, the newly appointed Acting Manager of the Water Unit at NSW Health, to update him on the day's findings. Farrant knew that those contamination levels posed a risk to public health. Yet, providing those organisms were being released into the system as a result of flushing the pipes, he was aware that they were likely to be dead (*Giardia* especially). After noting the new results, Farrant indicated that he would advise Jeremy McNulty, the Department's medical epidemiologist in the AIDS/Infectious Diseases Branch, on Monday morning. At this stage, Sydney Water was continuing to flush out the system and it still didn't look as though the contamination had been caused by an influx of raw sewerage or any similar event. Also, no illnesses had been reported to date.

Pollett also had an important job on Monday morning: his regular monthly briefing with David Hill and Minister Knowles, neither of whom had been briefed on the situation. Following that, there was to be a scheduled teleconference at 11.45 am between the general managers of Sydney Water and NSW Health officials which would hopefully shed some light on exactly what was going on. Pollett had to decide what to say to the Minister.

¹⁷Ibid p.33.

Exhibit 1: Sydney's Water Supply

D Map of the Warragamba Catchment



F Diagram of the system after Prospect plant

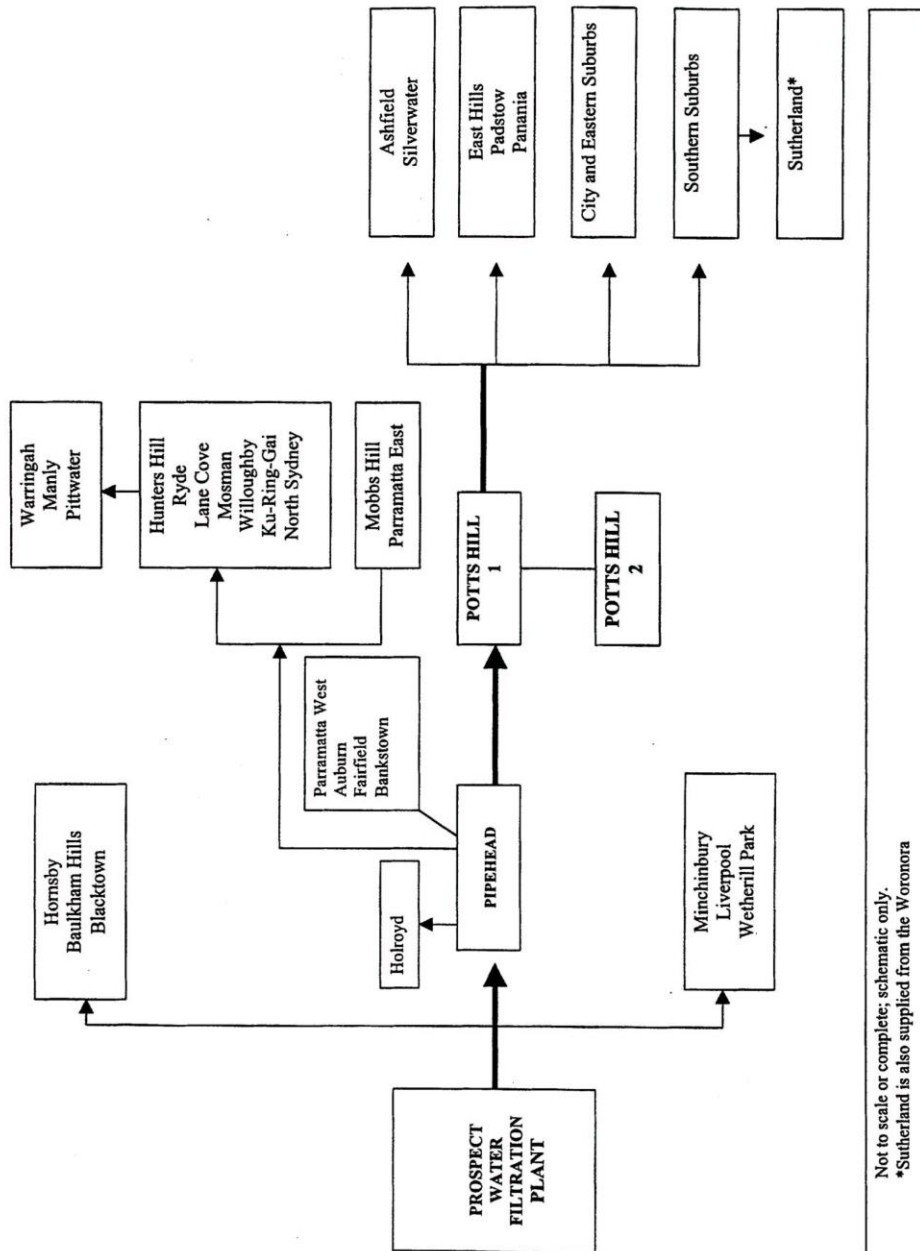


Exhibit 2: Sydney Water Organisational Chart – July 1998

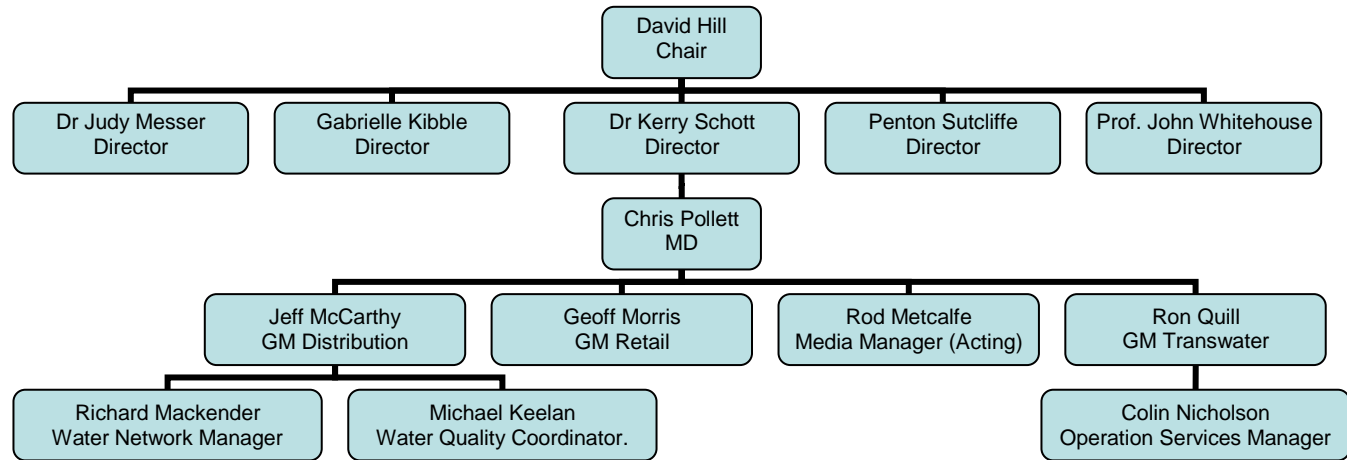


Exhibit 3: NSW Health Annual Report 1997/98 Organisational Chart

