REPORT OF PROCEEDINGS BEFORE

GENERAL PURPOSE STANDING COMMITTEE No. 5

INQUIRY INTO A SUSTAINABLE WATER SUPPLY FOR SYDNEY

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At Sydney on Monday 20 March 2006

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The Committee met at 10.00 a.m.

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PRESENT

Mr I. Cohen (Chair)

The Hon. R. H. Colless
The Hon. G. J. Donnelly
The Hon. P. Forsythe
Ms S. P. Hale
The Hon. P. T. Primrose
The Hon. H. S. Tsang

CHAIR: Welcome to the second public hearing of General Purpose Standing Committee No. 5—its inquiry into a sustainable water supply for Sydney. Before, we commence, I would like to make some comments about procedure for today' hearing.

The Committee is holding a third hearing this Thursday 23 March. Witnesses at Thursday's hearing hearing will include department heads from Sydney Water, the Sydney Catchment Authority, Environment and Conservation, and Planning.

A proof transcript of today's evidence will be placed on the Committee's web site for public and media access. It normally takes a few days before the transcript is available on the web site.

The Committee has previously resolved to authorise the media to broadcast sound and video excerpts of its public hearings. Copies of the guidelines governing the broadcasting of proceedings are available from the table by the door.

In accordance with Legislative Council guidelines for the broadcasting of proceedings, a member of the Committee and witnesses may be filmed or recorded but people in the public gallery should not be the primary focus of any filming or photographs. In reporting the proceedings of the Committee members of the media must take responsibility for what they publish or what interpretation they place on anything that is said before the Committee.

Witnesses, members and their staff are advised that any messages should be delivered through the attendants or the Committee clerks. Under the standing orders of the Legislative Council any documents presented to the Committee that have not yet been tabled in Parliament may not, except with the permission of the Committee, be disclosed or published by any member of such a committee or by any other person. The Committee prefers to conduct its hearings in public. However, it may decide to hear certain evidence in private if there is a need to do so. If such a case arises it will ask members of the public and the media to leave the room for a short period. Mobile phones must be turned off for the duration of the hearing as they interfere with the equipment that is used to record the evidence.

GREGORY LAWRENCE LESLIE, Associate Professor, University of New South Wales, School of Chemical Engineering, sworn and examined:

CHAIR: In what capacity are you appearing before the Committee—as an individual or as a representative of an organisation?

Dr LESLIE: I am appearing as an individual.

CHAIR: Are you conversant with the terms of reference of this inquiry?

Dr LESLIE: Yes, I have read them.

CHAIR: Should you consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. Prior to questions being asked by Committee members would you like to make a short statement?

Dr LESLIE: I would like to thank the Committee for the chance to make a submission. I am fortunate to have been involved in a number of water strategies for different communities around the world, mainly in Southern California for the Orange County Water District and in the Republic of Singapore. Based on that experience and on the three points that I made in my submission I believe that a sustainable water supply should be built on a number of tenets, three of which are as follows: First, that recycled water can be produced safely for any purpose—indeed that has been done; second, that a community has a responsibility to value its water resources and in some jurisdictions that has been written into both the constitution and the legislative statutes; and, third, that those responsible for administering a water supply need to recognise that the assets a community has have been built up over a number of generations and represent a significant asset.

So not only does the resource need to be valued; the assets used to deliver and move that resource around need to be valued. Those two things need to be factored largely into the economics of water recycling. When you do that you see that it becomes a technically, economically and socially viable option to sustain a community's water supply.

CHAIR: You have investigated areas such as those you mentioned in California and Singapore, which is of great value to the Committee. You made reference in your submission to a two-year study conducted in Singapore between 2001 and 2003 to evaluate water quality and possible acute and chronic health effects. The study concluded that the quality of the recycled water was superior to existing potable supplies. What sort of treatment was involved? How expensive would that be, for example, in the context of Sydney? How far away are we from that type of result? Perhaps you could compare that with desalination or other processes.

Dr LESLIE: Sure.

CHAIR: How successful is the Singapore example? Is that something we should be copying, or should we be looking at lower forms of treatment for other forms of re-use?

Dr LESLIE: The method used at the Singapore plant, at the facilities in California and at the facilities in Washington DC, Atlanta Georgia, Belgium, the Netherlands and Namibia where all these schemes are practised, begin with the secondary treatment of wastewater. So municipal sewage is collected and treated to a secondary standard to a point where it can be discharged safely into the environment. When I spoke earlier about community assets we need to understand that we will be doing that anyway. In the context of Sydney, large ocean plants only take the water to primary standards but our inland plants take it to tertiary standard, which is one step beyond the secondary. So that asset exists.

The costs associated with setting up that asset and operating it are already being incurred by the community. In Singapore, like the other facilities, they go three steps further. They then apply a technology called microfiltration, or ultrafiltration, which is a fine membrane separation that does not remove salt but it does remove a lot of the particulate matter. They then process the water through

reverse osmosis, which is broad-spectrum technology, to remove salts and dissolved organics. The water is then irradiated with ultraviolet light as a final measure to inactivate pathogens.

In some jurisdictions where there are some low molecular weight organic molecules—and I mean by that things such as the products that result from the reaction of chlorine with organics; we had those in our drinking water supplies—they also remove those through the ultraviolet process by adding some hydrogen peroxide in a step called advanced oxidation. In that level of treatment the experience has been that if you were to amortise the capital over 25 years at 6 per cent, which is sort of standard for this type of work, it will run somewhere around AU45¢ to 50¢ a cubic metre, and if you buy power, at 7¢ a kilowatt hour. So that is the combined capital and operating cost.

To contrast that with desalination—I would say that the Ashkelon facility in Israel would probably be best practice in the recovery of both water and energy—you have about $1 to $1.20. I will not be prescriptive on that figure but it is certainly of that order or of that magnitude. The energy costs associated with producing that quality of water, as in Singapore, typically is around 0.9 to 1 kilowatt hour for every cubic metre. That contrasts with seawater desalination that ranges between around 4½ to 5½ kilowatt hours per cubic metre. The water then needs to be reticulated. It cannot be put back into the drinking water supply directly so it needs to be reintroduced into the environment in a place where it will be extracted at a later date and then retreated through the existing drinking water treatment plant.

In Singapore they go into a series of reservoirs—Bedok, Kranji and Seletar. At the moment the amount of water that is going in is about 2 per cent. In that project the reason for that is that the bulk of the water is delivered to electronics plants that have a need for a very high grade of water—much higher than their regular drinking water supply. The scheme was subject to a two-year health effect study for both chronic and acute effects. It was the first study that used both fish and mice in long-term multigenerational tests to check for chronic effects. Previous work on that in Denver, in the United States of America, used only the mice. The results of that study showed that when you quantified the risk, the risk attendant with the recycled water is less than or equal to an untreated potable water supply. That finding was consistent with the work that we did in California in 1999, in San Diego in 1996, in Orange County in 1978, in Virginia in 1980, and in Tampa, Florida. I cannot remember the year that Tampa did its testing.

CHAIR: It is interesting that Orange County has been going through this augmentation of ground water since 1978.

Dr LESLIE: It is 1976.

CHAIR: So why not Sydney? What has held us back here? Why have we seen so many innovative schemes, for example, in California, which is closely related to our climatic conditions, but which has greater population pressures? Why have we seen such innovative schemes there but not in Sydney?

Dr LESLIE: Given the normal rainfall, when our surface impoundments and storages are full, we have four years of supply. Historically, there has not been the need to recycle water in places like Sydney that there has been in places like Southern California. Southern California supports a population of 20 million people. In the years that I worked for Orange County Water District—it was a public agency—it became acutely aware of the history of water supply. The most important finding, or the most important fact, is that in 1968 the United States Supreme Court ruled in favour of Arizona against California in rights to the Colorado River. It caps the allotment that California is allowed to take at 4.4 million acre feet a year. They currently take around 5.4 million acre feet per year.

There has been the institutional knowledge, if you like, by all the water agencies that at some point in their future they will have to give back about 20 per cent of their supply. So independent of climate change, which is something quite honestly that was not really discussed in the years I worked there, they just knew there was going to be this return of flows that they had relied on, and all water agencies were planning on that. So we looked at a suite of options. Desalination was one option. At the time it was rejected because the agency I worked for, which supplied water to 2.5 million people, had a track record since 1976 of using recycled water to reinject into the potable water supply.

The project, in particular, from the sanitation agency—the agency responsible for the collection, treatment and discharge of sewage—wanted to avoid building any more ocean outfalls. They saw that as a stranded asset. It would be more appropriate to take that money and to invest it into recycling schemes that could take the water and put it back into the ground. Quite frankly, that was all consistent with the view of the legislature as embodied in article 10 of the Californian Constitution, which states that the water resources of the State shall be put to the maximum beneficial use and that unreasonable uses, such as throwing it into the ocean, will be prohibited.

CHAIR: You went into some detail to define that reasonable use, which is of great interest. Is it working and was there much opposition to it? We are trying to promote effective alternative schemes. How does that reflect on conditions that exist in California today?

Dr LESLIE: I would not want to mislead the Committee in saying that general managers of water utilities wander around with article 10 of the Constitution in their hands. This dates back to the history of California, when the Constitution was written 150 years ago, and subsequently amended. The Spanish land grant families were very much connected with the land and recognised the value of water. It was not until the mid-1960s that the Porter-Cologne Act picked up on the language in the Constitution and tried to embody it into something that was workable. What they had in mind was to conserve supplies. Basically, they would not have used the expression then, but had they been living in our time they would have said: To create a sustainable supply we need to value all of our water; waste water is water which, as a result of treatment—and this is the language in the Porter-Cologne Act—can be put to a beneficial use; the technology exists to treat waste water, sewage, whatever you want to call it, to a level at which it can be put to a beneficial use, therefore it should be treated the same way as other water supplies are treated under the Constitution.

So, in the sixties, they were thinking that when you had communities such as Irvine—one of the more famous master-planned communities of Southern California, a city, a university and houses basically all from bean fields—you can flush toilets, you can irrigate parks, you can do lots of things with water that comes from either the Colorado River or the State water project, but that would be a waste; you should really be putting waste water to those purposes. So the purpose of the Porter-Cologne Act was to give legislative teeth to compel developers and the Irvine company that developed it to begin to put in those third-pipe schemes. A third-pipe scheme would be something like we have here at Rouse Hill. So the purpose was some legislative encouragement, but also to begin to set leadership in the whole area, by acknowledging that a community builds sewers, connects houses to sewers, and then builds waste water treatment plants and then builds an outfall, and then year after it year continues to upgrade and operate them.

For Sydney, I believe that since 1996 Treasury has set aside, on average, $600 million a year—not for the operation of the Sydney system but just for its upgrade. Some years they spend it, some years they do not. The Porter-Cologne Act was saying: We do all this, and the end product, the waste water, is valuable, so we need to put in place some framework that does a little bit more than just encourage people to put it to use. In the years that I worked there, between 1993 and 2000, we worked on the development of what was called the groundwater replenishment system, which will produce out of the water discharged to the ocean a little more than 20 per cent of the demand for potable water each year; that that water will be injected into the groundwater basin and then spread out to the drinking wells that are owned and operated by some 23 cities that overlie the Orange Country groundwater basin, or pumped to spreading basins, where it will percolate in.

We were fortunate in that that agency had been recycling water, for injection anyway, since 1976—though not nearly on that scale; it was about 1 per cent that went back into the ground from the plant that was built in 1976—and we were beginning to engage the community, and, more importantly, beginning to engage the cities that overlaid the basin and were essentially our customers and began to talk about the benefits of the recycling scheme—for example, deferring a new outfall, which was very important to environmental groups, like surf riders—and began to talk about recycling water giving the ability to back off water that is transferred from either northern California or the Colorado River, which particularly in northern California was having a lot of deleterious effects on the Sacramento-San Joaquin Delta, particularly loss of species diversity, mainly the salmon and some birds. So that resonated with the Audubon Society (bird watchers). It used less energy and was much cheaper than desalination, so that resonated with the Orange County Taxpayers Association. And, in terms of the city councils, it was saying: What we are doing is embodying recycling in the framework

of the Constitution and the legislature under which this State operates. So, in building support for recycling projects you need to canvass a suite of benefits.

CHAIR: In terms of energy usage, it has been debated that desalination is a high-energy exercise. From your experience, can you compare that level of energy use with the energy consumption involved in water recycling?

Dr LESLIE: In the context of Sydney?

CHAIR: In the context of Sydney, and the levels of energy consumption. Are there basic differences in terms of saline through the membrane, and the effort involved compared with that in recycling?

Dr LESLIE: The best way to think of it is that when engineers design pumping systems they generally talk in terms of metres of lift, or metres of head, at which you need to pump the water. Because seawater is salty—it contains, on average, about 33,000 milligrams per litre of salt—when you begin to concentrate that against a membrane it creates an osmotic pressure which you have to pump against. The pumping head lift is around about 800 metres. It varies depending where you are on the globe. In the Middle East, for example the Arabian Gulf, the pumping head is much higher simply because the water is more saline. In parts of the Atlantic the water is less saline and warmer, so that the pumping head is lower.

The Hon. RICK COLLESS: Might I clarify that, Mr Chairman?

CHAIR: Yes.

The Hon. RICK COLLESS: It requires a head of 800 metres to force the seawater through the membrane. Is that what you are saying?

Dr LESLIE: To keep the salt on one side of the membrane and force the water through the membrane, that is correct. Secondary effluent, or the waste water that ordinarily would go into the ocean, contains about 1000 milligrams of salt per litre. So, to force water across, allowing for the resistance of the membrane, the equivalent energy lift is around about 120 to 200 metres, depending on a variety of factors, but it is significantly lower. Unlike seawater desalination, reuse of waste water requires introducing the water back to the environment. We do not put it directly into the existing potable distribution system. In California, getting it back into the environment, where I worked, meant getting it back into the ground. That was attended by modest pumping costs. To that 120 to 200 metres of head, it would probably add about 40 metres of head. In Singapore, because of the topography of the island—the highest point is only about 45 metres above sea level—obviously, it does not take a lot of energy to lift it.

In Sydney, this is where it begins to get complicated. To have the same impact in terms of volume as a desalination plant, given the quantity of water in the ocean, we would need to locate one of these water factories—the vernacular used to describe these recycling plants—probably at one of our coastal facilities. So then you have an 80-kilometre distance to get it back to say behind the wall at Warragamba, where it would mix with water collected by our rainfall and, depending on how you do that, there will be anything from a 300 to 600-metre head lift.

The beauty of putting water in a dam is that it stores energy, so that you could recover some of that energy on the way out. In some work that we did for Sydney Water—which I believe is now in the public domain—our estimates were that to get the water to the standard that you would need say at a facility like the Malabar treatment plant, and pump it back to the catchment behind Warragamba at a place called Nattai, you are looking at about 3.8 kilowatt hours per cubic metre of water produced and delivered. It still compares favourably with the numbers that are on the Sydney Water web site for desalination, which is around about 5.4 kilowatt hours per cubic metre.

I would like to add, as an interesting technical anecdote, that in 1999 California deregulated its power industry. The next summer it went through the first brownouts they had experienced in more than 30 years. Basically, the big three energy utilities sold off what traditionally had been referred to as standby capacity, and in post-regulation was referred to as redundant capacity. So, in the peak

summer months there was a real strain on the system. We had compared, for this project in California, the energy savings associated with pumping water from the Colorado River and from northern California with the energy savings in recycling water locally. The difference between pumping it from northern California and recycling it locally was about the same quantum as the difference between desalination in Sydney and pumping the water from the coast to Warragamba, in Sydney—a little bit less than 2 kilowatt hours for every cubic metre. For a population of 2.5 million people, that energy difference in 12 months was equivalent to one million barrels of oil.

Water is inherently heavy; it is 1 kilogram per litre. Of everything we bring into our house--muesli, flower—water is the most dense. It is denser than petrol. You have really got to get very creative to find things that we use in our day-to-day lives that are more dense than water. So, even though 5.4 versus 3.8 does not seem like a big number, over the course of a year it is a significant amount of energy and attendant greenhouse emissions. A reasonable turbine at the base of Warragamba—which exists, but is not used—would recover about half of the pumping costs, or around about a kilowatt hour, so that would bring it down to about 2.8 or 2.4.

CHAIR: Are you saying there is a turbine at the base of Warragamba that is not being used at the moment?

Dr LESLIE: I am not an expert on that. If you are an engineer involved in building a dam, just out of habit you would a turbine at the bottom of it. I have never seen it, but Sydney Water told me that they are there and they do have the ability for Warragamba to serve a dual storage and hydro capacity.

Ms SYLVIA HALE: Is it necessary to take it all the way out to Warragamba? Is there any intermediate storage that would serve a similar purpose?

Dr LESLIE: It is not necessary. I started teaching about two years ago, but for the 12 years prior to that I was working in the private sector and in the public sector, and most of my work hinged around the treatment technology and the health effects. In Sydney, we have a reservoir called Prospect reservoir. The water could be reticulated from the coast to Prospect reservoir using significantly less energy than lifting it all the way up. Moreover, I am engaged in a project in Victorian, through the university, called the Gippsland water factory, which is a large water recycling project down there. In my travels to Gippsland I get from Melbourne to Traralgon by train. If you look at a railway line, it is the perfect easement in which to lay a major water line. Without ripping up a whole lot of streets, it is not an incredible stretch of the imagination to say that we could run a large pipeline along the railway easement and get it to Prospect reservoir.

From a health perspective—and this is from working with people who are experts in that area on a variety of projects, both in Singapore and now in California—the ability to put recycled water into an independent impoundment, where it is then blended back in with the regular water supply, is the best way to do this form of recycling, because one of the things that drives regulations and drives the thinking of health departments, particularly in California, is that if something ever goes wrong—not so much from an acute risk, about people getting sick, because that is more than adequately covered, but from some unknown organic contaminant—by putting it back into your regular water supply you have contaminated that supply. Putting it into an impoundment that can be taken off line is actually the best way.

By putting it into an impoundment that can be taken off line is actually the best way. In the context of Sydney we have, I would say, the perfect topography and empowerment to practise this form of recycling. Because we already own more than 50 per cent of the asset to begin with, which is the waste water treatment plant, it is just the logical step to build the next bit of infrastructure and get the water back into the reservoir at Prospect. Again, there was the material I believe the Committee released that we got from Sydney Water, which indicates that if you want to take some water from inland treatment plants—St Marys, Quakers Hill and Liverpool—you could treat it to that standard and put it into Prospect for around about 1.3 kilowatt hours per cubic metre. The cost of the scheme—again I do not have the numbers in front of me, but they are now in the public domain—from memory were half of what a desalination plant would be, that is $1.3 billion for 10 per cent additional water through desalination versus about half of that with one-fifth of the energy for the same quantum of water recycled back into Prospect.

CHAIR: That is all very interesting stuff. In your experience, in terms of the processes of treating recycled effluent and even going into indirect potable and suchlike, are there any specific problems? For example, you mentioned certain chemicals such as toxic chemicals and trade waste still coming into the system, so we have that set of problems and, on the other hand, endocrine disrupters. Obviously the Department of Health has to take a very conservative position on these matters.

Dr LESLIE: I am going to try really hard to answer it shortly. The ability to detect chemicals and water in the 1970s was done routinely at the parts per million level. In the 1980s it was the parts per billion. We now regulate—not in Australia, but in schemes that I worked on overseas—at the parts per trillion level. The harder you look in water the more material you will find. You have to accept that municipal sewage will contain just about every chemical you can think of. The important thing is: Can the treatment processes get them out and do they pose a problem to public health? An individual treatment process can never get out all of the compounds. It does not matter whether you are building a desalination plant or using reverse osmosis to turn sea water into drinking water or the same membranes to turn sewage into waste water. These low molecular weight compounds will get through the membrane because the membrane sees them sort of the same as a water molecule. The endocrine disrupters cover a broad range of chemicals. Basically they are anything that can inhibit, stimulate or suppress our endocrine system. We tend to get them, even professionals, confused with the pharmaceutically active compounds.

Our experience with reverse osmosis and the pharmaceutically active compounds is that for molecules to cross the blood brain barrier or to have a physiological effect they tend to be big, and reverse osmosis membranes are very effective at dealing with them. On the data that we generated in California and Singapore at the parts per trillion level you do not see these molecules. Some of the endocrine disrupters, such as disinfection by-products that are regulated under our drinking water guidelines at the parts per million level—one billion times higher than the level that we see them in these waters—cannot be removed by reverse osmosis. Using the approach of multiple barriers you build an advanced oxidation system. In doing this in schemes that I have been involved with a premium always has been placed on identifying all risks and producing as clean a water as possible. Notwithstanding that, you still enjoy the benefits of recycling. It does not hike up the cost to where it approaches desalination.

Another way to go through this problem is that right now Penrith Sewage Treatment Plant discharges water just downstream of Penrith Weir and that sits in the Hawkesbury-Nepean river for about 18 kilometres, at which point it is extracted at Richmond Drinking Water Treatment Plant. That facility has no barrier, other than the biological treatment process, to deal with pharmaceutically active compounds—endocrine disrupters—yet that water is reticulated through Richmond without any adverse health effects. The chemicals that are very hard to remove, and can have a deleterious effect on health, are the industrial solvents, the polychlorinated biphenyls, which we do not use a whole lot of, the heavy metals that come from plating shops. There can be small diffuse operations all over Sydney.

CHAIR: Are they still getting in on trade waste agreements?

Dr LESLIE: No, that is the strength of it. We have instituted trade waste policies—in the United States of America they are referred to as source control—with the primary objective of protecting the environment. But in the context of an indirect potable or a reuse scheme they actually form the first barrier to public health. They are the first line of defence, physically keeping these chemicals out. I will not wax on, but there are celebrated examples of where a chemical was detected in the recycled water and then by using the trade waste process, going back up the sewers, talking with the industries, you can keep it out. That occurred on the scheme that we worked on, on behalf of the Government in Singapore. The chemical was incredibly prosaic. It was hydrofluoric acid. It was used to etch the circuits on silicon wafers in the electronics plants. But we were having trouble taking it out with the reverse osmosis membranes. It had limited ability to reject fluoride. Organising a trade waste agreement solved that problem. In California it was some of the precursors to a carcinogen called N-nitrosodymethylamine, and again it was possible to limit that concentration and treatment but also through trade waste.

If you want to give it a euphemism, closing the loop, just taking advantage of everything that we do right now to protect the environment is a platform also for protecting public health if you then take the next step and return that water. It is an abhorrent thought. My mother is 82 years old. She is on board with it. You begin to talk to people about what your experience has been and they say to you, "You do want? You put sewage back in the drinking water supply?" It is a normal, healthy reaction that people think that it is disgusting. It reaffirms a couple of hundred yards of sanitary engineering practice and thousands of years of good anthropological evolution where we separate our waste from our drinking water. But notwithstanding all that, the science has been repeated and improves, and we come back to the same conclusion: The water is as safe, or better than, the recycled water. If we have a problem with that, and this is talking from an educator's perspective where we train people, it is incumbent on us to shut down Richmond because we know it is not getting the same level of treatment as these other schemes, or the practice of discharging into the Molonglo River outside of Canberra, which is then going to go to Wagga Wagga, et cetera.

If there is a perception in the community that the representatives would somehow put the public at risk by encouraging indirect potable reuse, to be consistent you would have to say, "We are going to identify those sewage treatment plants that are discharging upstream of a drinking water supply and shut those down as well." They are not getting the same treatment and in some cases because the environmental flows have been cut back from Warragamba Dam the blend of recycled water to dam water that is being seen at Richmond at the moment far exceeds levels that would go on in an indirect potable reuse scheme. There is only one exception to that, and that would be Washington DC where, in the summer months, they see 90 per cent of recycled water out of the river through their drinking water supply.

The Hon. RICK COLLESS: You made some very interesting comments. It is worth pointing out that on inland rivers virtually all sewage treatment plants discharge into the river system and in dry times the water experts tell me that in a lot of cases it is those discharges from the sewerage systems that keeps the inland rivers running during drought.

Dr LESLIE: Yes.

The Hon. RICK COLLESS: It is fair to say that most of those inland sewage treatment plants treat water to a tertiary standard before it goes back into the river system?

Dr LESLIE: Yes, and they would take out a lot of the nutrients.

The Hon. RICK COLLESS: Following on from that, have you had any experience with the biological cleansing of sewage treatment plants?

Dr LESLIE: The activated sludge process uses bacteria, or biology—

The Hon. RICK COLLESS: In the primary treatment phase?

Dr LESLIE: That is in the secondary treatment. The primary treatment really is just gravity. You let the material sink. The secondary treatment process, you provide oxygen to get heterotrophic organisms going that begin to break down the soluble organic material and some autotrophic biological organisms will begin to break down the nitrogen, or convert the nitrogen.

The Hon. RICK COLLESS: Are you aware of work that was done at the University of New England [UNE] using a plant called duckweed to tertiary treat the water?

Dr LESLIE: I am not familiar with New England's work, but the use of duckweed in constructive wetlands, yes. The agency I worked for in California had a large wetland scheme made to protect the ground water supply from run-off from large dairy operations. Yes.

The Hon. RICK COLLESS: You think there is a possibility of applying that on a larger scale? One of the by-products of that process is the duckweed itself, which has very high value as stock fodder?

Dr LESLIE: Yes, it has. San Diego looked at schemes with a plant called water hyacinth that could then be turned into biodiesel. In Sydney I believe that they probably will have to start having that discussion if they begin to get serious about using recycled water to restore environmental flows in the upper reaches of the Hawkesbury-Nepean.

The Hon. RICK COLLESS: Which has a water hyacinth problem at the moment, does it not?

Dr LESLIE: Does it? I am not sure.

CHAIR: That is salvinia, which is another potential biodiesel product.

Dr LESLIE: The issue there is that as good as these treatment processes are, even with biological treatment of the waste water and membrane treatment it is difficult to get the nitrogen levels down to the 0.5 milligram per litre range that they think is required to prevent a lot of the problems in the river. Having a constructed wetland to pass that water through would be a very sensible step rather than trying to find a manmade solution.

The Hon. RICK COLLESS: The duckweed work that the UNE did found that they could get the nitrogen out without any trouble, but it was the phosphorus level they could not get out.

Dr LESLIE: Phosphorous is easy. We can take that out somewhere else.

The Hon. RICK COLLESS: But they had to put nitrogen back into it to get the duckweed to grow to take the phosphorus out. In relation to the suite of options that you speak about, the additional infrastructure for waste water management, how will that relate cost wise in terms of capital infrastructure required?

Dr LESLIE: The number I gave you of 45¢ to 50¢ has the capital embodied in it through the annual debt service. But to give you a feel for what it costs to build something like this, the rule of thumb is that the equipment is about $1 per litre. If you needed to build a 10 million litre a day plant you would be up for around about $10 million worth of equipment.

The cost associated with installing that in a plant, with all the civils and electricals, adds about another $1 per litre to that. That is based on the bids that we ran in Singapore, and it is consistent with projects in which we have been involved in Western Australia and Brisbane.

The advantage is that, because of the way you size that waste water treatment plant and where you located, installing that equipment usually does not require opening up most parts of the environmental review process. The exception would be for the additional truck movements because you are physically in the boundary. That would eliminate a lot of the problems that were associated with siting a desalination plant at Kurnell or somewhere else; you are physically within the bounds of your existing asset.

The Hon. RICK COLLESS: When you talk about waste water management or waste water recycling, do you are include in that urban stormwater?

Dr LESLIE: No. Most of our waste water plants do see stormwater, because when it rains we have a leaky system. Stormwater has been tricky. The only scheme in which I have had any involvement in a review capacity was in Santa Monica, California, where they built a dry weather run-off plant. The city of Santa Monica is a huge paved area, so even with water restrictions you find that there is a base flow of stuff coming through the stormwater drains. The city chose to build the facility at the pier at Santa Monica to take that water, treat it, and recycle it. But it was an expensive endeavour for the yield you got. The problem is that when it really rains, the flows increase so much that the loading on your equipment is such that you have to turn it off, otherwise it will plug up.

If you look at stormwater drains around Sydney at the coast, when it is not raining they tend to be dry, so you really are looking at trying to treat those big flows. They do that in Singapore, but it comes at a big expense to the environment. They physically take a river and they build a barrage, which is like a dam but you can deal with tidal variations. Over the course of the year—or you can

accelerate it a bit with pumping—you let the stormwater flush out the sea water. Then you can pump out the sea water if you want to accelerate it, and you are physically left with an empowerment of stormwater. I cannot see us doing that in Sydney, but that is one way to do it.

The other method is that if you have access to a good groundwater system, an aquifer, and also with wetlands because you can then turn it into a visual amenity, you can design what are called rapid infiltration and extraction systems. They have some experience with this in South Australia, where you take a piece of land and you funnel your stormwater to it somehow. The land is very porous and it absorbs the water quite quickly. But in the urban settings, unless you want to go to the extremes that Singapore has done and block off the mouth of the Singapore River, which would be akin to closing off either Sydney Harbour or Botany Bay, it is low-yield schemes and they tend to be expensive.

Ms SYLVIA HALE: You have obviously had experience in many areas, including in Namibia, Orange County, Singapore, and so on. Has the "yuck" factor been a consistent problem there with communities, and how has the perception that sewage is going back into the water supply been successfully overcome?

Dr LESLIE: The "yuck" factor is almost a given, for the reasons that we discussed before. The thought of it is anathema to most of us. The strategy that worked very well in Orange County, and is still going on, was to avoid the blanket approach and begin to work with core groups in the communities at the organisational level. It takes a significant effort. The people who are in the public affairs department at the Orange County water district, between 1997 and 2000, which was when the project really was in its developmental and early design phase—the key for getting the approval would have made over 350 community presentations and they would have been targeted. For example, they spoke to surf riders, they spoke to the parents and citizens group, they spoke to the equivalent of the AMA and the registered nurses, and they addressed particular concerns.

I find it patronising to call it an education process because I feel that the community is pretty well educated about water to begin with. The Deputy Chair's comment on knowing that if you live downstream of another community you are probably drinking their water anyway—that is a common experience that people have. You really need to get in there and explain why you are doing the project—and it is not just to recycle water, as it was in California. We were doing it because they did not want to build another ocean outfall; we were doing it because we did not want to import more water from northern California and mess up the habitat for the fish and the birds; we were doing it because it was cheaper than desalination, and that was the other alternative and it was going to have less impact on the typical family's bill. So you really need to find the suite of messages that resonate with different groups.

When it comes down to talking about the technology—and really that was the easiest part—when you describe the rigours of what reverse osmosis is and how brutal it is to force water through essentially a piece of plastic that does not actually have holes in it, and then expose it to countless kilowatts of ultraviolet radiation in the presence of hydrogen peroxide that is going to turn anything in there into carbon dioxide and water, and the fact that the water then sits in the environment and gets treated again before you get it, it usually deals with all those issues.

Unless it is something like fluoride, there is a programmed resistance in some communities in Australia, most notably Queensland, to the fluoridation of water; they think it is like a plot. But with this sort of thing, you can usually overcome the barriers. If you explain why you are doing it, rather than just, "We have run out of water" or "We want to do it for giggles", that it has all these multiple benefits, you overcome that factor. But it does exist. The focus groups that we ran in the time that I was there indicated that it could not be dealt with through a blanket advertising campaign; that would just fail. The issues were emotional, and you cannot overcome those emotional issues with technical information in 30 seconds; it has to be overcome with an equally powerful and innovative reason, such as saving the fish or stopping pollution in the ocean.

(The witness withdrew)

STUART JAMES KHAN, Research Fellow, Centre for Water and Waste Technology, University of New South Wales, Sydney, affirmed and examined:

CHAIR: Are you conversant with the terms of reference for this inquiry?

Dr KHAN: Yes.

CHAIR: Should you consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. Before questions commence, would you like to make a short opening statement, bearing in mind that you have provided a lengthy submission, which is very much appreciated?

Dr KHAN: I will not speak for too long, given that you have most of what I have to say in writing, but there are a couple of points that I would like to reiterate. My submission is basically making the case for water reuse, which I see you have heard a number of times now, including this morning, and I have read the transcript from the previous hearing. I see that that is a consistent theme, as water recycling should be a valuable and major component of water management in Sydney, and I very much agree with that.

One of the points I would like to make is that I congratulate the inquiry on looking at drinking water as an issue that needs to be addressed urgently in Sydney. However, it is a little difficult to take that particular issue, drinking water management, out of the wider context of water management or management of the whole water cycle as a whole, because the issues interact with each other and overlap.

As far as water recycling is concerned, I think there are two major advantages of it. One advantage is that it gives us the opportunity to find new sources of clean water for all sorts of uses. The other is that it minimises the detrimental impacts of sewage effluent discharge. The previous witness spoke about the need to not waste water by discharging it into the ocean, but I think it goes slightly further than that. We know that we are throwing out primary-treated sewage from the three major sewage treatment plants in Sydney. That is raw sewage that has had little more than the gravity effects of removal of some of the large solids. As the previous witness mentioned, the complete suite of chemicals that are possibly in existence, we have to assume are in that sewage, and we know that they are.

Just last year those three major treatment plants—North Head, Bondi and Malabar—discharged 2,500 tonnes of phosphorus and 13 tonnes of nitrogen into the Pacific Ocean. Most of that nitrogen was in the form of ammonia, which is a highly toxic chemical to many marine organisms. That was about nine tonnes of ammonia. A recent study at the University of New South Wales in the department that I work in identified for the first time the accumulation of, - you were talking about endocrine disrupters. Three of the most potent endocrine disruptors are the oestrogenic hormones: oestrogen itself (17 beta oestradiol), oestrone, and the contraceptive pill (the pharmaceutical oestrogen, ethinyl oestradiol)

Those three hormones were identified in the sediment around the base of the Malabar outfall, or around the outfall discharge points. The study showed that once this fresh water comes out of the outfall, it mixes with this much higher ionic-strength sea water, and it appears that a lot of these compounds start to associate with some of the particulates in the water and then with gravity they fall directly to around the outfall. So we are ending up with higher background concentrations in a small vicinity around that point.

Of course, they are only three chemicals. The suite of chemicals that we are discharging into the ocean is enormous. Not all those chemicals are things that break down naturally; things like heavy metals and so on we can expect to accumulate in the marine environment for long periods of time. We really have an urgency to reassess the way we are discharging that water into the ocean—not just because of the water wastage but also because of the effect on the environment.

In my view, desalination only further entrenches that "take water, use it once, and discharge it" paradigm. Basically, what we will end up doing is taking ever-increasing volumes of water out of the ocean, desalinating them, adding them to our municipal supply, and discharging ever-increasing volumes of water. I think that is an issue that we need to look at closely and perhaps come up with some alternatives.

Water recycling, on the other hand, presents us with the opportunity to really start to decrease the amount of water that we are discharging by reusing that water. In my submission I bring up one topic which there is very little information about out there, but because it is something that I have not really heard other people speak about, I would not mind mentioning it again, and that is the potential impact of desalination on social behaviour and attitudes.

In Sydney during the last three years, as you know, it has been publicised by Sydney Water that the public has made a great achievement by reducing water consumption in Sydney by 12.6 per cent below the 10-year averages since the introduction of the mandatory water restrictions. That is because people are concerned that the amount of water that they have available is being reduced. If suddenly the potential reservoir of water becomes something as enormous as the Pacific Ocean, are people really going to feel that urgency to save water? Are they going to think, "I really should not wash my car with this hose but we have a desalination plant now. My taxes are paying for it, why shouldn't I use it?" That desalination plant that was being proposed—the later version of it, the 125 mega litres per day—I calculate that that would supplement about 9 per cent of Sydney's water needs, whereas the change in behaviour, the change in consumption, Sydney Water has told us, saved 12.6 per cent of Sydney's water needs.

So if attitudes change not only do we have the potential to erode some of that 12.6 per cent, but if we actually go back to where we were, to the 10-year averages of where we were, that 9 per cent is not even going to make up for what we have lost. So we can invest a lot of money and actually go backwards in the amount of additional water to Sydney if that practice kicks in. The main problem here is that we do not know; suitable studies have not been done that can actually tell us whether or not those social effects may take place and to what degree. I think that that means that the impact study of the desalination plant is incomplete until those sorts of studies have been considered.

I will not talk about the extreme electricity consumption of desalination as we have just heard all about that. I also discussed briefly in my report the impact of discharge brine on marine ecosystems. Basically, the major point there is another lack of knowledge, as is acknowledged in the assessment, for the concept for the desalination plant. The ecology lab that prepared a report for GHD for the assessment indicated a severe lack of knowledge in regard to the potential impacts on marine organisms. The water research laboratory undertook some plume dispersion modelling, the point being that since the amount of impact was not able to be properly quantified, the approach would be just to disperse the saline brine as quickly as possible, and again the water research laboratory in their report also indicated a large degree of uncertainty regarding near field dispersion. So there are many, many unknowns that we cannot pretend we know exactly what is going to happen with that brine.

Sydney Water actually has quite a bit of experience with water reuse. Even though we talk about the numbers being fairly low, they have undertaken a diverse range of smaller schemes that have been implemented around Sydney, and that experience is valuable. Some of the approaches that we can take are: on-site municipal reuse—I think that should be looked at much more closely; targeted municipal irrigation, taking water and then finding an area that will use a large volume of it at once for irrigation, like the Botanic Gardens or a racecourse, et cetera; industrial reuse has a lot of potential scope in Sydney; we have some experience with reticulation for household use, things like Sydney Olympic Park and Rouse Hill; stream flow augmentation is a very important and very useful and potentially fairly simple approach for water reuse in Sydney; and, of course, indirect potable reuse.

Indirect potable in some ways might be considered an ideal reuse approach because it means delivering water to one destination and having this one reservoir, or whatever, to retain the water and to treat it and put it back through the entire supply without having to implement a lot of major extra infrastructure. However, I wonder whether it really is the ideal approach in all circumstances. For example, it is a high-energy approach; it requires high treatment. All of that phosphorus and nitrogen that we are talking about discharging out of the outfalls has to be removed for indirect potable reuse. However, if we are looking at agricultural uses, maybe we can make use of some of the nutrients that

are already in that water and not need to invest so much energy in upgrading it to a potable standard. Also, realistically speaking, Sydney's water issues at the moment are urgent and they need to be addressed quickly, but are we going to see the political courage to implement an indirect potable reuse scheme in the short-term? I am not sure that we are. So I think maybe we should be looking at alternative forms of reuse, at least in the meantime, and forms of reuse that can supplement our drinking water supply; replace water that is currently potable water in our drinking water rather than having to put the recycled water directly back into the dams immediately.

In my submission I included a fairly large section on improvements and reforms that are required for water recycling in Sydney at the moment, and a lot of those, I think, are things that the New South Wales Government could act on immediately. So they are some of the ones I would like to talk about. For example, under Financial and Economic Reforms to Facilitate Water Reuse Implementation there are a couple of things there; one of them is the need to really assess our water management approaches by full social cost accounting methods or triple bottom-line methods. Economically, nothing is going to stack up with just letting the rain fall, taking all of that water, reusing it once and dumping it out to sea. Even though we have just heard about the high maintenance costs of those outfalls, water reuse always comes up as an economically more expensive approach simply because of the extra treatment that is required and the extra infrastructure. So we need to take into account some of the environmental and social benefits as well, and social costs.

Another point on the economic side is the way we price water. I was looking at my recent Sydney Water bill and my last bill was for $133, of which $94 is for the sewerage system, nearly $20 is for the water service and only $12 was my usage fee for water. So for one point, there is not a lot of potential elasticity there; I cannot do anything really to save a lot of money on that bill; I have $12 out of that $133 that I have any power over. But, more importantly, if we are talking about water recycling, traditionally the costs for tertiary treatment have been applied to the sewerage generators—the sewerage service costs here—and that is the largest part of my bill, that is the $94. If we are talking about water recycling that is being put into place to save potable water then there is a good argument for some of that cost to be moved from the sewerage service fee onto the drinking water usage fee. That means that the bill payer does not pay any more, if it is done well, but the service fee for one thing becomes more elastic, the usage charge for water—but also it means that the recycled water scheme, when Sydney Water or any other organisation wants to put in a recycled water scheme and they want to look at the cost to the consumer of what a person would be prepared to pay compared with recycled water, it moves the bar upwards without actually costing anybody any more because it comes off the sewerage service fee. So I think some things like that would be worth taking a good look at.

We have already talked about the management of chemical species in water. There are a few of these that I probably will not talk too much about.

CHAIR: I appreciate what you are saying and what you have actually submitted. Perhaps if we had some questions in the remaining time, unless there are any specific new things you would like to add at this point. I am just aware that there is a lot of material you have already given us—and it is fantastic stuff.

Dr KHAN: Just one. Nationally we have new guidelines for water recycling and those new guidelines take a very, very different approach to the traditional approach to guidelines in Australia for water recycling and they implement a very innovative risk management approach, which is very different to what we have in New South Wales at the moment, which is about three or four microbial species and things like suspended solids and things that need to be met—this concentration or underneath this particular concentration in order for something to meet the guidelines or otherwise. However, this new national approach I think will really facilitate the implementation of water recycling in Australia if all the States can be convinced to implement consistent guidelines with that, and Queensland has just done that. I think that is something that New South Wales should be pushing strongly at the moment.

The one area that I would like to talk about a little bit is right at the end of my submission, which is a downhill water reuse plan. We just heard about how it is expensive energy-wise to pump water from the coastal areas back to western Sydney. A lot of the water recycling proposals that are on the table at the moment involve doing just that: taking water from somewhere like Malabar and

pumping it to western Sydney. However, an alternative approach is to prevent as much water from getting to Malabar in the first place: use the sewerage treatment plants in the western suburbs and take the water from those treatment plants and use it as it flows towards the coast rather than letting it get there. Since preparing my submission I have had a closer look at that and come up with a more specific proposal.

In north-west Sydney, Sydney Water is doing a lot of work looking at how they can reuse some of the sewage that is coming from places like Riverstone, Penrith, Quakers Hill, St Marys, et cetera, and that is good. But I can see some real opportunities in south-western Sydney which are about to be overlooked. At the moment the Georges River sewerage treatment plants, Glenfield and Liverpool, are two of the biggest inland treatment plants in Sydney; Glenfield produces 37 mega litres per day in dry weather of secondary treated sewage, or greater than; Liverpool another 17 mega litres per day in dry weather. That is a total of 54 mega litres per day of highly treated sewage, compared with what is at Malabar, and it is here in the western suburbs. That is over 20 gigalitres per year of sewage already treated and already in the western suburbs. So that water has energy invested in it in treating it. But what happens at the moment is that water is treated through those sewerage treatment plants and then it is actually dropped back into the sewers and sent to Malabar. So it is mixed again with all of that raw wastewater and then it is discharged into the ocean at Malabar. Some of these proposals are talking about retreating it and bringing it back again.

At the moment Sydney Water has a scheme that they are about to start implementing this year called the Southwest Sydney Sewerage Scheme, and that involves building a 24-kilometre pipeline from Liverpool to Ashfield. That is going to take the sewage that is secondary treated, or greater, to Ashfield so that that will free up some of the flow in the north Georges River sub main to allow development in that area and increased capacity of that sub main. When Sydney Water talked about this they said that that pipe has the potential for maybe a sewerage reuse scheme sometime in the future, or whatever, but I think that before the pipe starts being built we really need to look at who can use that sewerage and we need to make sure that that pipe is planned and built with whatever requirements, in terms of pressure or flow or in terms of access to that pipe; that it is built optimally for industries between Liverpool and Ashfield to tap into it and be able to use it. Our aim should be for nothing more than a trickle of that secondary treated water to actually make it to Ashfield.

People talk about sewer mining. Sewer mining involves basically putting a pipe down into the sewerage system, taking it out and treating it. But that is talking about raw sewage. Already we are far, far ahead with this particular scheme. As far as that goes, even if we just looked at the 10 biggest inland plants in Sydney, being Winmalee, Penrith, St Marys, Quakers Hill, West Camden, Castle Hill, West Hornsby and Hornsby Heights, plus Glenfield and Liverpool, that is around 200 mega litres per day of dry weather sewerage flow, which is getting close to pretty much half of what comes out of Malabar—not that all of that goes to Malabar, of course. But just to consider what sorts of volumes we are talking about, there is a huge amount of scope for recycling from those plants where we have already invested the energy

The Hon. RICK COLLESS: The Committee has heard about the issue of stormwater harvesting and has taken evidence to suggest that that could produce around 500 gigalitres of water per year from the Sydney urban area. The Committee has also heard from several different people that the cost of doing that may in fact be prohibitive. What is your view about that?

Dr KHAN: I am not an expert on stormwater harvesting—I have worked mainly in municipal wastewater—but an obvious issue is that at the moment stormwater management in Sydney is basically flood management. It is aimed at getting the water out of the city as quickly as possible. The reason for that is that when it rains we have plenty of it, and that is when we do not need it; when it is dry we do not have stormwater, and that is when we do need it.

The Hon. RICK COLLESS: That is no different to harvesting it from the catchment, is it? That is exactly the same situation.

Dr KHAN: Of course, yes. Basically what I am saying is that to undertake stormwater harvesting large scale you need large storage areas.

The Hon. RICK COLLESS: Secondly, with regard to waste water management, processing sewage and so on, what do you do with the sludge at the end of the chain?

Dr KHAN: At the moment a lot of the sludge at the end of the chain in Sydney is going to land remediation. Whether or not you discharge the sewage effluent or you recycle it, I do not see why that has impact on sludge management. You can manage the sludge in whatever is the optimum approach, regardless of whether it is discharged or recycled.

The Hon. RICK COLLESS: One obvious use for it is in agricultural fertilisers. You spoke about 2,500 tonnes of phosphorous per day, was it?

Dr KHAN: Over the last year, 2004-05.

The Hon. RICK COLLESS: That, of course, has a tremendous agricultural value. Do you think it is possible to process that sludge to a standard where it could safely be applied to agricultural land without serious impact? I know a lot of sludge has been put on as fertiliser, but there are some quite severe restrictions on the types of crops and so on that you can use it on.

Dr KHAN: Just to be clear, the mass of phosphorous and nitrogen that I was talking about is actually in the water phase that is coming out of the outfall, not in the sludge. That is a different number. I should be careful about not talking out of my area that I really am familiar with. Biosolids management is just not an area that I feel comfortable pretending to be an expert on.

CHAIR: We have seen the Government moving away from desalination and looking at a 30 per cent dam capacity before bringing in emergency moves. Many would say that is fair enough but others will say that the scale of recycling is not going to cut the mustard, so to speak, in terms of maintaining water supplies to Sydney; that the reuse and recycling options are not going to have a big enough impact to resolve the massive problems that we are facing and our responsibility to deal with emergency situations and what is absolutely essential, that is, water supply. What is your view?

Dr KHAN: With regard to the desalination plant, there may be a place for desalination in the future if we really find that Sydney has become a desert and there are no other options for finding water in Sydney. The volume that we were talking about in the most recent version of plant that has been publicly discussed is 125 megalilitres per day. May I clarify something? Were you asking me whether that volume is available, or whether there are uses available?

CHAIR: I was talking about availability and what can be achieved through reuse and recycling. Is it feasible that it could manage the whole situation?

Dr KHAN: Can we come up with the same sorts of volumes from recycling water?

CHAIR: Yes.

Dr KHAN: In the inland sewage treatment plants around Sydney there is in excess of 200 megalitres per day, compared with 125 megalitres per day from the desalination plant, if we wanted to start taking water directly from Malabar, Bondi and North Head, I think about 450 per day is available from Malabar, about 130 per day from Bondi and 330 from North Head—that is dry weather flow. So, much more, 10 times more than we are talking about with regard to the desalination plant.

CHAIR: You state on page three of your submission that some Australian cities, such as Melbourne, have highlighted the need to reduce discharges from ocean outfalls and are now actively working to increase the feasibility of ceasing ocean discharge of sewage. You state that unfortunately Sydney is not among them. Why is Sydney not among them?

Dr KHAN: Sydney has invested billions of dollars—let us say millions, because I do not know the numbers—in the infrastructure it has, which involves ocean outfalls. The deepwater ocean outfalls are only 15 years old. Sydney is not talking about wanting to change significantly and reinvest in a completely opposing infrastructure, I assume.

CHAIR: There was a big issue, of course, with the northside storage tunnel. I understand that in the prospectus originally there was to be a return pipe of some sort, which I do not think has been put into the system. Do you know anything about that? Is there a potential for there to be a reuse option of some sort with the northside storage tunnel?

Dr KHAN: I am aware that those discussions took place, but I have not been involved in them. I cannot give you any more details than one of your speakers was able to provide on the first day of the session.

CHAIR: Dealing with the different levels of material, we have heard about taking the black water out of the grey water systems and that it is a much easier situation to reuse and recycle; and also about separation of the urine gold stream, as some people call it, from the point of view of its value. Do you see opportunities to effectively separate those streams and therefore have a different type of reuse program? Perhaps you could provide some information for the benefit of the Committee?

Dr KHAN: Absolutely! I think if our aim is to minimise the amount of water that makes it to Malabar and to the treatment plants, one of the first things we should be putting in place is on-site household water recycling, especially grey water recycling. Of course, the grey water, being water from showers and washing machines, is mixed with septic water from toilets and the treatment processes and the issues involved become much more complex, but if we can keep those separate—as there are many approaches towards doing at the moment—then, even though there are still significant health concerns that need to be properly managed with grey water, the potential is there to use that grey water on-site. I think about 30 per cent of household water use is in the backyard on the garden, and about 10 per cent is used in flushing toilets. Close to half the water that we use in the house could be second-hand water that could be used on the garden or outside—from the outside taps and in toilet flushing without really getting into areas which would involve too intimate human contact.

CHAIR: My understanding is that about 25 per cent to 30 per cent is used to flush toilets in an average household, although I may be wrong. Is there any opportunity, or is this pie in the sky, that when we are looking at the importance of separating the various effluent or sewage drains we look at actually taking toilets out of the equation and dry composting toilets, et cetera? Is that feasible, or is that pie in the sky stuff?

Dr KHAN: I would not like to say it is pie-in-the-sky, but it is a major change to the way we manage water at the moment in the city. It is certainly not something I would see as being implemented on a large-scale in the timeframe in which we need to urgently address the problems.

CHAIR: Could sewer mining become a component of a strategy to minimise water flowing into the black water stream?

Dr KHAN: Technically, of course, yes. That is an approach that could be followed. Where institutions such as the Health Department would stand on such major changes to municipal waste management or sewage management, I cannot presume.

The Hon. HENRY TSANG: You referred to Liverpool and Glenfield and said that the treatment plant produced wastewater of a high standard, indeed that the Government is piping this water to Ashfield and so on. You also referred to the use of the pipes. Do you mean to say that that wastewater capacity could be increased so that some of the water should be further treated to add into the drinking water supply? I did not quite understand the last point you made.

Dr KHAN: At the moment Sydney Water has a proposal, which it is about to start working on, which involves building this pipeline. I am saying that that pipeline is water that has a lot of energy invested in bringing it up to a higher level, secondary-plus wastewater. It is still sewage, secondary treated sewage.

The Hon. HENRY TSANG: But they use it for industry now.

Dr KHAN: They are not using it for anything. At the moment they are talking about building a pipeline to take this water from Liverpool to Ashfield. At Ashfield it will rejoin the sewer system and then mix with raw sewage again and end up at Malabar. What I am suggesting is that they should

be looking at building that pipeline in such a way and doing the studies before they build it and before they dig the hole in the ground, to look at how they might build that pipeline, the precise route that it might take, the junctions that they might put in it, the accessibility to that pipeline for industry to take it out. It will probably require additional treatment depending on the specific reuse applications—whether it be irrigation or for other industrial processes. Councils might be able to tap into that water and use it to irrigate public parks and things like that.

The Hon. HENRY TSANG: I think the Government is already planning for that industrial use for western Sydney.

CHAIR: For north-western Sydney you are specifically talking about that pipe.

Dr KHAN: South-western Sydney, yes.

CHAIR: Which is Liverpool to Ashfield. I think you are right, Henry, in that there are reuse strategies in regard to other plans. If I understand you correctly you are saying specifically that pipe is going to be a flow from Liverpool to Ashfield to allow greater capacity in other areas, but, with that particular pipe, Sydney Water does not envisage at this moment the same sewer mining, water-factory type projects that are occurring in other areas.

Dr KHAN: If they are, they have not widely announced it.

CHAIR: It is a question the Committee can ask of Sydney Water.

Ms SYLVIA HALE: Following up on that, for how long as this proposal been under study? Has it been a five-year or 10-year project? Was the planning for it taking place before this major public concern about Sydney's water supply?

Dr KHAN: That is a question for Sydney Water. I do not know, but I notice that at the moment the Sydney Water web site has a couple of community information sheets about that scheme. Those community information sheets started appearing in late 2004 early 2005. That is really when it started to get some public discussion, but I could not tell you how long it has been on their books.

The Hon. HENRY TSANG: Could I ask that Sydney Water take that question on notice, whether that pipe referred to by Dr. Khan has any design for industrial use?

CHAIR: Yes. We will endeavour to find out. They will be appearing Thursday and we will get that opportunity then. Dr Khan, thank you for your very detailed submission. It is most appreciated. I hope that, with all your academic papers, you do not forget to pay your water bill as a result. The material that you have given the inquiry this morning has been very helpful and certainly will be of great support to us in our deliberations. I thank you for all your efforts, which have been considerable.

Dr KHAN: Thank you for the opportunity.

(The witness withdrew)

PETER JAMES PRINEAS, Member of the Executive, Nature Conservation Council of New South Wales Inc., 362 Kent Street, Sydney, sworn and examined:

CHAIR: Are you conversant with the terms of reference for this inquiry?

Mr PRINEAS: Yes. I have read the terms of reference.

CHAIR: Mr Prineas, if at any stage you would like to give any evidence or documents that you wish to be heard or seen only by the Committee, please indicate the fact and the Committee will consider your request.

Mr PRINEAS: Thank you.

CHAIR: Would you like to make a short statement before the Committee asks questions of you?

Mr PRINEAS: Yes, if I can. I have some notes here, which I will use.

CHAIR: Certainly. If you would like to make those submissions to the Committee, that is also welcome.

Mr PRINEAS: I will do that. First, I thank the Committee for this opportunity to appear on behalf of the Nature Conservation Council [NCC]. Our organisation has devoted a lot of time and effort and resources over many years to improving the sustainability of Sydney's water supply and waste water systems. I believe you have already been sent copies of the major documents that we have involved in and I will attempt to clarify any questions arising from them. They are very voluminous, so if I am not able to clarify something, I hope I can do it later in writing. One of the most significant documents is the 1995 report, A New Course for Sydney Water. I am glad to say that I was the convenor of the steering committee for that. Going back over it recently, I was pleased to see how relevant the recommendations are and how they have stood the test of time over 10 years. I believe over the years the environment groups, including the NCC, have, by these studies, helped the community toward the goal of sustainable water supplies in Sydney.

I will summarise the problem in the following terms. We are taking too much water from the environment and returning it in an unsatisfactory condition at the wrong places, in the wrong amounts, and at the wrong times, and using too much energy in the process. A sustainable solution to Sydney's water supply problems will address all of these issues. I have already stated our strong opposition to desalinised sea water as a source of water for Sydney. We see desalination as an energy profligate approach to Sydney's water supply problems. It would also undermine the Government's green house policy and water conservation or demand management initiatives. The NCC is glad that the Government has decided to indefinitely defer the development of the desalination plant at Kurnell and we urge the Government to now abandon the development of the plant as a policy response to extreme drought. It should be replaced by sustainable approaches, including stormwater harvesting, sewer mining—that is re-use, recycling—and water conservation or demand management. We believe that these approaches can meet Sydney's needs.

We have also, as an organisation, opposed the proposed expansion of the Shoalhaven transfer scheme, involving the raising of Tallowa Dam. Again we are glad that the Government has decided not to proceed with this expansion. The Government has recently said that greater reliance will be placed on ground water resources to meet the contingency of an extreme drought. Deep aquifers, which are to provide these supplies, have been identified in the southern highlands and in Western Sydney. The Government is also adopting what might be called a liberal approach to landholders wishing to put down bores or spear points to draw on shallow aquifers. Our attitude is this: We want a precautionary approach to ground waters as they are not a separate source of water unrelated to everything else. Aquifers have complex relationships with surface waters and it is not a sustainable solution to Sydney's water supply problems to take ever-increasing quantities of water from the environment, whether it is from the surface or from underground sources.

Ground water resources in the Sydney area, we believe, are not well understood, not well assessed, and the impacts of extraction are not well studied. Adequate studies of ground waters and their relationships with surface waters and the characteristics of particular aquifers is needed before these sources can be managed with any confidence. We would also say that regulation of ground water use may also need to be reviewed in the current policy climate to make sure there is in fact effective control over extraction. Another point we would like to make is that investment in recycled water projects needs to be substantially increased and the only way that this is likely to happen in Sydney is if indirect potable re-use is adopted as government policy. Non-potable re-use has its problems in that there is a need for a different reticulation system and also there is a problem with the size of the market for non-potable water.

We would say that in spite of some of the rhetoric heard on the subject in recent times, the community will accept indirect potable re-use if the case for it is examined and advanced scientifically. Indirect potable re-use exists in many countries around the world, and in Australia it has been in existence informally ever since towns were built on riverbanks. Most towns drawing on rivers for their water supply take and treat the effluent from towns upstream and use it in their water supply—Dubbo, for instance. Sydney is no exception as sewage effluent from the city of the Blue Mountains, Lithgow, Goulburn, Bowral, Mittagong and Moss Vale currently finds its way into Warragamba Dam, Sydney's major drinking water supply. So we are informally involved in potable re-use at this very moment, although most people would not appreciate it.

The NCC is very pleased to support the Government's Western Sydney's recycled water initiative, even though it is a non-potable response. It promises to deliver non-potable water for industrial and agricultural purposes and for environmental flows to the Hawkesbury and Nepean. We also note with some approval that the water is to be stripped of the nutrients which currently contribute to the severe algal bloom problems in the river. nevertheless we note that the environmental flow requirements for the river are three or four times the output of the new scheme and the river could continue in its currently stressed condition for years. So although it is a good response, it is not enough.

Therefore we request the Committee to put forward as a major recommendation that the Government initiate another major recycle water project for eastern Sydney. We would not be too concerned about the geographical qualification but it should be at a scale comparable with the Western Sydney recycled water project. Tenders should be let for a definite scheme within a reasonable time—say, a couple of years. The scheme should be based either on stormwater harvesting or sewer mining and unlike the Western Sydney scheme, involve treatment of reclaimed water to a standard suitable for indirect potable re-use: that is, water to be mixed with surface waters where it will undergo further and natural purification before harvesting, further treatment and use. An approach used in southern California is to inject treated reclaimed waste water into an underground aquifer in which water is extracted for treatment and use in the urban water supply. Before such an approach could be considered for Sydney, much investigation would need to be done to ensure that environmental impacts were acceptable.

To address some of the concerns about quality and treatment of water sourced from sewer mining, the Committee should recommend a complete review of trade waste disposal to sewer and the investigation of alternatives, such as source control. The NCC believes that water conservation or demand management is an essential element in developing a sustainable water supply for Sydney. We have made some progress in this area in recent years, but Sydney Water has not yet been able to reduce per capita demand in line with the targets set out in its operating licence. The NCC believes that Sydney Water's commercial aims are in conflict with its environmental aims in the area of demand management. In other words, there is an imperative to sell water.

The Committee should consider recommending penalty pricing by the Sydney Catchment Authority [SCA] when Sydney Water buys water from the SCA in excess of its operating licence targets. This has been proposed by us, but not at this stage supported by the Independent Pricing and Regulatory Tribunal [IPART]. The NCC also requests the Committee recommend the adoption of an ecologically sustainable consumption target for Sydney which would avoid the development of a new dam and ensure environmental flows for the Hawkesbury-Nepean. The overall annual draw from Sydney dams which meets these objectives is around 500 billion litres or 5 gigalitres per annum and we are currently using something towards 600 billion litres, or a bit less, in the current water

restriction climate. Meeting such a target in the face of population growth will require constant improvements in recycling and water conservation performance. However it is not an impossible task as the volume of water available for recycling, that is, currently flowing into the sea from Sydney's sewer and stormwater pipes, does exceed this total volume. I think that is 450 gigalitres a year from the sewer system. I do not have a figure for the stormwater system, but no doubt you have heard one by this time.

Sydney Water's demand management performance would be worse if it was not for the water restrictions imposed in the current drought. We favour the continuation of low level water restrictions on a permanent basis. The restrictions should involve the following limitations: No hosing of hard surfaces at any time and no use of garden sprinkler systems in daylight hours between 7 a.m. and 7 p.m.. In relation to investment in the system, we support both public and private investment in Sydney's water and waste water systems in the most efficient mix, using joint venture and contractual models which should be sought. The NCC does not support privatisation in general as there is insufficient competition in the supply of water and waste water services at the present time to protect consumer interests.

In relation prices, we say that prices have been too low for many years for water. The first 10 years of IPART decision making saw the urban water price fall significantly in real terms. You could say in IPART's defence that this was a function of making the water industry more efficient so it was not entirely a bad thing. However, with the price of water falling in real terms, the incentive for investment in water conservation was low. Recent IPART determinations have gone some way to correcting this trend and price increases have been allowed which are considerable and likely to make a difference. Prices for recycled water need to be high enough to promote investment and low enough to make the product attractive compared with the price of mains water. Also, we have been a strong advocate of inclining or stepped block pricing so that people who use large volumes of water pay more. This has now been approved by IPART, we are glad to say.

In relation to institutional and market reform, we observe that Sydney Water's corporatisation some 10 years ago has been wound back to such an extent as to be pretty meaningless today. The organisation seems to behave more like a government department with short-term political considerations entering too much into its decision-making. Sydney Water may also lean too much towards maintaining and expanding its big system in which it has a very large investment, and its whole culture is directed in that way. The result is that decentralised and innovative models of water supply and wastewater management are stifled.

One means of addressing this that we have put forward could be to award government subsidies for sewage, water supply and stormwater infrastructure on an open and competitive basis. Another may be to establish a water conservation credits trading scheme to promote private sector involvement. With relation to IPART, as an institution it might be improved if it were given a more independent statutory charter. We say that a seat on the tribunal should be established for a member with environmental expertise. That concludes my remarks today, Mr Chairman.

CHAIR: Thank you. A few things arise from your remarks. When you were talking about decentralised and innovative models, were you saying that Sydney Water stifled those opportunities? What were you talking about there? Were you talking about sewer mining by industrial interests, or were you also talking about opportunities in domestic situations?

Mr PRINEAS: Well, yes. When you have a new development, if there is a proposal for somebody not involved with Sydney Water to put up a package or a cluster scheme for dealing with wastewater or servicing a new estate, that really does not get a guernsey. The places are just getting connected to the big system.

CHAIR: In your opinion, where does the problem lie?

Mr PRINEAS: If we are to get improvements I think we need to free up the system a bit. It is very rare that one party or one approach has all the solutions. Some institutional change at the edges that allows competition, ideas and proposals cannot be a bad thing. Those proposals have been put forward by the NCC and by other environmental groups from time to time.

CHAIR: Understandably, you put forward issues relating to the drought and certain water restrictions and you said that they should be maintained indefinitely?

Mr PRINEAS: The permanent ones, yes, but we say at a low level. I indicated that that would be restricted to non-hosing of hard surfaces and daylight hour use of sprinklers only. Those would be permanent.

CHAIR: What do you think of the general attitude to water restrictions? There has been a certain hardening of attitude over time. What might work in a short period could be eroded over time.

Mr PRINEAS: You mean people will become resistant to that?

CHAIR: Yes.

Mr PRINEAS: I think on the contrary. When people get used to a particular regime, provided it has a good rational basis, they are more likely to accept it. It just becomes part of the background. I have not seen any recent research about community attitudes, but my impression is that the water restrictions are well accepted. There are some people who will object, but most people accept the need for them and feel somewhat involved in the whole process of meeting Sydney's water problem by making this contribution. So I think it is a realistic response to our environmental reality. We do not have a lot of water and we should not be wasting it.

CHAIR: You recommend a major recycling project in eastern Sydney, in a vein similar to what is successfully occurring in areas in Western Sydney. Are you talking there about impacting directly on major plants and current outfalls, or are you looking at another strategy that would work for eastern Sydney?

Mr PRINEAS: If it's going to be eastern Sydney it would have to be the ocean outfalls. If you are not looking at stormwater and you are looking at the sewer system, it would be the ocean outfalls from which you would be taking the resource. So, yes, is the short answer to your question.

CHAIR: Some of the papers from the NCC went into specific detail about brine pollution, its impact on the receiving environment and the differences between that sort of pollution and current ocean outfalls, where there is greater potential for dispersion. Do you see specific problems emanating from any plant raising salinity levels in the receiving environment?

Mr PRINEAS: Are you talking about the proposed desalination plant?

CHAIR: Yes.

Mr PRINEAS: We said that there would be a problem with brine, but I am afraid I am not in a position to go into the technicalities or the detail of it. However, I could get more information.

CHAIR: I would appreciate it if you took that question on notice. With the dredging of Botany Bay do you have specific information about toxic sediments?

Mr PRINEAS: No, I am sorry. I am afraid that I cannot help you on the specifics of that.

The Hon. PATRICIA FORSYTHE: In your opening comments you made reference to the Californian system of recycling ground water. I think you said that much research was needed. We heard evidence this morning from a witness who suggested that much research has been done. He gave us a fairly good example of the Californian experience. Was your comment a suggestion of scepticism on behalf of the NCC, or do you simply believe it is not a system for Sydney?

Mr PRINEAS: No, I do not. That is not intended to say that it is not a system for Sydney; it is just that we are rather sensitive to the sudden interest in ground water by the Government. We do not want everybody rushing towards ground water as a solution without doing the necessary homework and carrying out the necessary studies, knowing the nature of the resource and the capacity of the resource, mapping aquifers and so on. I think there would be a longer lead-time if you were going to introduce that in Sydney to satisfy all these requirements. I do not know how much work has

been done on ground water in Sydney, but I imagine that it is not a lot. If you have received evidence to the contrary I would be very interested to hear about it.

Ms SYLVIA HALE: You said earlier that the size of the market for non-potable water was doubtful.

Mr PRINEAS: Yes.

Ms SYLVIA HALE: Why do you say that?

Mr PRINEAS: Because we have lost a lot of our secondary industry, which would have used a lot of that non-potable water over the years. If you are to have a non-potable water source you need a fairly large user concentrated in a specific geographic location. We do not have that to a large extent. There is a big problem with reticulating the separate water stream because of the cost. I have not seen any figures recently. When we were talking to Sydney Water about this a long time ago—maybe even 10 years ago—they said it would cost $5 billion to retrofit Sydney for dual reticulation. Maybe it would be double that now, I do not know, but those are the sorts of figures. That is a bit of a problem when you are looking for a way of reducing Sydney's sustainable water problem.

Ms SYLVIA HALE: When you were talking about initiating another major re-use strategy for eastern Sydney, you said that should be based either on stormwater harvesting or on sewer mining?

Mr PRINEAS: Yes.

Ms SYLVIA HALE: The Committee received evidence about the difficulty of stormwater harvesting, namely, requiring large areas in which to store it and the variability of the flow. Do you have any comments on that?

Mr PRINEAS: I agree that there are problems. I understand that such water may be expensive. However, it is a myth to think that all the water we use in Sydney is sourced at the same cost. There is a variable price for water; we just average it out and charge people an average amount. The truth is we are at the end of our cheap water and we will have to exploit more expensive options now. Perhaps stormwater is one of them. I would not rule it out just because it is difficult. Unfortunately, I did not come equipped with plans, drawings and a final proposal. I am not an engineer, so I would not try to. I think we need to think big and think laterally if we are to get a sustainable water supply system. So we have to look at this seriously.

The Hon. HENRY TSANG: Earlier you referred to demand management.

Mr PRINEAS: Yes.

The Hon. HENRY TSANG: What do you recommend as best practice for Sydney Water in relation to demand management?

Mr PRINEAS: They are doing many things. There are two approaches—the price approach and the non-price approach. After a long period of not doing anything we are addressing the price approach by looking at the price of water, its relative price with recycled water, making sure the relativities are correct and making sure the prices are high enough.

The Hon. HENRY TSANG: So that part is done?

Mr PRINEAS: It is not done but at least we are on that path. The non-price approach has worked. Again, a lot has been done. We have a basic system that requires a certain performance in water conservation from new housing developments. I believe that will be extended to existing houses when they are renovated, if it has not already been extended. We have a scheme that promotes the purchase and use of water-conserving products, like front-end opening washing machines and so on. We have the basic cheap retrofit—$25, I think it is—which I have done in a house, which is good. I think many tens of thousands of houses may now have this. All these things are contributing but there is more that could be done.

If there are any obstacles to people wanting to install rainwater tanks and reticulate grey water into their gardens, those obstacles need to be removed. There may still be some at a local government level or at the health level. We should ensure that those obstacles are removed so people who want to do that in a reasonable situation are allowed to. Unfortunately, as I said earlier, all the things that have been done are not getting to the target. Sydney Water has a particular demand management target and it is supposed to reduce the per capita demand by so much by certain years. That is in its operating licence. Unfortunately, it did not meet the last target and, without water restrictions, it is not on track to meet the next target, which is about 2010 or 2011.

CHAIR: What are the implications if it does not meet targets? Is anything written into the contracts? I guess it gets back to the sale of water being at odds with conservation.

Mr PRINEAS: The implications are that they get a rap on the knuckles at the board level, I suppose, because nothing much has happened so far in terms of sanctions. A sanction that we would like is for Sydney Water to have to pay a penalty to the Sydney Catchment Authority for water in excess of the target, so that it would feel the impact on the bottom line. That has not been taken up.

CHAIR: Has that been suggested?

Mr PRINEAS: Yes. It was very thoroughly vetted with the Independent Pricing and Regulatory Tribunal [IPART], but IPART did not take it up. It looked like a possibility that was being considered seriously, but in the end IPART did not take it up, for reasons that I am not quite sure of. It seemed to me to be an appropriate thing to build into the system, so that the commercial gain from selling all water above the target would be cancelled out and maybe as well they would feel a bit of pain as well by the imposition of a penalty.

The Hon. GREG DONNELLY: On the use of grey water and rainwater, you said a moment ago that you thought the obstacles that acted as a brake on the utilisation of those two forms of water should be removed. Should that be without any qualification?

Mr PRINEAS: No. We live in a civilised society, and there is going to be regulation, and people have to have their health protected—subject to all those rules. But we need to make sure that rules are not being applied without good reason. If there is no really good reason why you cannot reticulate washing machine water on your garden, or have a rainwater tank without expensive plumbing, fixtures and add-ons, there should be no reason you should not be able to do that.

The Hon. GREG DONNELLY: Has the Nature Conservation Council done some particular work on trying to assess the contribution that better utilisation of rainwater tanks would have on Sydney's water supply?

Mr PRINEAS: Yes, I think we did in our last study, which was funded by Sydney Water. For our last Sydney Water project we did have a consultant who looked at that. I would have to get that study and send it to you.

The Hon. GREG DONNELLY: That would be appreciated.

Mr PRINEAS: And I will put you in touch with that person.

The Hon. HENRY TSANG: In your submission you mention that desalination plants should be subject to a full environmental impact statement, rather than an environmental assessment. What is the difference in the two processes, the environmental assessment and a full environmental impact statement? Is there much difference between them?

Mr PRINEAS: I believe there is a lot of difference. We are talking about the desalination plant being approved as critical infrastructure under new rules that avoid some of the checks and balances and environmental investigations that would have been done normally. One of those was an environmental impact statement, which is a pretty full consideration of the project and its environmental impacts and the alternatives. You are not getting that under the new legislation, part 3 (a) I think.

Ms SYLVIA HALE: Yes, part 3 (a).

Mr PRINEAS: You are just getting some tick-a-box approach, which is—

The Hon. HENRY TSANG: So the environmental assessment itself is just a tick-a-box approach?

Mr PRINEAS: Well, it is cursory compared with an EIS. It is like the study you do before you decide whether you are going to do an EIS, and it is not sufficient. The Nature Conservation Council and many others in the community have expressed concern about the weakening of environmental controls implicit in the changes to the planning Act. It is one thing to have controversial proposals put up, but it is quite another thing to have them put up under a regime that does not allow them to be properly assessed.

The Hon. HENRY TSANG: The result would be the same though.

Mr PRINEAS: You mean you are going to get it under either?

The Hon. HENRY TSANG: Either one would indicate that it is either environmentally sustainable or it is not. It is just that one spends more time and money, when the cheaper process should indicate exactly the same.

Mr PRINEAS: I am a bit hard-bitten having been involved in the environment area for many years, but I am not that cynical that I think an environmental impact statement never produces a better decision. They often do, because in the process of carrying them out the proponents see better ways of doing things. You may not hear about the changes that are made because they are made before the environmental impact statement actually reaches the street. But, in the process of getting the consultants in and doing the studies, things happen and things change. Anyway, that is a big subject.

Ms SYLVIA HALE: Do you believe that the benefits of increasing subsidies for the installation of rainwater tanks would be sufficient for the Government to go down that path? I understand people complain that the cost of buying the tank in the first place is one thing, but that the cost of getting it installed and working is another. Do you think more incentives for the installation of tanks would be a good thing?

Mr PRINEAS: I think we need more incentives to install tanks, yes.

Ms SYLVIA HALE: Have you put a figure on the cost of that?

Mr PRINEAS: I have not. But, again, I will go back and have a look at our last study, which involved some work on rainwater tanks by consultants, and see if I can get that report. It may have something in it that might be helpful. Can I do that?

Ms SYLVIA HALE: By all means, with the Chair's permission.

CHAIR: Certainly. You have raised a number of things that you could take on notice, and the Committee would be happy to receive that further information.

Ms SYLVIA HALE: Have you any other suggestions, other than water restrictions, rainwater tanks, the $25 adjustment for installation of water-saving shower heads and whatever, as to what individuals might do?

Mr PRINEAS: No. Earlier I discussed more efficient water-using devices. The washing machine is the main one. The modern, front-loading washing machine will save a significant amount of water over the breadth of Sydney if enough people take it up. That is another thing that can be done. I think I have pretty much gone through the gamut of reasonably possible things to do at the moment at the domestic level. That is about it.

The Hon. RICK COLLESS: Following on from your comments about washing machine and tank subsidies: If the subsidies are good enough to be applied for the community of Sydney, should they not be applied for other communities in New South Wales?

Mr PRINEAS: I imagine that it would come from the water supplier.

The Hon. RICK COLLESS: It comes from the State Government, does it not?

Mr PRINEAS: You are right. Did you understand me to say that it should be limited to Sydney?

The Hon. RICK COLLESS: The point is that both the washing machine subsidy and the rainwater tank subsidy do not apply outside Sydney, so that people living in communities like Dubbo, Tibooburra and other small communities, and people living on farms—myself included—who pay a lot more money for their water than do Sydney people, because our own water storage, reticulation, pumps, maintenance and so on is all at our own expense—do not get any subsidies.

The Hon. HENRY TSANG: Demand management.

The Hon. RICK COLLESS: We have demand management anyway, because water is so scarce in our communities. The point is: do you think the subsidies should be applied across the board?

Mr PRINEAS: It does make sense from a social point of view, yes.

The Hon. RICK COLLESS: In relation to the desalination plant, do you consider that the situation may arise at some time in the future where a desalination plant simply will be needed in Sydney?

Mr PRINEAS: I listened to the last witness, who said, "once Sydney is a desert and there is no other opportunity." But I hope we never get to that point.

The Hon. RICK COLLESS: On the issue of stormwater harvesting in the urban area, we have heard from other witnesses that it is a very expensive option. I think you alluded to that in your evidence today. Do you think it would be more expensive than a desalination plant, both in terms of capital cost and also operating costs?

Mr PRINEAS: I do not have any figurers on that, and I have not seen a really good scheme, proposed by anyone, which has been costed. So the jury is out on that. If you have been to Europe and visited a medieval city, you will know they all had that sort of system. They are probably not using it any more, but they all had that kind of system. They used to have big underground cisterns that collected rainwater, and that was how those people got their water. So there is precedent for it. If it worked at one stage in our social evolution, it might work in our modern cities, with modern technical modifications and all the knowledge that we now have.

The Hon. RICK COLLESS: Earlier you spoke about the need for advancing a case for water reuse given rigorous science and so on. Do you agree that many of the statements you make in your submission should also be subject to the same scientific rigour?

Mr PRINEAS: Yes. We are happy to have the scientific debate and let everybody's arguments be subjected to rigorous criticism.

The Hon. RICK COLLESS: Many of the statements that you make in your submission do not appear to have any scientific research references supporting them.

Mr PRINEAS: Which submission are you talking about?

The Hon. RICK COLLESS: I am referring of the submission on the Sydney desalination plant at Kurnell. To give you an example of what I am talking about, under the heading of "Potential significant impacts on the green and golden bell frog" your submission states, "It is thus possible that

the proposed desalination plant is likely to have a significant impact on this species." Could not somebody else have written that statement as simply, "It is thus possible that the proposed desalination plant is unlikely to have a significant impact on this species"?

Mr PRINEAS: They could, yes.

The Hon. RICK COLLESS: Where is the scientific rigour in that statement?

Mr PRINEAS: We are not a scientific body. We are the Nature Conservation Council of New South Wales, and we are a community environmental organisation. We are not a body of scientists. The positions that we put, although they are reasoned and logical, and wherever possible are factual and informed by science, are not always informed by science because the science has not been done.

The Hon. RICK COLLESS: But, Mr Prineas, I have got to say that when I read through some of these statements I am concerned that they are being written, and accepted, as truth, when in fact they are nothing more than anecdotal statements. All through this submission there are terms like "may kill", "could sink", "potentially causing adverse impacts", and "may avoid". There are no definitive statements in there at all; they are a collection of anecdotes being put forward as the truth.

Mr PRINEAS: There is a well-settled approach in environmental management, accepted by scientists, called the precautionary principle. A lot of material simply relies on that. If you do not know what the effect of something is you should be careful about doing it because you may have this impact and you may have that impact. I think it is legitimate for an environmental group to rely on the precautionary principle in the absence of information in assessing a development like the desalination plant.

Ms SYLVIA HALE: You mentioned that one of the things the Government should do is review the trade waste disposal and source control.

Mr PRINEAS: Yes.

Ms SYLVIA HALE: Do you have evidence that it is not working adequately at the moment?

Mr PRINEAS: I think it is working adequately if you do not want to reuse that resource. If you are just pumping it out to sea it probably is working all right, but if you want to reuse it for something like indirect potable you will have to look at it much more carefully than we are now. Trade waste probably is one of the things you do not want in there. You have to direct that into some new stream, waste stream. That is why we are making that point.

CHAIR: You have had quite a bit to do with Sydney Water bureaucracy over the years, as an advocate for conservation. Trade waste certainly has been a debate that has gone along with the convenience of ocean outfalls.

Mr PRINEAS: Sure.

CHAIR: You referred to the sale of water being at odds with conservation. From your perspective and your experience can Sydney Water deliver? Do you see an infrastructural bureaucracy there that can change and adapt to the requirements that are in focus with public debate at this point in time? I have had concerns with the culture of pipes out to ocean and not enough attention given to more creative options. As the Committee has said previously, there needs to be a suite of options. Can Sydney Water deliver on that suite of options or part of it? If that is not the case, could you suggest any changes?

Mr PRINEAS: I think it probably was a better organisation under the corporatisation that took place originally, when it was a bit more distant from government on a day-to-day basis. It was surer of its own direction then and could plan better. But the corporatisation has changed, you know that, from being a true corporatisation to one of these neither fish nor fowl corporatisations where it is in government but not in government. The Minister is taking a pretty strong role in appearing to head the organisation. I am not sure that is in the best interests of anybody. I would think that if it went

back to its earlier corporatised model and had the right people running it, it could do a reasonably good job. I think it should not get any bigger. For this big organisation to keep getting bigger probably is not the way to go. But there are other arguments. If you are going to get serious about accessing the sewer for reuse resource then, as some people have said, maybe it is better to have it in one system because then you can get at it all.

I do not have a definite view about the future shape of Sydney Water. It is more important that the organisation be given a proper charter and the capacity to address it without too much day-to-day politics entering into its decisions because a lot of the decisions have to be made about the long term. A lot of these projects have long lead times, and results and outcomes are years down the track. You cannot run it as a political exercise. That is the most that I could say about Sydney Water right now. I do not have any dramatic scheme that I can put forward to break it up. Some people want to break it up on functional lines and some people want to break it up on geographic lines. I just do not know whether those are going to get you a better result than you have now, I am afraid. But we should look at it. Institutions are an important issue. I do not know whether you have had much evidence on that, but I think it requires a good look.

CHAIR: We have had some criticism, and we will have Sydney Water representatives here for further questioning. Thank you very much for your input today. I anticipate the further information that you will be able to supply.

(The witness withdrew.)

(Short adjournment)

NICHOLAS JOHN ASHBOLT, Professor, Head of School of Civil and Environmental Engineering, University of New South Wales, Sydney, affirmed and examined:

CHAIR: In what capacity are you appearing before the Committee? That is, are you appearing as an individual or as a representative of an organisation?

Professor ASHBOLT: I am appearing as an individual. However, I also represent a group. We call ourselves the Kensington Group, which is a group of academics, within the University of New South Wales and a few outside, on issues to do with sustainability.

CHAIR: Are you conversant with the terms of reference for this inquiry?

Professor ASHBOLT: Yes, I am.

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate the fact and the Committee will consider your request.

Professor ASHBOLT: I am happy for all my evidence to be open.

CHAIR: Would you like to make an opening statement? I understand you have a PowerPoint presentation. Would you like to run through that presentation for our benefit? Each of the members of the Committee will then have an opportunity to ask questions.

Professor ASHBOLT: Certainly. There is also a copy of the presentation in front of each of you. My main points to put to this Committee for consideration relate to process. How do we go about determining what is a sustainable solution to Sydney's water services? I use the term "water services" deliberately, because it is not just drinking water. If we provide drinking water, we produce wastewater. We need to be looking at it holistically.

My sense is that we are missing some opportunities because of the nature of the current process that has been applied. I would like to give a history to that, to build up to a possible model for how to better get consideration and all stakeholders active in the process, and indeed to identify that when we go through such a process other options suddenly become apparent, which currently are not being considered for Sydney as far as I am aware.

For example, we take the revised February 2006 comments in the Metropolitan Water Plan to do with recycling. The plan states clearly that the Government has undertaken detailed planning and it is now going to call for expressions of interest in a proposal that takes some 35 gigalitres from the inland sewage treatment plants to put into the Hawkesbury-Nepean for environmental flows. On what basis was that decision made? Why is that considered a useful step forward in recycling? I get the impression that it is not being looked at holistically. Is that the best way we can spend our money in getting recycling? Is that the most sustainable solution?

In essence, it is a useful step. I am not against the step per se; I am against the apparent lack of process that has been followed to come up to: Why push that versus some other option? If there are a range of other options, including indirect potable reuse into Prospect Dam or Warragamba Dam, or indeed having homes that totally recycle themselves, in a sense of rain water and other ways of dealing with water. I am not seeing that looked at in a holistic way.

We have had government statements in the past such as this: "It is beyond debate." So there is stifled debate, if any, in some of these areas, which concerns me. The comment down the bottom there is more of a global one: that we cannot really be sustainable without really taking on board the cultural and other human aspects to do with water.

The history of decisions made in this city for water are rather driven—but not solely driven—by various crises. We could start with the Tank Stream. The pollution problems there led on to Busby's Bore, and so on. We could go through the Botany Swamps. Really, from there on, all of these

were driven by droughts. We had certain droughts when the Nepean scheme was coming on board, we had a royal commission during the turn of the last century. Cordeaux was thought of. The first date given there is when the proposal was put forward; the final date is when the actual dam came into commissioning. We have had the other escarpment ones: the Avon, Nepean, Woronora dams coming on following the droughts in the early and mid 1920s and early 1930s, each of those giving successive further dams. Warragamba Dam itself, as a weir, came on board in 1937, but it was not really built until we had a later major drought before the 1960s, in that the period that drove that one to be really necessary.

Welcome Reef was planned back in 1968, with the land purchases there. Now we have finally decided we will not build that, for the simple reason of environmental flows. We cannot keep taking more source waters from our rivers; we now realise that; I think there has been an expectation and engineering conscience that that was the way forward in the past: that we could, when needed, just harvest water from the environment. We now realise we are part of the environment, that that really is not a long-term, sustainable solution.

We have also had commissioned reports, like this one, which followed in February 2006, from a couple of consultants, saying that we now do not need to worry so much, we have some groundwaters that might feed into the system and therefore everything is okay and the desalination plant can be brought online if a drought should suddenly necessitate that. To me, this is a little head in the sand in the way of thinking; we need to be planning for the long-term future. We should not be waiting for the next drought or crisis to suddenly put on desalination, which I think many of us would consider, whilst a solution that is technically achievable, is not really the most sustainable solution, in the sense of energy, the environment and the provision of water services.

I have a resounding "No" there, that there are other options and ways of going forward. As I indicated, desalination, whilst possible, is not really sensible because the more water we put into the system, the more wastewater we generate, which means more contaminants into the environment, as currently practised. Our current systems are relatively leaky. We have an aged sewer network, there is significantly more greenhouse gas production from the desalination process, more so than any other option that has even been considered, and there is no real change in the public's use.

We have had good progress with demand management, and excellent results have been achieved with Sydney water's retrofit program, but we probably do not have much more room there. We have BASIX coming on board, another good government initiative, to look at conservation, and to look at new dwellings with regard to both energy and water conservation. We have many good initiatives, but in themselves they are not the total saviour we need, nor are they really integrating across energy and water.

Another factor that is not even mentioned in any government report I have seen so far is that nutrients currently get discharged into our environment, and we spend a lot of energy treating waste water to send the nutrients into the atmosphere as gas, and they are then lost, in the form of nitrogen gas.

My main push is that there are now better ways of doing this. I have been part of a project funded by the Swedish Government called the Urban Water Program, which over the last six years has developed a sustainability toolkit, if you like, of how to look at sustainability in a more holistic way. The diagram here illustrates that. The web site is given there, if you are interested. We are going through this process realising we have users, the public, we have organisations, the governments if you like, and we have technology, all interacting. When we are considering what is sustainable, we need to look across those five basic principles of sustainability: human health, environmental health, the cost—that is the life-cycle cost, not just the current pricing, short-term financial side—the socio-cultural issues—do people want to use these systems, will they use them, what changes are needed—and the technological function.

To me, sustainability is integrating across those five principal aspects. I do not really see that debate happening at this stage in our decision-making processes. When you go through that type of process, you start looking at what are some of the other likely trends. What do people want to use water for? We clearly understand the environmental flow needs at the moment, but what about carbon

credits? They cannot be far off for Australia. How will that suddenly change the short-term vision of current economic crises versus a macroeconomic assessment of where we are going?

Clearly, phosphorus is a limited resource globally. We are going to run out of phosphorus in many parts of the world in about 70 years, and perhaps in 150 years in parts of China, where the main reservoirs will be left. We need to be recycling the nutrients that are part of the urban production by generating waste waters. Currently, the vast majority of those in Sydney go out through the ocean outfalls. It is a shameful waste, if you think about it in the sense that those nutrients will not be reclaimed as phosphorus by that process.

Of course, there is also the increasing cost of maintaining such large pipe infrastructure. If we are talking about third pipe infrastructure, there are also the long-term ramifications of that. Through the work I have undertaken with the Swedish Government, we were commissioned by the Water Services Association of Australia as part of an ARC discovery grant and linkage grant to look into better ways of looking at sustainable urban water systems.

So the Water Services Association of Australia commissioned us, along with the Total Environment Centre and the Australian Government to come up with a better sustainability framework, which we have now delivered, and it is the second item I have given to you in the second handout. That is purely the executive summary. It does say "commercial in confidence"; that is as it was produced last year; you will see the date on there. The Water Services Association of Australia have now approved that, through their board, as a public release document, although it has yet to be released publicly. But they are happy for me to disclose it and there is the full report available also with the secretariat here.

But the process is the important point. It is a six-step process and I do not want to bore you with the details of the process other than to say each step involves public and other stakeholder participation—very much so in phase 1. What are we really needing here? We are not just needing more water for the growing population of Sydney, we are needing water services, which means certainly some drinking water, but only 10 per cent really needs to be of drinking water quality for household use. So we need water services, not just drinking water, and how best to provide that service with human environmental needs particularly being identified? These are just working through and brainstorming a range of options. Again, the generation of options seems to have been done within the bounds of a few government organisations and not in a public way. The missed opportunity here is the lack of diversity of options that would have come forward via a more open process. We have got good instruments here in the form of PENGOs and other peak environment groups, as well as other organisations that can assist in this type of process, but we are not harnessing that energy from our local community.

They are the basic criteria. I mentioned the five for selecting options. The last point I want to make about phase 5, although not mentioned, but it is in the executive summary I have given to you, is that there are now tools available to look at, in a much more holistic way, the environmental impacts, the human health impacts and the life cycle costings—that is through the whole lifetime of our system—structures that we are considering as options here for Sydney. There is not one solution for Sydney, there are many, and many of the proposals so far on the table are a good step towards that. My main concern is the lack of vision for the overall integration of those and the government levers, if you like, and carrots to give better incentives for these to happen.

Just to give an example of a lost opportunity for what I have said, household grey water recycling: in the document of February 2006 it does state that recycling is going to be a major push, and I wholeheartedly say that is a great thing, and the Government is now pushing water recycling more so perhaps than it appeared to before. But one area they have also open slather to is companies that produce grey water recycling devices, so people can purchase these, if they are approved devices, and put them in their homes. In some ways that is quite a risky way of going about it. Let us identify the home owner's needs offsets. Most people will not want to spend $6,000 for a grey water recycling system for their own home and, perhaps, why should they? They do not contribute upfront costs for the sewer pipes and other things that mean being connected to the sewer in the same way. So the lost opportunity here is to work with the companies that can produce these devices and the agencies that can maintain in the long term the functionality of those devices.

The other advantage is that it gives enormous flexibility. These devices may last 15 to 20 years; they will be naturally serviced, but after that time they can be upgraded with the latest technology. We do not have that opportunity with large desalination and other types of plants. Those structures are in place for a lot longer and there are a lot more upfront costs there. So these are built on as needed and as houses are renovated. I have left a few other points there without going into it, but there is the issue of cross connections. Rouse Hill and Newington, whilst an interesting concept of having a third pipe, really do suffer from cross connections. Whilst we can become smarter at detecting these—indeed some of my colleagues may have mentioned that this morning at the hearing, I do not know—and there are methods to improve on that, why put up with it in the first place? We can deal with water recycling within the home where people are already exposed to most of those hazards in the home far more so than they would be through some minor accident in the grey water system. So it is actually a lot safer to be recycling within homes rather than taking communal wastewater, treating it—and therefore treating it to a high level—before recycling it back to those homes. It actually uses more energy, more infrastructure in pipes, and is not as safe.

So this is a lost opportunity, in my opinion, and people might have written it off as being too quirky, but it is really not if you look at the long-term vision of where this can go, and economically it makes sense. It makes sense energetically if you package it also with solar power or some other localised source of energy. So the whole package needs to be considered, and I would strongly encourage a recommendation from this Committee, if it is feasible to say such a thing, to consider at least the integration of water and energy services at the domestic level; to give the right incentives for that to be encouraged. If you look at that in the life cycle cost, if you look at that in an environmental cost, it makes a lot more sense. You do not need to build another coal or gas-fired power station for a desalination plant, we have the local community producing that with their own tanks. So I really do believe, as written there, that this, in the long term, is a cheaper option both for the brown field refits as well as the current green fields where dual reticulation has more or less been mandated now through BASIX.

So why are we not doing this? It is, in part, the nature of the institutions that we have that govern and manage water service provision. In some ways Sydney Water are basically acting on what they have been told to do necessarily rather than going out and saying, " What might be the more sustainable?" It is not in Sydney Water's interest, for example, initially to be involved in small-scale water recycling systems. I believe they would probably say it is not even part of their business to be involved, and maybe that is the case, but I am suggesting strongly that somebody should and some organisation with the stability and longevity that Sydney Water has should be in charge of such a system. So we are losing that opportunity. If we could integrate energy, compostable wastes or crop fertilisers, nutrients—particularly nitrate phosphorous—in compostable waste in the sense of kitchen waste, as we have pickups every week, which cost quite a lot in transport and so forth, of the solid wastes.

There are in Singapore and parts of Stockholm in Sweden, for example, the use now of vacuum or pressure sewer mains—the equivalent of—that take those human kitchen wastes. So you can use a food waste disposal unit along with, say, a vacuum flush toilet to take the food and nutrients stream from households. This could be going through a separate small bore pipe through the existing sewer network—just a pipe within a pipe—to localised areas, and that could be connected up to, if you like, energy recovery stations. I have got some examples here of where waste to energy plants are becoming more common. These are some shots in the United Kingdom, in the Isle of Man and another site within England, just some examples of what these waste to energy plants look like. So they are taking these compostable, organic harboured waste and recovering the energy from those organics. That can be done through a range of techniques. One option I am suggesting is that it could be done, as shown in this sort of vision slide, decentrally. It could be done within parts of the community. It could be harvesting the methane and hydrogen from our food and faecal waste.

I am looking now well into the future, but we need to be looking out to the future while we have this opportunity to really re-engineer the right water waste services that our householders here want. If we just go and plug in a new desalination plant or a new aquifer recovery, it is part of the solution maybe, but is it really looking at the big picture—moving towards sustainability in the long-term? I believe that it is not necessarily the case. We need to be looking at it more holistically. I have just identified some options that could happen here. There are now valves coming onto the market that can select smartly, automatically between a rainwater source and another non-potable source in the

home. So these become cheap and simple reliable devices. We are all familiar with rainwater. I would like us to move away from the terminology of "recycled wastewater" and the use of the word "grey water" to say "purified water" so we market it better to communities; it is all part of this process. And in that marketing or other recommendation the Committee uses, to really push for icon development so we can demonstrate and get community and, for that matter, other agencies' familiarisation with these sorts of options. We are missing that. We have Rouse Hill, we have Sydney Olympic Park Authority sites for third pipe options but we do not have icon developments for other options. We have a good opportunity to do that.

In conclusion, I do not really believe we have quite the right institutional structures for the best—and we are certainly not using the best available decision-making approaches here. It seems a little ad hoc at times and certainly not holistic in the overall sense of what I have been describing. We may need to change some of the political carrots rather than sticks to get better incentives here to get integration across urban water service provision. We may well need to restructure some of these organisations. I do not really like to say that because I guess governments are forever restructuring organisations, but I am still not sure we have got it right at this stage. The Water Services Association framework, as I have called it, that my team put together through the Centre for Water and Waste Technology, gives a good starting point in the sense that it has been accepted now by all the major water utilities in this country as a framework for urban water sustainability. So let us use it. I think that is all of my formal statement.

CHAIR: Thank you for adding what might be a few new dimensions to the debate. You mentioned carrots for better integration across urban water sustainability, if I understood correctly. What are you actually referring to there?

Professor ASHBOLT: To take a particular example: at the moment householders, which are most people I talk with, say that if there was a device they could use to recycle their grey water safely and that somebody was going to look after it, they would have no qualms in having it. At the moment they have to purchase that outright, for example, for around $6,000. If there was the incentive that became part of their water service provision that they lease that; if the Government made this a more mandatory way that there were approved items for recycling that were capable technologies but they were delivered in a sense on a long-term contractual basis; so rather than just paying more water or sewerage rates to Sydney Water Corporation—that may still be paid to Sydney Water if they were the managers of this money, for example—but that the government would have a system in place to allow for other agencies to be supplying, if you like, that hardware, so it could be, in essence, leased and operated and maintained by an outside organisation professionally and for a long-term. At the moment individuals are almost penalised if they wish to be environmentally aware and conscious by having to pay for their own renovations.

At the moment the temptation is to go to a cheap hardware store, buy a grey water diversion device for a few hundred dollars and for the home handyman or person to do that themselves. That really delivers the worst outcome: potentially a health risk; uncontrolled grey water recycling, to some degree—and not very effectively, just to the garden.

CHAIR: How does that fit with the Government's announcement that it was removing from local councils the power to control grey water reuse in a domestic situation? You are seeing this as a retrograde step? Do I understand you appropriately there?

Professor ASHBOLT: It is my understanding that the document in February this year is saying that the home person can now not only put in their own rainwater tank of up to 10,000 litres but can also put in their own grey water and treatment system without any council approval. It is retrograde, in my opinion, in the sense of what might happen and how might that be done and who was going to be able to police that. I would much rather see a much more formal approach: an organisational structure to maintain and operate those systems. We know from years of experience with septic tanks and other sorts of on-site wastewater treatment systems that the home owner or renter of a property does not maintain those sorts of infrastructures. They may be keen and excited in the first five or even ten years, but we are talking about longer lives than that, and someone who is coming in and renting a place does not have the same interest or incentive.

I do see the current proposal as going in the wrong direction. I would like to see a carrot that there was support for either a private or public—I do not mind which—organisation that would maintain and look after the provision, but that would be a necessary council-approved maintenance contract, if you like, for such systems.

CHAIR: So you are recommending that local councils be involved; that grey water systems have ongoing monitoring of some sort and one could even be looking, for example at, one of my pet things, compost toilet systems, that would have some sort of authority, which would be local employment, both to install and to monitor. Could you expand on that?

Professor ASHBOLT: The critical link is that there needs to be an outside professional organisation maintaining these sorts of on-site systems. That is extremely clear from the last 100 years or so of experience with septic tanks and absorption trenches. There is no question there. That is one of the reasons why we have a large centralised water service and wastewater provision, because of that inherent problem with individuals not being able to look after their own backyards, if you like. We need Sydney Water to be charged with the brief to also maintain and manage such on-site systems, or government incentives that will allow other organisations to come in and provide that.

Ms SYLVIA HALE: In relation to that, you mentioned a figure of $6,000 if a private individual were to do it. Would you expect there to be considerable economies of scale if it were, for example, mandated for a particular local government area?

Professor ASHBOLT: You need to talk with the people producing these things but these are early days in the evolution of these grey water recycling devices and there have to be improvements both technologically and of course in production. There is nothing better than having a larger market for that. Whilst I cannot answer that specifically because I do not know the truthful answer as to how much the price might come down, I suspect quite considerably. Therefore, there are many gains to be made by, if you like, mandating that people can have one of five or six or whatever the number might be—as new devices come on the market they can be approved and, if they pass the approval process, brought into that—and if there is an agency, for want of a better word, to make sure they are maintained and regularly checked and updated as technology changes. The devices on the market at the moment come with cell phone-type connections and when they sense a problem they automatically telephone the supplier—who could be the local plumber. They are a lot safer than the current system whereby we rely on someone noticing that there is a flood of sewage in the back garden and calling the local plumber.

The Hon. PATRICIA FORSYTHE: You made reference on one or two occasions to programs in Sweden. Is there any reason why we cannot make a comparison with Sweden, in the sense that the density of Swedish cities is, as I recall, greater on the whole than in Australia? Is there any reason why, if the Committee were to look at some recommendations in relation to, say, models from Sweden, that it would not be a good comparison?

Professor ASHBOLT: My comments on Sweden were more related to developing a process to evaluate sustainability. Sustainability is not a fixed point; it is a continuum. We are always striving for a more sustainable solution. It is the process of deciding on how to make the system more sustainable. That is what we can learn from the Swedes, or what we have learned from the Swedes and even now have implemented in this national framework. You are right that there is certainly more of a Kings Cross density of dwellings in major cities such as Stockholm and Gothenburg. The actual solutions, therefore, may well differ. You are talking about large apartment blocks with water recycling systems, whereas here in Sydney we are largely, though not solely, talking more of single or small duplex dwellings. So the technological differences will be there but the process is the same of how to select for the mix of systems to be more sustainable—geographically and demographically and how people live.

CHAIR: It might have been in an interview that I read that you said you were favouring grey water systems over water storage systems on site because of the lack of opportunity with limited area and such like. Most households have car garages and there are immense areas for storage underneath those garages. Is there any opportunity there to change the culture so that we see water storage under those areas that would not be otherwise used?

Professor ASHBOLT: In most dwellings out towards Cherrybrook and the newly-developed areas there have been stormwater retention basins by law by councils in those areas. Typically that is under the carport or driveway area, so a lot of these do exist in houses that have been built on that scale in that part of Sydney. The answer is yes, you can store water underground, but when you want to start to recycle water, water underground, whilst it is good aesthetically, there is no tank in the way and it gives the appearance that there is no other change, there is always a slight hesitation, in my voice anyway, that there are risks that you do not notice, in the sense of cracks and leaks into underground storage tanks. There is some inherent risk that, over the longer term, with regard to a lot of underground storage tanks if that water was being recycled in the home, in the sense that there might be a broken sewer leaking into that tank. There is that potential with subsurface storage containers.

The other point that you might be referring to is that compared with rainwater you only need a 1,000-litre tank to collect the dump from the bath, shower and washing machine in one day. That is treated on the same day and the water is recycled back into the home into cisterns for flushing toilets, for clothes washing and, if you like, excess into a storage tank because it is now stable and it can be kept for garden irrigation. I would be happier with underground storage if it were to be used only in the garden for irrigation purposes. Even then there are risks because if faecal contamination was to come to that water there is the likelihood down the track that someone mighty accidentally or deliberately drink some of that water whilst in the garden, so there is potential increase of risk through subsurface storage containers.

CHAIR: You referred to Sydney Water not been suited to this obvious small-scale—

Professor ASHBOLT: Not so much "suited". I guess talking with people at Sydney Water they say that that is not really their business.

CHAIR: Perhaps this is inappropriate but what about BP, the big petrochemical company, going into BP solar, for example. It is making something that, on the surface, would contradict its main area of economic interest and yet it has successfully moved into that area. Why could there not be a change of culture with Sydney Water?

Professor ASHBOLT: That is one of the carrots I was referring to. It can happen within the current corporation in which the Government has shareholdings. Indeed, in my opinion Sydney Water would be a very good organisation to look after these decentralised systems. It exists already and has a lot of the expertise in-house, but it does not have the current manpower. That is perhaps the thing that worries me the most, the resources to administer it. But it has everything else in terms of systems in place for such a thing.

CHAIR: What is stopping something that could well be a profitable enterprise? Is it that cultural issue?

Professor ASHBOLT: It is partly not seen as profitable for some people. There are small companies coming into the market and larger agencies with takeovers happening over the next few months. Some of the small companies producing grey water systems are being bought out by larger organisations literally as we speak so that they can better market and finance to customers these sorts of grey water recycling devices. The market forces are, if you like, playing at that level. I just think it needs to be actively encouraged further, to really be pushed along. I suppose half the problem is that we are not doing full life cycle costing of the sorts of infrastructure upgrades we are currently considering with water recycling, or for that matter with desalination. We are not looking at that over the lifetime of those structures, what are they really costing us. When I say life cycle costing, it is really the raw materials that go into the hardware that is used throughout the whole life of those structures and their disposal. When we start doing that, plus getting some restoration of environmental costs, the economics look very different. We need to develop the skills for that sort of analysis. That is another holding back at the moment, that we do not have organisations with the experience and skills for doing these life cycle costing estimates. That is another thing that needs government incentive to encourage that and, if you like, legislate the life cycle costing or some rudimentary form of that should be advocated to demonstrate why this option is being considered or advocated.

The Hon. RICK COLLESS: I am very interested in your comments about the nutrient reclamation aspect. When you talk about nutrient reclamation are you referring to the nutrients that are contained in both the liquid form and the solid form?

Professor ASHBOLT: I am. Furthermore, if you are happy with a little more detail, if you are looking at the wastewater currently in a sewer, about 80 per cent of the nitrogen and somewhere around 50 per cent to 60 per cent of the phosphorus is contributed just from the urine stream alone in sewage, and the urine is less than 1 per cent of the total flow in that sewer. As I have in my house as a demonstration, there are urine diversion toilets available commercially in Scandinavia and Germany, which actually keep the urine separate in the first place. That is one option, to have urine diversion toilets. We know, of course, that urinals are already in existence through all public buildings and large public places, so we already have the potential to keep that urine separate. It adds an enormous cost because we have to put energy as well as pumping costs into removing that nitrogen and phosphorus from the wastewater stream. That is one option, in certain places, keeping the urine separate.

CHAIR: Could I just ask a question about something that is confusing to me. When is it a cost and a pollutant to be removed, and when is it a resource?

Professor ASHBOLT: There is no such thing in my opinion when talking about waste. The use of the word "waste" is part of the social problem we have in labelling themes. These are the nutrients; they are resources. They end up in our "wastewater" as currently termed, but they are essential nutrients for our society to live with. As adults, most nutrients we eat in our food we excrete in our urine and, to a lesser degree, phosphorus in our faecal matter. We can either capture it by urine diversion toilets or, as I was also advocating, by keeping the urine and faeces, and food compostable waste as a stream, which is my preferred option. It is perhaps a longer-term vision and that is where we need these icon developments, to really work towards community systems that do that. You can use much smaller bore pipes under pressure or vacuum. Technology exists today, we have it in parts of the Sydney system already, that could utilise that type of stream from the household. Taking the fruit and faeces out of the sewer makes the sewer much safer. It could then just be taking grey water and the existing sewers are so leaky they take stormwater anyway. That makes capture of the grey water and stormwater in the current sewer system, as it would then be, much simpler for treatment, groundwater recharge and local reuse. It integrates very nicely in a retrofit manner. Back to your question: Yes, those nutrients are essential for our food production. Here in Sydney we have lots of golf courses and green areas that are currently fertilised within organic fertiliser that we buy in. We would be using at least half of the nutrients that we could recover from the wastewater stream at the moment.

The Hon. RICK COLLESS: Have you any idea of the volume of nitrogen and phosphorus that would come out of the Sydney sewer system?

Professor ASHBOLT: Every person produces about 500 litres of urine per year, so 500 multiplied by the contributing Sydney sewer population is the amount of liquid urine that could be, if you like, ultimately captured and utilised. If you look at my statistics coming out of Sweden, in Stockholm they are growing wheat, rye and barley on human urine separated in just a few of these smaller communities within the outskirts of Stockholm and going for that annual crop production, and they are the sole source of fertiliser for wheat, rye and barley there. Here in western Sydney we have market gardens as well as all the golf courses, which buy in fertiliser from overseas, to which we could be contributing in a safe way.

The Hon. RICK COLLESS: Just to put some numbers on that, in my former life I was an agricultural consultant specialising in sewer management. Just out of interest, be the value of the elemental phosphorus in fertiliser is probably of the order of $2,000 a tonne with probably a similar value, perhaps a little less, around $1,500 or $2,000 for any elemental nitrogen. With those sorts of numbers in mind, the opportunity surely must be there for industry to take that by the throat and drive it.

Professor ASHBOLT: You would have thought so, particularly looking down the barrel of ultimately running out of rock phosphate for agricultural supply here. I am amazed, and I have talked with a number of people from agricultural research organisations in this State and interstate, that while they are aware of the problem, it is still politically too far out there for them to be active. So, again,

that is another carrot that government can support by actively encouraging options of discovering how we recover these nutrients that are in our so-called waste streams at the moment.

I could also present, if the Committee is interested, something that a PhD student within our school did, if you like. It is what we call a material flux analysis for Sydney of where all the phosphorous comes and goes. That very nicely puts in perspective how useful it would be to have urine diversion. So if you would like that I could submit that to the Committee.

CHAIR: I think that would be most appreciated. We would certainly like to get a copy of that.

The Hon. HENRY TSANG: Professor, I notice on this statement here you refer to the how and who that decides on the metropolitan water recycling plan, February 2006. Now that it has been decided, can you perhaps brief the Committee on whether there is any missed opportunity, as you said in the paper, in the water plan, and in your opinion, are there any areas requiring increased focus and activities?

Professor ASHBOLT: Okay. Part of that package is a new sewage treatment plant in the south-west area. We may not even need that sewage treatment plant if we were to have localised treatment within buildings or clusters of buildings, as I have been referring to. It could be quite a different plant. It could be receiving just a concentrated waste stream, so there is one lost opportunity, but maybe that is moving too quickly. We need to have some of these icon developments first, but part of that new development in my opinion wants to be along these icon developments so we would get the experience and that is part of the lost opportunity.

The 35 gigalitres a year roughly that can be harvested from St Marys, Quaker's Hill and so forth in that area is a bit of a chicken and egg situation. The amount of treatment required depends on the use. If the use is going as environmental flow, there is actually not a great deal more treatment that is needed than currently because at the moment those waste waters go into the Hawkesbury-Nepean river system. So there is not a great deal of treatment necessary to take them a little further upstream to Pheasants Nest or Camden and that area and put it into the Hawkesbury-Nepean river for environmental flow. So the missed opportunity is saying well there is another option here or there are several other options. One is the new developments, taking on different ways of water recycling, which is one opportunity lost, perhaps, and the other is to consider taking that water very close by is the Prospect Reservoir.

Prospect Reservoir, of course, is next to the largest water filtration plant here in Sydney whereas it bled in for indirect potable re-use eventually. That is seen by many as more controversial but, quite frankly, it is no different to what is currently happening for those in the lower Blue Mountains area who currently drink water from the North Richmond supply which, at times, is 20 per cent recycled waste water going down the Hawkesbury-Nepean river where the offtake is at North Richmond. In fact this would be far better treated waste water—we should not even call it waste water,—it would be highly purified water that goes back into Prospect Reservoir. There again is perhaps a lost opportunity of learning and building up to that to get people in Sydney comfortable and favourable with that as an option. Again, it is another way of saving water. There are those two types of possible missed opportunities—not that I am against the scheme, per se. I am just against how is it considered against other options and why have we gone for this one versus something else.

CHAIR: We are actually out of time. It has been very worthwhile, and time flies when you are having fun, so to speak. That is excellent information, Professor Ashbolt, and certainly we have a copy of your display. I am wondering if you would be prepared to accept more questions on notice? I have the feeling that there will be quite a few more questions that the Committee would like to ask, time allowing.

Professor ASHBOLT: Meaning for me to be here, or just by written response?

CHAIR: Written, which would mean written questions to you and from other members and also a written response.

Professor ASHBOLT: I am happy to take the questions and I guess I can say that I can answer them or I cannot answer them, and I can respond that way.

CHAIR: Yes. That is all we can ask for. I thank you very much for your time here today. It has been very valuable.

Professor ASHBOLT: Thank you for the opportunity.

(The witness withdrew)

ROBERT ERNEST WILSON, Board Member, Hawkesbury-Nepean Catchment Management Authority, affirmed and examined:

CHAIR: Are you conversant with the terms of reference for this inquiry?

Mr WILSON: Yes, I am.

CHAIR: If you should consider at any stage that evidence you may wish to give or documents you may wish to tender should be seen or heard only the Committee, please indicate that and the Committee will consider your request.

Mr WILSON: Thank you. I think it will be all open.

CHAIR: Before questions procedures from the Committee, would you like to make on opening statement?

Mr WILSON: The Hawkesbury-Nepean submission in summary is based on the premise that the inquiry cannot consider sustainability of the water supply for Sydney without considering the environmental and socioeconomic processes that depend on the health of the Hawkesbury-Nepean river. The current regulatory processes create a bias toward Sydney's all-consuming thirst, to the detriment of everybody and everything else. We believe this inquiry has an opportunity to arrest this bias and to consider the equitable management of the water supplies.

To not do so puts the health of the river and its flora and fauna in further danger. It denies people of Lithgow, Goulburn, Moss Vale, Mittagong and other southern highland towns due consideration in sharing the waters of the river, now and into the future. It endangers the livelihood of irrigators, oyster growers, tourism operators, fisher people and all those employed in the recreational industry, and fishing stocks are the lowest they have ever been in living memory. We applaud the Government's decision to introduce recycling into the management of Sydney's water supply. This at least gives us some hope that the river and its communities are being considered. We hope that recycling goes much further and that re-use of what is known, as Nick Ashbolt said, as waste water can be investigated by an expert panel and eventually introduced into the potable water supply system. I support Nick in that.

Ms SYLVIA HALE: Mr Wilson, there has been considerable concern expressed by a number of witnesses today and at earlier hearings about the discharge of water into the Hawkesbury-Nepean where it goes in, in a partly reclaimed state, and then it flows out. Do you have any comment on that?

Mr WILSON: I have a lot of comments on that. Generally there are too many nutrients in the water and the current advanced technology that Sydney Water is using will not get those nutrients out much further than they do now. I believe they should not go in at all and they should be used on farmlands and put to beneficial uses where nutrients can be of benefit. I think all the flows coming out of sewage treatment works, whether they are below the dam or above the dams coming out of Farmers Creek at Lithgow or whatever else it may be, are all constant flows and Australian rivers do not like constant flows. They like variable flows.

If you cannot get variable flows by storage manipulation, which I would have thought was easier in treatment works, with all those tanks and reservoirs and things, then you are going to cause a problem. It is okay in high flow but we are not getting much high flow at the moment and we are in a cycle of climate that is not going to give us a lot of high flows, despite the variations of El Niño and La Niña. Where Nick Ashbolt said 20 per cent of the flows were sewage-related downstream of Penrith Weir, I think that is a very conservative estimate. when I look at the water balance going past North Richmond water treatment plant, it is mainly sewage, especially if some of the tributaries downstream of Penrith are not flowing much. It is mainly sewage at the moment, and that is being pumped out by the North Richmond treatment works and the irrigators but it is leaving a lot of the nutrients in the river.

Ms SYLVIA HALE: So what do you see as the desirable approach to the use of the river?

Mr WILSON: As I said in my opening remarks, I think to put any more sewage in river would be wrong. I think the Government has done the right thing by announcing these new release areas and not putting water in, more effluent in the river. We all tend to concentrate on the Hawkesbury bit, but the Nepean around Camden is not too hot, either. There is weed infestation coming into that area and there is also blue-green algae going in there. I believe that if you look at the Hawkesbury-Nepean forums report, you will see that it is just as cheap to put in a recycling scheme for farmers as it is to upgrade the treatment works so why would you upgrade the treatment works? It is a very insular view in my regard, and I think you were quizzing the previous person about that same insularity, that it is not their business. That is one of the problems I suppose with the Westminster system—that you divide things too narrowly. But I think there is no doubt about it: The best place to put that effluent is onto farmlands along the river. You cannot develop those farmlands anyway because they are all on flood-prone land.

The Hon. RICK COLLESS: Mr Wilson, how much water are we talking about when you say if is nearly all sewage? What sort of flows are in the river at that low flow level?

Mr WILSON: I do not have those numbers but I think they are pumping out of the river about 5 gigalitres or 6 gigalitres a year at North Richmond and probably about 15 gigalitres in irrigation so that is about 20 gigalitres a year.

The Hon. RICK COLLESS: How much does the Penrith system put out a year?

Mr WILSON: I do not have those numbers with me but the Penrith treatment works could be used to top up Penrith lakes. If you put that through a wetlands, as Penrith City Council want to do, then you would take those nutrients out, if the wetlands were operated properly, and that would mean you would get a much more constant level of water in Penrith lakes. At the moment, if you pump out of the river, it is difficult to pump out of the river in low flow conditions, even though they have licences, but I think those licences will be restricted so they cannot pump out. In high flows, yes, but we are not getting the high flows so it would be better to manage the constant flows. I mean we have international obligations in that regatta area, et cetera, at Penrith lakes.

The Hon. RICK COLLESS: Where do they get the water from now?

Mr WILSON: They get it from runoff from the catchment, the subcatchment draining through Penrith.

The Hon. RICK COLLESS: So it is urban stormwater?

Mr WILSON: And a bit of leakage out of ground water, but that has not proved very effective.

The Hon. RICK COLLESS: When we talked about the 20 per cent that Nick Ashbolt talked about earlier you said it was a very conservative figure. Do the people using the water that is treated by the Richmond plant understand that?

Mr WILSON: Yes. The Catchment Management Authority has an office at Windsor. We always toast Sydney Water's supply when we have water like this at our meetings. Everyone knows and I have heard them on the radio talking about it. They understand this. Potable re-use of effluent is not a scary thing to those people because they have grown up with it.

The Hon. RICK COLLESS: Are they comfortable with it? I do not suppose they have much choice really?

Mr WILSON: Yes. Epidemiological work has shown that there is no difference in disease in that area.

The Hon. PATRICIA FORSYTHE: I refer to the wetland issue and to Penrith Lakes. Has that issue been costed?

Mr WILSON: I believe it has. I do not have those figures, but both the Penrith Lakes Development Corporation and Penrith City Council would have those figures. It would come late in the development because it would be in the area where the fines are currently deposited. They want to turn that into a golf course-recreation-wetlands area. So it would be of great benefit for residents of that area as well as for the river. That is probably the worst part of the river. The water below Penrith weir is probably the worst section of the river.

CHAIR: I was looking earlier at the interesting history relating to the northside storage tunnel. Either you or an organisation that was involved at the time said:

> The private sector demonstrated an ability to address issues within a strategic approach to water cycle management, which is different from the approach of the Sydney Water proposal. The panel believes that Sydney Water should be encouraged to undertake trials of the alternative approaches to determine their effectiveness in the Sydney region.

That panel, more or less, was looking at the northside storage tunnel with which you were involved. Does that translate across to the Hawkesbury-Nepean? How do you see the culture, the way Sydney Water is looking at the issue, and other alternatives that might be more productive for the health of the river system?

Mr WILSON: Before we get as far as west as the Hawkesbury-Nepean let us stay for the moment on the northside storage tunnel. The three people appointed to that tunnel by the Government—people who were outside government—David Harley, Ian Kiernan and me, insisted that the tunnel could be tapped and the water taken back towards Western Sydney instead of going into North Head where you have to pump up and then pump down again.

CHAIR: Was it part of the original agreement to have a return pipe on the northside storage tunnel?

Mr WILSON: Yes it was.

CHAIR: What happened to that?

Mr WILSON: I think it can still do that.

CHAIR: It has not been built into the infrastructure at this stage?

Mr WILSON: No. They still have land at Camellia. They could still tap it or suck it out of that big storage area. It is a big reservoir underneath the ground which is just elongated. Sydney Water said they could take it out so there is no need for a return pipe. There would be a need for some pipe work because of the slope of the tunnel.

CHAIR: If I understand it correctly, the return pipe that was in the original idea was to treat it at North Head and have the facility pipe it back within the system to Camellia, for example.

Mr WILSON: It was an easier thing to do. That is why, at the time I was in Sydney Water, the land at Camellia was bought. It was to intercept both the northern suburbs sewer and the southern and western sewer and to build a recycling plant at Camellia. Why go all the way to North Head when you could pick it up at Camellia? It is much nearer to the industrial areas of Sydney. I have deflected your question somewhat, but you can see the culture that thinks about big, thinks about centralism and thinks about wastewater. To use Nick Ashbolt's terms, it is seen as a waste product; it is not as a beneficial use product.

I think that same culture prevails when they think about sewage treatment flows in the Hawkesbury-Nepean. It is still seen as a waste product; it is not seen as a beneficial use product. I do not know where all that stems from. I could name plenty of people in Sydney Water who would not agree with that sort of view. People understand that, but I imagine that some culture is emanating fairly high up that is directing people to think in a more minimalist way. "We have an engineering structure in place; let us operate that engineering structure in the way the Romans invented it for us."

CHAIR: You are saying that a certain level of management in Sydney Water is using traditional perspectives to deal with the situation. But part of the problem now is developing what has often been referred to as a suite of strategies to resolve many of these issues. Why are we getting that sort of blockage? Why is Sydney Water not progressing with that innovative suite of strategies? Why does it have to be left, in some cases, to private initiatives such as Services Sydney, for example, to look at other strategies? Why does an organisation that has such a high level of expertise and history with water management in Sydney not take that step? That is not only a popular request; it is also necessary, because of the resources we have available today, to create that cultural change so we can all move forward.

Mr WILSON: There is a great deal of scepticism within the consulting industry that advises people on long-term plans. They tend to think of organisations operating in the short term. At times in the past I have seen them coming in and advising Sydney Water, "Look to the short term. Look at a couple of years plans." Sydney Water's assets last for between 31 and 150 years so they always have to look at the long term. I am surprised that is not occurring because, as you say, Services Sydney and competitors on the northside storage tunnel were certainly looking at it longer term than Sydney Water. It was looking only at short-term fixes for this. I have not looked at the balance sheets for Sydney Water for a long time and I do not know whether they are capital starved, or whether they have a non-borrowing policy. It is not always just a matter of culture; it can also be a structure of balance sheets.

CHAIR: I think it has $600 million for infrastructure. Sydney Water has a specific and significant budget for infrastructure maintenance, which sometimes is used and sometimes is not.

Mr WILSON: As I said, I have not looked at its balance sheets. Sometimes you need to borrow to take big steps. When you build a dam you borrow to take a big step; you do not expect current ratepayers to pay for an investment into the future. That has to come from borrowing into the future and then you have to pay it off. As I said, I do not know how much Sydney is borrowing, but it is time to do those things. When I was at Sydney Water I could always take to the board long-term plans that stated, "We are going to come into a drought." That is what was considered back in 1988. We knew the drought was coming, we knew the cycle was going that way and so we put in a lot of processes. Those processes do not seem to have been carried forward for some time—processes of getting better education to the public, applying water restrictions when things got tough and getting fairly big into recycling.

The Hon. RICK COLLESS: So these are things that you suggested back in 1988?

Mr WILSON: Yes and they were agreed to by the board. Some of them were implemented. Rouse Hill development, which was the largest recycling project in the Southern Hemisphere, was commenced in 1988. There was full agreement between the board and the developers that we would go down not only a dual reticulation sewage system; but also look at full management of the stormwater system for environmental as well as water conservation benefits. That was the last we heard of it until the Premier announced the other day we were going down that path again. So, yes, there is something wrong with the culture in Sydney Water. It cannot take something that was going to occur in 1988—it did occur then—and just stop it. We have had a lot of land releases since 1988.

CHAIR: So what is the solution? You have that historical knowledge. Obviously there is competition with private consortiums and there has been recent pressure. What other solution is there for that suite of options, that creativity, that seems to be called for now?

Mr WILSON: When Sydney Water was corporatised they did not really do what the British water industry did and require water companies in Sydney and in the Hunter to produce asset management plans. There was no forward thinking about what the assets were and what those assets would serve in the future. You do not even generate a regulatory process that states, "You need asset management plans that the regulator looks at and says, 'You are not planning for Sydney'". It requires good consultation with the Department of Infrastructure, Planning and Natural Resources. But that should be done. It should not just be done when we are going to build a new sewage treatment works; it should be done when we are trying to establish how to supply Sydney with water in 2030. That is what we should be looking at now. For some reason or other, 2010 is arriving and we do not seem to ask people, "How are we going to supply people in Sydney in 2010 or 2015?"

CHAIR: So?

Mr WILSON: A process is in place. Asset management programs are placing some really tight structures on them through the Independent Pricing and Regulatory Tribunal, the regulatory processes, and probably the Department of Infrastructure, Planning and Natural Resources. If you cap the water supply take of Sydney Water from both the Hawkesbury-Nepean and the Shoalhaven systems and you cap Gosford-Wyong I believe you will get innovation.

CHAIR: What innovation can you see, given your obvious history with the organisation? Is there a priority short list of innovations that would be effective?

Mr WILSON: You have to look at it in the long term. The first thing you would do is start answering the question that the Hon. Rick Colless asked, "What are people's views on the sort of water they will drink?" You have to get together a group of scientists, not only health scientists but also social scientists, to think about how you would introduce potable re-use in Sydney and you would let everyone know that you were doing that.

I would keep the water restrictions on, even if we get some rain. I think Sydney has grown up a little in the last few years in that it now once again understands it has to save water. I applaud governments that put on water restrictions at times like that. I know that politicians I talk to always get worried about those things, but I have applauded governments that have done that in the past. I think it has been a good thing to discipline Sydney. So you need to discipline Sydney. I think you need to build up recycling. You need to go to industry and say: It is your turn to start working with us.

I did some work for a former Minister and showed where industry can be quite willing, with a few incentives, such as trying to simplify the plethora of regulations that hit them all at one time, to show them that they can recycle. So you get examples, you get the farmers in the Hawkesbury-Nepean on side and show them, in a very positive way, how to improve pasture and improve production. You get the nursery people and all those sorts of people and start off in a small way. You do not hit them overnight with, "Do you want to drink water out of the toilet?" That seems to have been the question that somebody has been asking people. You have to do it in a gradual way.

But, at the same time, you have the scientific panel working away and doing all sorts of things, and you force Sydney Water to start preparing some assets management plans that anticipate where those experimental or pilot works are going, like the Hawkesbury-Nepean, like some of the work that the Government has now announced for around Camellia and Rosehill racecourse, popularise those, and you say, "Government is working. Government is going to do better with its schools, putting in rainwater tanks and putting in a whole series of recycling schemes," so that you instil throughout the community an expectation that you can save water and reuse water, and that we are no longer going to send anything to sea. I do not think there is yet an expectation in Sydney Water that would take seriously any suggestion that we will stop sending water to sea. So you have to ask Sydney Water for an asset management plan, and they will tell you how to do it. They can do it.

CHAIR: To actually turn around the ocean outfalls?

Mr WILSON: Yes. North Head is a perfect example. You have put that long pipe there, and you could always put water into that pipe at North Head and transport it back towards Blacktown, or at least Parramatta. You just have to be innovative.

The Hon. PATRICIA FORSYTHE: Mr Wilson, you mentioned the need for a cap on the amount of water that Sydney Water can take from rivers. Is that not effectively what happens under Sydney Water's operating licence?

Mr WILSON: No.

The Hon. PATRICIA FORSYTHE: Should it be?

Mr WILSON: Should it be? Yes. I mean, Sydney Water's operating licence says something like 580. They took 630-odd for something like three or four years in a row.

The Hon. PATRICIA FORSYTHE: How would you cap it any other way? Effectively, that is what Sydney Water's licence is meant to do.

Mr WILSON: You put a fairly hefty penalty on them.

The Hon. PATRICIA FORSYTHE: Exactly. That is a different issue though, is it not?

Mr WILSON: It is still cheaper to flout IPART's ruling, because of the extra profit from the extra water that Sydney Water has sold. You have got to change the financial incentive, and the financial incentive is not there yet.

The Hon. PATRICIA FORSYTHE: My other question relates to your views about water restrictions. At an earlier hearing the Committee received a view that if restrictions stay in a community basically forever that the community becomes very blasé and does not regard that as a penalty at difficult times, and therefore it does not achieve in the long term the savings that might initially have been made when the conditions were placed on the community. Do you have any evidence or views about restrictions?

Mr WILSON: Yes, I do. If you look at any consumption graph of any major city in New South Wales—so we are talking about Wollongong, Newcastle and Sydney—when you put on water restrictions you stop the gradual per capita climb in water use. That per capita climb is never recovered when you remove the water restrictions. So the graph rises, then plateaus, and then may continue in a line parallel with the horizontal, but it never really returns to the first line on the graph. That has been proven over and over again. But I do not believe that you bring in water restrictions by themselves; you really need a decent communications strategy that continues to argue that people have to be conscious of water.

I used to be Water Resources Commissioner, and I know that those in western New South Wales will bellyache about water restrictions, but they know that is their livelihood. You make concessions for standing crops and certain precious natural resources so that you do not destroy them, but for annual crops and things like that you bring in restrictions. So, yes, I suppose you can have some variation in the severity of restrictions, but we will never go back to a constant restriction on overnight watering and hosing down of paths and buildings. I think you should not underestimate the power of people complaining that there are water restrictions on, because that generates an impetus of its own. You will get arguments both ways, and it is good to be discussing water. Sydney has not discussed water enough.

The Hon. PATRICIA FORSYTHE: I will get onto my hobbyhorse, as Committee members well know about. Why should the person who thinks it is a good idea to have a significant rose garden not be allowed to hose the garden for two hours a day as a matter of free choice? And why is that person's exercise of free choice any different from the person who wants to use water for two hours a day to clean down buildings or do something else with it? In other word, they are exercising a choice in deciding what use will be made of the water, not so much the time being allowed to use that water.

Mr WILSON: I think the difference is that our culture says we will have gardens around our homes, and we will have a beautiful city. I do not think the culture says that we will waste water willy-nilly and use it as a broom when there is an alternative. There are alternatives to roses—grevilleas, for instance—and there are plenty of alternatives to using a hose to brush away a few leaves. My next-door neighbour is a classic case—the number of arguments I have had with him about that very issue!

Restrictions do not have to be that onerous once you have a decent education program in place. If you think of some of those EPA programs about not running water down the drain and so on, they worked very well. We have a much tidier city these days because of that. I just do not think we have understood the social sciences enough in this process. You may find, in the longer run, that you do not need those heavy restrictions. We certainly do at the moment because we have to hammer home that water is precious, and we are using too much of it—and 635 gigalitres is just too much!

The Hon. GREG DONNELLY: Mr Wilson, you mentioned briefly in your evidence a role for incentives for industrial consumers of water. With respect to domestic consumers, and the role of incentives for them, particularly with respect to, say, water-saving devices, what types of practical incentives do you think could operate?

Mr WILSON: I think the Government has gone a fair way down the path with BASIX. It is not always just the householder that you need to think of; you need to think of the design of a suburb. So I will start there. If you think about the design of a suburb, it is quite easy to design a suburb that is attractive to live in but that does not demand a lot of water, because you can trap water, capture overland flows and all those sorts of things. Even if you cannot always put a water tank in a particular house, you can put it in a particular landscape that that house sits in. So there need to be some incentives for developers as well—and BASIX does that of course.

I think you need step pricing. I know the problems with step pricing. People who say, "But we have got to look after a large family," do not recognise that there are ways of looking after large families in a regulatory process that allows you to give them some relief, but still caps the amount of water that people would use normally, and then gives other people an allowance, because that is what happens with most welfare systems now: we recognise the size of families, and those with particular problems. We do not give anyone an incentive for looking to their own ways to save water. I have installed a groundwater pump in my house, because I like a good garden—as the Hon. Patricia Forsythe mentioned. My groundwater pump is on a timer. I do not use it all the time but, especially when I am away, I put the timer on.

The Hon. RICK COLLESS: Have you got a licence for that?

Mr WILSON: Yes, it is all licensed. I was a Water Resources Commissioner! We give some incentives for water tanks. Once again, the Government has done the right thing on water tanks by getting over some of the unnecessary regulation that we have had in the past. I think we could do much better with giving people incentives to refit to direct some of their washing machine water into storage. I can understand why the Government has gone down the new-house side of things, because Sydney is growing at such a rate that you really have to tackle the new house infrastructure. So there are a lot of incentives there. I think the time is now coming for a little bit more in incentives, even in terms of BASIX, which of course there is talk about being introduced at sale time. All of those incentives are working for householders. They are not necessarily working for industry and commerce yet, and I think that should be explored as well. I think there has been a reasonable take-up of some of Sydney Water's programs on refitting taps and those sorts of things. I think those incentives are good. I cannot think of any other incentives at the moment.

CHAIR: We are nearly out of time, so I will allow maybe one more brief question and a brief answer.

The Hon. HENRY TSANG: I have a question, but I will defer to Ms Sylvia Hale.

Ms SYLVIA HALE: I want to pick up on something you said about accessing groundwater. Do you think there is a need for much stricter regulation of the sinking of bores throughout the State, but particularly in Sydney? My thinking is in the light of the experience at Botany and the possible contamination there, but do you think there should be tighter regulation for other reasons?

Mr WILSON: That is two issues, one is a volumetric one and one is a quality control one. But the quality control stuff has been a bit lax. I am not sure that the Botany aquifer has been that well assessed. I tapped into the Botany aquifer and I tell my friends that I have done it, but I have some reservations because I do not know whether there is a cap because no-one tells you whether there is a cap on the Botany aquifer. It really does need to be considered, but it certainly is a nice little aquifer because you get a lot of rain along the coast and if people over water, it just goes back into the aquifer. It costs a bit of energy, and if you see my paper I am not in favour of too much energy consumption either because the power stations require thermal energy, which is water. Yes, I think they need to be regulated seriously and I think they need to be regulated in line with all the other water accessibility issues, all other natural resource issues. At the moment the Department of Natural Resources tends to divide them in two. I think you should think about the two of them together.

CHAIR: Unfortunately, we are out of time. There certainly is some great information there. If there are any other questions that come from the Committee, would you be prepared to take them on notice?

Mr WILSON: Yes, I would.

CHAIR: There are a few other questions we do not have time for today. I thank you very much for your attendance.

(The witness withdrew.)

ROSS JAMES YOUNG, Executive Director, Water Services Association of Australia, affirmed and examined:

CHAIR: In what capacity are you appearing before the Committee? Are you appearing as an individual or as a representative of an organisation?

Mr YOUNG: As a representative of an organisation.

CHAIR: Which is?

Mr YOUNG: Water Services Association of Australia as its executive director.

CHAIR: Are you conversant with the terms of reference of the inquiry?

Mr YOUNG: Yes, I am.

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request. If you would like to make a short statement, then there will be follow-up questions from the Committee.

Mr YOUNG: I thought I would start by outlining briefly what the Water Services Association of Australia [WSAA] is. It is the peak body that represents the major urban water utilities around Australia. Members of the Water Services Association provide water services to just over 15 million Australians, which is about 75 per cent of the population. We have very wide coverage over Australia. The only areas where we really do not have any members is inland New South Wales and inland Queensland, where water services are still provided by local council because we have a cut-off limit of 50,000 connections before you can become a member of the association. Essentially, we benchmark the urban water industry annually and produce a document, which is called WSAA Facts, which you may or may not have heard of and I certainly can make copies available to members of the Committee afterwards, if you would like that.

CHAIR: That would be appreciated. Thank you.

Mr YOUNG: That has the performance of all of the 28 WSAA members in there, three of which are from New Zealand, and a whole range of customer service, environmental and asset management performance indicators. We also develop codes of practice for water and sewerage infrastructure so we do not run up against the rain gauge issue so that manufacturers do not need to produce different valve sizes and different taps in each of the States and Territories. We also appraise products for use in the urban water industry so that, once again, entrepreneurs do not have to knock on the door of every major utility around Australia. They can knock on our door and we appraise a product on their behalf. We also undertake somewhere between $1 million and $1.5 million worth of research into projects of common interest to the urban water industry around Australia. Finally, we represent the urban water industry at the Commonwealth level, which is a particularly important role in the context of the national water initiative.

I believe that I can add value to your inquiry this afternoon by really providing a national and international perspective on what is happening with urban water. I think sometimes people forget what is happening outside of their jurisdictional boundary and believe that they have unique challenges. But when you are in a helicopter, like I am, and you have a national view there is a remarkable degree of similarity in the challenges that are confronting cities around Australia and, indeed, internationally. Those challenges can be characterised as being uncertainty in rainfall going forward in the context of population growth. If it were not for those two factors we probably would not be sitting around the table today. The response of the urban water industry around Australia is very much diversifying its sources of water, so we are not totally reliant on surface run-off from dams. For the dams to fill you actually need rainfall, and rainfall of a pattern that will create run-off.

With the exception of Perth, all the other Australian capital cities are almost totally reliant on surface water run-off. Perth already obtains 40 per cent of its trading water from groundwater, so it

does not have its eggs in the same basket to the extent that the rest of the cities do. Sydney particularly is vulnerable because it has one dam, Warragamba, as you would know, which provides 80 per cent of the city's water. You only need a storm or a rainfall event to miss that catchment and you have missed out altogether, whereas if you go to other cities they have their dams spread around a number of the catchments close to the city so that if a storm misses one catchment there is a fair chance that it might hit one of the other catchments. If you look at the water resource strategies for each of the cities you can see they are diversifying their sources of water by looking at ways to use recycled water for non-potable purposes and looking at rainwater tanks. Desalination is an option in a number of cities. Groundwater certainly is an option and so is trading with the agricultural sector. I think that the solutions will vary from city to city, depending on a whole range of environmental and other solutions.

In conclusion, I would like to make these following comments. There is no silver bullet to the water resource challenges that the cities are facing at the moment. It will be a range of measures, not a single measure as we might have done in years gone by just going out and building a dam. The second thing is that quite often you have proposed putting up single solutions as being the panacea and the sole magic solution that will get us across the line. My advice to you all is that if it sounds too good to be true, then it probably is. The devil is in the detail here. We are dealing with the public health of the community because trading water is absolutely paramount to the public health of the community. We also are dealing with considerable community resources, and it is incumbent on us all to make sure that every dollar is spent in a wise and prudent way. That is why the detail is important. It is also to bear in mind that whatever you are doing on the supply side of the equation, water conservation programs always will be the backbone of water resource strategies around Australia. We never can become complacent in this regard, but that does not mean that we need to lower living standards or reduce the liveability of our cities.

We should not be frightened that we do not have all of the solutions going forward because if you look back 20 or 25 years to compare what we were doing then to what we are doing now you will see that technology has a habit of evolving. We can do things now with water that were not dreamed of 25 years ago. In that regard we have to have an adaptive management process and prepare strategies, but be prepared to monitor them continually and adapt them as social and technological situations emerge. Finally, water resource assets are long term. Reservoirs and the like, our dams, are over 100 years old. Pipes can last for nearly that long. Whenever you undertake long-term planning you become a hostage to fortune, and in that regard we must be prepared to amend and modify, and take into account changing context. I might leave it at that as just some opening comments. I would be more than willing to take some questions.

CHAIR: I appreciate that. There is some information from your organisation saying that average household consumption has fallen by 9 per cent from 251 kilolitres per household per annum in 2001 to 225 kilolitres per household per annum in 2004-05. Is that primarily because of education? You mentioned strategies of water saving devices by the Government. I note that you mentioned, as others have mentioned, the importance of a whole suite of options. Are there any other issues from your point of view, both in New South Wales and other areas, that stand out as effective means of this type of reduction and continuing?

Mr YOUNG: It really is difficult in this area to pinpoint exactly what is working and what is not working, and that is why I think in the future with smart meters and better social research we really will be able to pinpoint what is contributing to those water savings. But if you go back to the 1980s in Sydney, up until the 1980s in Sydney population growth and water consumption virtually paralleled each other. In the early 1980s there was a divergence and population growth kept going up as water consumption flattened off. I think that change coincides with the introduction of volumetric charging for water and also a move to introduce dual flush toilets. Since then there has been a whole range of community education programs on water, and the drought really has focused the community's mind on the fragility of our water supply.

I think it is a combination of community education, more efficient water devices in homes like washing machines and dishwashers, a larger proportion of the population living in apartments and units where there is no outdoor water use as well as community awareness that this is the right thing to do and, of course, as people retrofit their bathrooms and renovate they are putting in more efficient toilets and more efficient fittings. It is a range of measures, and if we had a better idea of the exact

ones that were delivering the water savings we probably could do better than target that, but without that evidence it is a matter of adopting a broad-brush approach and covering all bases.

CHAIR: You mentioned smart meters, which we have discussed. Has your organisation looked at the advantage that can be gained from metering in areas in which that currently is not the case? For example, a lot of older units and flats in Sydney do not have individual metering. Is this something that could be cost effective?

Mr YOUNG: It could be cost effective, but even with traditional meters it is possible to retrofit those existing 1960s and 1970s blocks of apartments with meters. This certainly has been done in cities like Melbourne. It really was forced down there when there was a change in the Residential Tenancies Act, which meant that the tenants then had to pay for the volumetric component of the water charge and the landlord had to pay just for the service charge. I think that is an area in New South Wales where you could send stronger price signals to a segment of the community. I think I read once that tenants comprise about 30 per cent of the properties in the Sydney area, which, essentially, is 30 per cent of the properties that are not getting any price signal for the amount of water they use.

We are watching very closely the developments in the electricity industry with Smart metres, particularly charging for electricity during peak periods—and the water industry is no different—to see whether we can piggyback off some of that work.

CHAIR: It has often been said that such metering would carry with it the cost of inspection and so on. Are you suggesting that the same person who reads the electricity meter reads the water meter and so on?

Mr YOUNG: Both in the reading and in the technology of the metres, and that is improving all the time. I think the cost could become prohibitive if we had to use the old style of metering. But I am confident that as metering technology improves, the costs will come down and we will be able to get smarter in regard to time-of-use metering or metering of water for different uses, perhaps with a different price for water internally as compared with externally to the household.

CHAIR: In your paper you said that the reduction in the infrastructure leakage index is an outstanding achievement by the urban water industry. You are quoted as saying that Australia is a world leader in managing water distribution systems so that the water loss is minimised. Do you stand by that statement, given Sydney Water's current program, and how effective is it? What is your assessment regarding Sydney Water and leakages? Both infiltration and exfiltration have pretty catastrophic effects both ways.

Mr YOUNG: I hope there is no infiltration into the Sydney Water drinking water system. That is normally an issue for a wastewater system or sewerage system. But I stand by the statement that even the worst of the performers in the Australian urban water industry are better than the North Americans, the Europeans, and certainly the South Africans. That is because at the time of drought the Australian urban water industry realised that if it wanted to encourage the community to be more frugal and efficient with their use of water, they really had to get their own house in order. So an enormous amount of money has been invested into finding where the leaks are and using new technology to enable those leaks to be fixed in a cost-effective way.

We need to understand that there are a number of elements that make up any leakage. There is the actual leakage itself, then there is the unaccounted-for water, and there is also what we call water losses. Water losses is typically the water that would be used for firefighting purposes, from hydrants, or water that is used to test fire systems in commercial and industrial buildings.

We also need to recognise that there is an economic point at which it becomes unreasonable to fix those last leaks in our cities, that you could spend inordinate amounts of water to chase every last kilolitre and find that, on a per-kilolitre basis, you might be spending hundreds of thousands of dollars a year just to save a small number of kilolitres. So it is important that the cities strive to reach the optimum economic point that they are tackling leakage.

We report annually on what is called the infrastructure leakage index, which is an index that measures the performance of the utilities and takes into account a range of parameters. You will clearly see there that Sydney's performance is very good and that there has been an overall performance across the Australian water industry, pretty much driven by the fact that people are competing with each other and trying to improve their performance.

The Hon. PATRICIA FORSYTHE: In your opening statement you referred to recyclable water for non-potable uses. Do I take it that it is the policy of the Water Services Association not to support recycling water for potable purposes, because you went on to say there were public health issues?

Mr YOUNG: We do not think we are at the point where we need to pursue that option in our cities because we believe there are a number of other leaders that we can pull that will ensure the reliability of water for our cities. That could be different in inland cities, where they do not have the option of, say, desalination as one of their diversification techniques.

I think it is fair to say that people often look at Europe and America and say: They recycle their water for drinking water, so why do we not do it over there. There is an ignorance about the different circumstances that apply in Australia. Perhaps I can explain aspects of that.

Unlike Europe and the United States, all of the Australian major population centres are coastal. That means that you end up with your treated wastewater being at the coast, at the last point, and to get it back to where it can be used requires a lot of pipe infrastructure and a lot of energy to pump it back. The second thing to understand is that no-one in the world puts their recycled water directly back into the drinking supply system. It always goes back into an environmental buffer such as a large lake, as they do in the United States, into aquifers, into large river systems, or, as they do in Singapore, back into their reservoir drinking water system where it gets what we call detention time.

While it gets this detention time in the environment, it is subject to UV from the sun and there are natural processes there that help cleanse the water. From a public perception point of view, it loses its identity, so it becomes a much more acceptable product. It is incredibly difficult to do that in a city like Sydney, when you think the only option you have to provide that detention time and for the recycled effluent to lose its identity is to pump it all the way back to Warragamba, which is a very long way to pump it. Whereas in places like Perth they are investigating putting it down into their aquifers, where they can give it detention time.

I do not know whether other witnesses have covered the issue of Singapore here. That always comes up as a case in point. As you probably know, it is only 1 per cent going in at the moment, it comes from a catchment where there are no trade waste discharges going into the wastewater system, they are proposing to take it up to 2.5 per cent. Singapore is following the same approach, except that we call it diversification whereas they call it the four taps policy. Recycling water is one, and desalination and water conservation are the others.

The Hon. PATRICIA FORSYTHE: What is the view of your association in relation to desalination?

Mr YOUNG: Our association says that desalination should not be ruled out as an option for our coastal cities but it should be looked at on its merits, like all the other options. We do not believe there are any silver bullets. For some cities it will be a viable option, where they may not have groundwater, where they may not have access to purchasing water from agricultural markets, or for whatever reason. We believe it is a "horses for courses" approach and that any policy that says "Thou shalt never build a desalination plant" is probably not prudent in this age of climatic uncertainty that we are living in. We must bear in mind that our historical rainfall and run-off records only go back 100 years or so. Who is to know we are not going to experience a drought that we have never had? And we cannot afford our cities to run out of water.

The Hon. RICK COLLESS: I attended the Water Summit in Sydney last week. You may well have been there as well.

Mr YOUNG: No, I was not there.

The Hon. RICK COLLESS: The summit was addressed by a fellow by the name of David Whisker, who is the Executive Manager for the Wide Bay Water Corporation in Queensland. The tenet of his address was the better management of water supply systems in urban areas. He talked about sectorising the supply, and applying pressure management and using that as a tool for identifying where the leaks were, and consequently how to chase the leaks. He told the conference that that had been almost spectacular in the number of leaks they had detected, and that water savings stemmed from that. How applicable is that process to a huge urban area like Sydney, particularly given that a lot of those areas are probably much older than the Wide Bay area in Queensland? Do you think that process could be applied successfully in Sydney?

Mr YOUNG: I think you will find that that same technology and approach is being adopted by Sydney Water already. Even though Sydney is a much larger city than the Wide Bay water area, all the urban water systems are managed in zones anyway. Sydney would be broken down into quite a number of zones, so you could manage those zones just like they are small water distribution systems. Reducing pressure, using that technology to listen for leaks and look at the flows in the middle of the night and comparing them with the flows during the day—they are all measures that have been undertaken by the utilities in order to improve their leakage performance and get the infrastructure leakage down. I cannot speak in detail about what Sydney Water has done, but I would be absolutely amazed if those elements of it are not part of their approach.

Ms SYLVIA HALE: You spoke briefly about improvements in metering. In public housing estates in this State the Department of Housing is imposing a water charge, but that bears no relationship to the amount of water used because the department says it is too expensive to install meters in many of those houses. Do you expect the price of meters to drop in the future, so that it might be feasible to install them?

Mr YOUNG: I cannot speculate in terms of which way meter prices will go. But what I would say is that new technology may enable us to do things using electronics or whatever, rather than the mechanical systems, for measuring water as it is now, which would enable more efficient metering. But I cannot sit here today and say whether they are definitely going to come down. But I think that metering technology will improve and will become more cost-effective.

Ms SYLVIA HALE: There are different ways of metering?

Mr YOUNG: That is right. I think anything that provides a price signal to people on how they use water has to be a good public policy outcome.

Ms SYLVIA HALE: We have had evidence that ocean outfalls lead to a loss of what is potentially a beneficial resource, that they lead to pollution build-ups, of sediments at the outfall, and that in fact what we would be sending out to sea via the outfall, if we adopted desalination, we would be then bringing back into the city. Does your association have any view on the use of ocean outfalls?

Mr YOUNG: Not a formal position. I think one of the things that is worth remembering about the new reverse osmosis and microfiltration technology, such as desalination, is that if you reuse 100 per cent using that technology it does not necessarily mean that your outfalls are closed. Once the water goes through the filtration system, you end up with what is called a concentrate. In the primary and secondary stages of treating the effluent, you get the biosolids that drop out, and they can be taken away and digested and gas generated. But once you get to the reverse osmosis and the microfiltration, they sieve out all the bugs and the other things and leave you with pure water, but you have this concentrate to get rid of.

You have three options with that concentrate. You can either put it out an outfall sewer or you can put it in large evaporation pans. You would probably need tens of hectares of evaporation pans to put that concentrate in for a city the size of Sydney. Or you can put it through a thermal process, where you use energy to drive it off. If you do that, you crank up your greenhouse gas emissions. No doubt everyone has told you that in the water area there is a direct trade-off between a water outcome and an energy outcome. We can do virtually anything we like with water if we could be assured cheap energy and there was not an issue of greenhouse gases.

But once you start taking into account the fact that you have got to take into account greenhouse gases—and it is often said it would be the height of irony if our response to climate change and increasingly unreliable rainfall was to increase our greenhouse gas emissions—it becomes a whole lot more problematic, and I get back to my point that quite often proponents of various solutions talk in broad generalities and concepts and never tell you the detail, and that is one of the details about 100 per cent recycling; there is a concentrate to be disposed of in some way that is environmentally benign and benign from an energy point of view.

Ms SYLVIA HALE: But you would agree, would you not, that the energy used in desalination would be a major contributor to those very problems that you have spoken about?

Mr YOUNG: Yes. But when you look at energy and the cost of desalination versus recycled water, quite often the costs and the greenhouse gas emissions are only ever compared at the treatment plant gate. There is no doubt that desalination is much more intensive and much more expensive than recycled water at the treatment plant gate. But the thing is, with recycled water you have got to pump it such a long way and build such large pipe networks to get it back to the point where you can use it in meaningful quantities that the economics of it start to look completely differently.

The Hon. RICK COLLESS: Does that not apply to desal too though?

Mr YOUNG: No. Desal can generally be put back into the nearest service reservoir and can be put back into the system that way; it does not need to go all the way back to the dam or to go through that environmental buffer stage. I think you have got to be very careful about just comparing the prices at the treatment plant gate; we should be comparing the prices at the point where the water is going to be used by customers—groups or clusters of customers.

CHAIR: Has your organisation looked at disposal of, for example, the by-product of desalination, the brine, and the fact that it does not distribute in the same way even as a sewage outfall plume does; it is heavier, it falls down in the immediate area and it has an impact on the environment?

Mr YOUNG: No, we have not done any work in that regard.

The Hon. RICK COLLESS: There has been a fair bit of discussion about the energy aspect of desalination, and obviously it is one of the major issues. Have we got the cart before the horse here? Should we in fact be discussing alternative energy sources before we even think about desalination?

Mr YOUNG: I go back to what I said. I think you have got to look at your range of options and look at them on their merits and not just be tied to a philosophical point of view that one is better than the other. This is where you need to take into account a whole range of social and economic and environmental aspects. It is pointless coming up with a proposal for a high-energy solution if there is not the energy there. That is why I think if you look at it in a broader sense and not just look at it from purely a water outcome point of view you are bound to come up with a much better solution than just taking a narrow view, and that is where your planning is very important and working with your communities.

CHAIR: Professor Ashbolt's presentation was, in part, on behalf of your organisation.

Mr YOUNG: He did not present on behalf of the Water Services Association. He may have quoted from some of our reports.

Ms SYLVIA HALE: Did he do a study for them?

Mr YOUNG: He might have been talking about the sustainability assessment index that he assisted us in preparing. That was one of the research projects we commissioned, which the University of New South Wales was one of the research providers. That is the index that we are using now in the water industry to try and make those trade-offs. For instance, if you need more water to a particular area, do you duplicate the pipeline and in doing so what is the disruption in digging the trench and the

embedded energy materials in a new pipe? Or do you just pressurise the existing pipeline by putting a pump station there and forcing more water down there and looking at the energy and greenhouse implications of that? So that is that framework that enables us to make those decisions.

CHAIR: Thank you very much for your contribution here today, it has certainly been valuable. If any further questions come out as part of our deliberations, would you be prepared to take them on notice?

Mr YOUNG: Absolutely. I would be pleased to do that.

(The witnesses withdrew)

(Short adjournment)

NOEL PATRICK MERRICK, Hydrogeologist, Director, National Centre for Groundwater Management, University of Technology, Sydney, PO Box 123, Broadway, sworn and examined:

CHAIR: In what capacity do you appear before the Committee—that is, as an individual or as a representative of an organisation?

Dr MERRICK: As a representative of the University of Technology, Sydney.

CHAIR: Are you conversant with the terms of reference for this inquiry?

Dr MERRICK: I am.

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request.

Dr MERRICK: Thank you.

CHAIR: Before questions commence do you wish to make a brief opening statement? If you have information you wish to present to the Committee please feel free to go ahead now.

Dr MERRICK: I will do so by means of a power point presentation. I expect that you might not have had much exposure to the groundwater side of the coin.

CHAIR: No. I have to admit that when I saw the program I realised that this was the first occasion. The issue has come up and we have talked about groundwater, but we have not had any definitive explanation of it.

Dr MERRICK: Part of my presentation will be to give a summary of what the resources are around Sydney, and what some of the issues are as well. As I said, I am from the University of Technology, Sydney [UTS], where I am Director of the National Centre for Groundwater Management. We have an educative role. We teach at graduate level only and we also do research and quite a lot of consulting to industry. What I want to cover in the short presentation is a bit of an overview of Sydney's groundwater resources, because they are quite different from other cities and I think that will explain why we do not turn to groundwater as our first, second or even third option; some of the problems that we have with groundwater in the Sydney area; and some of the work that we have been doing at UTS that can inform the debate, in particular the models that we or others have set up that enable us to do scenarios on water planning. Some research that we are doing in backyard drainage I think will be pertinent to be Committee's terms of reference. Also, we have had a number of students undertake research projects on the applicability of grey water in some council areas.

I borrowed this diagram from the *Sydney Morning Herald*. It covers the area around Sydney, the sandstone rim around Sydney. It highlights the fact that close to the central business district [CBD] there is only one decent groundwater supply, in the Botany sands; then we have a sandstone belt from the northern area around Gosford and we have the Mangrove Mountain aquifer; coming around the rim to the Blue Mountains—I am sure you are all aware that there has been recent drilling at the foot of the monocline at Leonay and I will say more about that later if you wish; coming around to the south into the Southern Highlands—I am sure you are aware that has been some very successful drilling there recently. This red dot is in the wrong place; Kangaloon is actually where the text is, rather than where the dot is.

The sorts of capacities in those areas, the Mangrove Mountain aquifer—I now realise this is not within reach of Sydney's water supply because it is the Gosford-Wyong council domain—we are doing a study there right now. The available water is about 8,000 megalitres per year and it is quite high-quality. That is where a lot of our bottled water comes from. On the Leonay aquifer out near Penrith there are actually two bores completed now. I rang up this morning to check on progress and the second bore has been finished. The yields are closer to 30 litres a second, which proves that the first bore was not chance. The second bore has been just as good as the first bore. It is not a proven area yet; it does need more work, but it is looking very promising. Botany Sands aquifer, which has

been used for 150 years, has a resource of about 12,000 megalitres a year. The quality is still very good in the north, but most of the southern half of the aquifer is contaminated pretty heavily. The Southern Highlands aquifer is yet to be proven fully. There are about 20 bores down with variable yields but it looks like you could get about 15,000 megalitres a year out of that aquifer in the short term. It is not a permanent supply; it could be relied on in times of drought, but you will have to let it rest. Perhaps pump it for about three years and then turn it off and let it recover. At this stage we do not know how long it will take to recover. It is very high-quality; good enough for bottling.

In Botany sands there is a northern area where most of the activity is. There is a lot of domestic use along the western side of the bay and there is a little bit of use on the southern side, around Kurnell—although the Kurnell area has some saltwater intrusion problems, so there is not a great deal of use made there. The diagram on the right is not really legible but shows roughly the approximate depth to water, and the water table is about two metres below ground, near the airport; and at Kensington, one to two metres. Where you have significant depth, that just means that there are surviving sand dunes there. The southern part of Botany sands—I am sure you are aware of the severe contaminant plume emanating from the Orica premises. This shows the outline of that plume, about 1 milligram per litre concentration. The central contour peaks at 1,000 milligrams per litre and in the core itself it is about 5,000 milligrams per litre, which is very strong.

CHAIR: Where is the Orica site on that map?

Dr MERRICK: The Orica site is this large outline. It used to be all ICI and now Orica owns the bottom half. They have sold off the top half, but it is all called the Botany Industrial Park now. The other area that is outlined is Southlands, which is Orica land but not used for anything. It was the site of the cogeneration plant that did not go ahead and there is a bioremediation trial down in this part of the paddock as well. The red dots are the locations of the bores that have gone in the past 12 months to capture the plume before it gets to the bay. I was the one who built the model and did the optimisation study for determining how much had to be pumped out with bores.

Ms SYLVIA HALE: May I ask how successfully that is operating?

Dr MERRICK: Very successfully. It is not fully implemented at the moment, because Orica had to build a groundwater treatment plant at a cost of something like $120 million. It was a massive exercise and a huge building and took a year to build. I think it has just come on line or is about to come on line. Until that was ready the only capacity they had was to pump up couple of megalitres per day from the area down at Foreshore Drive, the critical area, but that is working very well and I am confident the plume has been stopped in its tracks.

The Hon. RICK COLLESS: Would you please go back to the last slide and show us where that is on the left-hand map?

Dr MERRICK: Yes. I will show you on the right one first, because I meant to point that out. This is the Orica land in yellow, with the Southlands underneath. We have this contamination essentially in that area. I mean you have low-grade contamination everywhere through here, through the industrial area.

CHAIR: Contamination of the water table itself?

Dr MERRICK: Of the water.

CHAIR: Of the underground water?

Dr MERRICK: That is right.

The Hon. HENRY TSANG: If the water is contaminated, that means it is of no use to anyone.

Dr MERRICK: That is right.

The Hon. HENRY TSANG: Can it be used for industrial or agricultural purposes?

Dr MERRICK: No. Not without treatment, but my point later on will be that all the northern half of the basin is in good shape and there is a resource there. Just to point out why we do not use more groundwater around Sydney, this is a very old map from 1942. In fact, the name of the author of this was "Old". Somehow he managed to get samples of water from all around the Cumberland Plain. To put into perspective, this is Sydney and Penrith is there. So, Penrith-Leonay is here and down here we have Thirlmere. Most of the Cumberland Plain is shale, which weathers to clay, so it is naturally not very good. Shale is of marine origin and has natural salts in it. You will see here in the centre part around Fairfield we have 25,000 milligrams per litre, which is about three-quarters the salinity of the seawater. It is not good stuff and we are not going to use it for anything.

The Hon. RICK COLLESS: How deep was that?

Dr MERRICK: This is actually in the shale, so I would say—this would be the water table and this would be quite shallow. That would have been especially so in 1942 when there would have been no motivation to drill into shale, into salty water. They would probably be just old wells, the first water that was struck. You can see that it improves a bit as you get around to the edges, but it is certainly bad in the middle. There is virtually no prospect of using any of the groundwater in that area until you get out to the alluvials on the Nepean River. There is a little bit there, which no one has really looked at properly. That is the reason why we have an urban salinity problem in a lot of western Sydney, because of the natural shales there, and housing estates that are planned in that Cumberland Plain area have to be conscious of a real risk of urban salinity.

Ms SYLVIA HALE: With the proposed opening up of the south-west and north-west growth centres, how aware are people of this potential problem?

Dr MERRICK: Probably unaware. I do not think there is much awareness at all.

CHAIR: The urban salinity in those areas is not coming from garden irrigation or exacerbated by watering and such like; you are saying that because the shale soils it is a natural phenomenon in that area.

Dr MERRICK: It is natural, but it is exacerbated because the excess water that is put on the water table causes it to rise. When the water table gets close to ground surface, the water evaporates off but the salts cannot; they stay behind.

Ms SYLVIA HALE: There is a lot of agricultural land in the south-west area. Is agriculture affected by this salinity?

Dr MERRICK: It varies with the crop, but once the salinity gets to several thousand milligrams per litre they would start having a sensitivity. I do not think you would find many firms using groundwater from shale, only if they were in the alluvial part when the groundwater would be okay, or they would pump from the river. The photo on the right shows some corrosion at a factory site in Penrith. You can see the corrosion there and the white is a salt. This water is actually coming up through the expansion cracks in the concrete. No other industry out there admits to having a problem, but they must have a problem. I am sure they are just not telling anyone so that their property values will not go down. So, that is a risk.

I mentioned Grey water because we have done a bit of work on it. Grey water when used for irrigating gardens and lawns is effectively pouring water onto the water table. Again, you have to be careful not to do it where you have an incipient salinity problem. It can save a lot of home water demand problems. I am sure you have had other people talk about problems with detergents.

From a geological perspective, you cannot use it everywhere. You have to be conscious of the soil type. It is not suitable in clay soils, it is not suitable where you have rock very close to the surface, and it is not suitable where you have land that slopes in excess of 10 degrees because water will run off onto the neighbour's property and will eventually pool at the bottom of the street.

Of the studies that we have done, in the Sydney metropolitan area it was found that about 25 per cent was suitable for direct disposal of grey water on sandstone soils. The rest of the area, if grey

water was to be used, you would have to have a closed system. You would have to store it in a tank and then use it for toilets and so on, but not for the garden. Another student we have had has looked at grey water applicability in the council areas, the local government areas, of Fairfield, Liverpool and Penrith. His finding was that 30 to 40 per cent of those areas are actually suitable despite the natural shale problem.

Models are available for scenarios, and there is a model that I developed 20 years ago for the whole Botany Sands aquifer which has been used on every infrastructure project that has come along since then. In particular it has been used on the Orica wellfield study. What is good about these models is that you can trial different scenarios, for example, for extracting ground water from one place and recharging somewhere else. It will come to a point where there is an opportunity for actual recharge of the northern part of the Botany Sands aquifer with waste water or treated water. We have a large model also, for the Mangrove Mountain aquifer. The difference there is that we have to preserve creek flow, so the ground water eventually finds its way out to the creeks and that is the water supply for those council areas. We are doing an optimisation study, preserving base flow into the streams.

In the Southern Highlands aquifer, there is a model being developed right now by the Sydney Catchment Authority which I am peer reviewing. That should be ready in a matter of weeks. That just shows an experimental site that we have at Windsor for drainage technology which I think will have some application in backyards. It is a very novel device and no-one knows about it yet. It is a competitor to the normal agriculture pipe but very different in design. It is actually a thin film of plastic about 15 centimetres wide and a few millimetres thick and it comes in 100 metre rolls. It consists of dozens of little channels that are designed to emulate the way tree roots work. It draws water in from underneath by capillary action. Once in there, it flows by siphonic action, so it is a very neat idea. It has come out of Taiwan and we are doing studies of it out at Windsor right now to see how it performs against agriculture pipe and other drainage materials.

There are some opportunities. I think there is quite a bit of ground water in Botany Sands that could be used and is not being used. There is a little bit of use in the northern area around Moore Park for some of the golf courses and some of the parks but there is a lot of water that just sits there. It is very fresh and no-one is using it. My estimate is about 4,000 megalitres a year. Even though that is replenishable by rain, I think there is an opportunity to draw out more than that and top it up with treated stormwater or sewage, so it is a place to store all that excess water rather than put it in a dam or some other manufactured storage. You can store it in the sands and the sands will provide additional filtering in the process.

Of interest here is the ground water treatment plant that Orica has put in. It is actually considerably overdesigned. It is designed for 15 megalitres per day which is about, I think, 2 per cent of Sydney's water requirements. It is likely that they will only need to pump out 8 megalitres a day from the contaminated area so there is a capacity of 7 or 8 megalitres a day just going to waste. I know that Orica has made approaches to the Government for permission for sewer mining and I think it is probably a pretty good idea to make use of a facility that is already constructed. Much, if not all, of that treated water could be injected in the northern part of Botany Sands and allow an extra kilometre or so of filtration and then pull it out by bores in the middle of the aquifer.

CHAIR: I am presuming that you are dealing here with primarily hexachlorobenzenes [HCBs] out of the Orica plant and other pretty nasty products. What level of contamination is there, if any, in the finished product, after what I presume is a microfiltration system that is being applied? How re-usable is that product in terms of dispersal into other aquifers?

Dr MERRICK: They plan to get it down to better than drinking water quality because they plan to use what they treat for their own industrial processes, so it has to be very clean.

CHAIR: So you are saying that, to a great extent, the necessity of setting that up is actually creating a closer source potential for re-using sewage effluent at Malabar for example?

Dr MERRICK: That is right. The sewer main goes past Orica's door, essentially, and half the facilities are not being used. I believe you could take the output and put it straight back into either

industries or domestic use, but if the people need a greater level of comfort, it can be put back into the aquifer for some natural filtration in addition.

CHAIR: I suppose that, given the nature of the toxic material, at least that is easily monitored.

Dr MERRICK: Oh yes. You certainly cannot let any water out that still has any toxic material in it.

Ms SYLVIA HALE: How long will it be before they clean up the Orica site, or will they never expect to do that?

Dr MERRICK: They wish they knew. Because it is pump and treat, the experience overseas is that these systems go on for decades so it could be 30 years. It will be pumped essentially forever, perhaps, because what happens is that while they are pulling the contaminants out, a lot of the contaminants are actually stuck to the soil particles and then as water gets pulled out, they slowly release from the soil particles and dissolve in the water again. They just bleed off very slowly so you cannot get it out in one hit.

CHAIR: I take your point on the soil particles. How much of it is coming from the deposits on the Orica site? Currently, for example, the capped car park, which has a mountain of that type of waste underneath it, in terms of the eternal process, how long will have to go on?

Dr MERRICK: It could take a decade before it gets down to the interception bores at the bottom—you know, towards the bay—so it is going to be a very slow process.

Ms SYLVIA HALE: Is it a very energy-intensive process, the one they are using?

Dr MERRICK: I imagine it would be because there are two processes, as I understand it. You have a reverse osmosis process and you have got potentially an incineration process, but it has a different name which makes it sound more attractive, but I cannot remember what I is.

CHAIR: Direct absorption?

Dr MERRICK: No. It is a catalytic converter or something.

Ms SYLVIA HALE: Are they doing that on-site, or are they proposing to?

Dr MERRICK: It is on-site. The treatment plant is on-site. I had a look at it just before Christmas. It is phenomenal. It is really worthwhile your having a look at it. It is very impressive. Just as an example of what others are doing, Perth has a plan to take treated sewage and to inject it into their Gnangara Mound, which is a pure sand hill, at the rate of 25,000 megalitres a year that they are planning to put in, in 2008. We are not as well off with sands as Perth is. We only have Botany and then only half of it, but we could put a little bit in.

Finally I know there has been a lot of talk about large-scale recycling schemes and I guess I would just like to emphasise the small scale, the backyard initiatives. For example, grey water, which I have already mentioned, can be either directly applied to the backyard where the soil and the slope are sufficient, or else I know there are companies out there that are offering services to store the grey water temporarily and to disinfect it in the process and then set it up for use in toilets and so on. There are also companies out there that are looking at engineered garden soil, so it is a full system of this drainage material that I showed you, plus bedding that into a sort of a designer soil, and then having a local recycling system. The water gets put on with a hose or a sprinkler, a normal garden and lawn operation, and any excess water gets taken away with this Capiphon belt and that water gets taken back up to the top of the garden and it is recycled that way. So I think there is a lot of opportunity for recycling at the local level. I believe there are some regulatory barriers at the moment. Local government has been a bit scared about the health implications of grey water and so on. I think that is it.

CHAIR: Thank you for that. I think it is very valuable at this stage of our deliberations. I am just very interested personally and I wonder about the extraction from aquifers. We are hearing about them being deep aquifers. What sort of impact could that have on surface waters and on more shallow aquifer water table systems? Is there a disconnect, or are they all connected there? I am thinking particularly in the Hawkesbury sandstone areas to the north west. There are quite a few creek systems and ecological systems that are dependent on what appears to be water extruding from aquifers from that Hawkesbury sandstone system. How safe are the aquifers if they are getting drained periodically? I appreciate that you say they recharge, but what sort of impact does that have on the top end, so to speak?

Dr MERRICK: It is a valid point in the Mangrove Mountain area where you have about 300 metres of sandstone above sea level and the ground waters discharge to the creeks. So you do have to be very careful about how much ground water is withdrawn there because it can affect the creek flow and the ecosystems therein. The actual recharge of water to that aquifer is something like 200,000 megalitres a year and the Government's or the department's position at the moment is to allow extraction of 8,000 of the 200,000. We are currently doing this study to refine that. It will probably come in with a value of even less than 8,000 in order to preserve the creek flow.

CHAIR: There is some dispute that went to court with the Coca-Cola Amatil extraction. I do not know whether you know the actual amounts they were licensed to extract and I think they have had to appeal against restrictions on that amount. Is that correct?

Dr MERRICK: Yes. They were looking for a tripling of their allocation. The allocations were small, very small, and they were given the allocation subject to ongoing monitoring. I believe that the monitoring has been infringed already so it is a very sensitive area.

The trick in that area is to extract ground water from greater depths. That is what we are looking at the moment in our study at the University of Technology, Sydney. You cannot pull the water out from shallow depths, but if you go down deep enough I think you can extract more water than is being extracted now with less impact.

CHAIR: So those aquifers at different depths are discrete; they have no connection with environmental impact?

Dr MERRICK: There is a connection. They are all connected, but I guess the trick is to make sure that the impact does not occur where the creeks are. That is a difficult one. I comment on the Southern Highlands and point out that it is a different story there. The drilling that has been done there was where all the rivers start. The Nepean River has its source very close to where the drilling has been done. There will not be any impact on flows. In fact, there is no ground water discharge to those river systems for quite a distance to the north. I am not sure, but 10 or 20 kilometres to the north of where the bores are you will start getting ground water feeding back into the streams. That is the subject of the model that is being done at the moment.

But we have to be sure that the draw down, that is, the reductions in pressure and water level, do not extend anywhere near as far as where the ground water starts interacting with the rivers. I am very confident that quite a bit of ground water can be pulled out without any impact on the river systems. I know that the locals are worried about springs coming off basalt. They are disconnected systems there. The basalt overlying the sandstone is a completely independent system because there is a large shale layer in between. So I think that would work well. Leonay will be a bit more problematic; I think there will have to be some careful studies there.

CHAIR: Generally speaking, you say that the so-called discovered deep aquifer material to the south is viable. It is safe to use and there is reasonable potential for augmenting Sydney's water in the near future?

Dr MERRICK: Yes. It is a very good resource. It was a surprise. After the studies are in I think we will find we can use it as a drought source without environmental impact.

CHAIR: Grey water and the re-use of grey water in domestic situations are centralised. Is there any way of avoiding detergent build up on site having a detrimental effect when we are looking at a decentralised system like that?

Dr MERRICK: I think it really comes down to educating households. I have an Envirocycle system and we have to be very careful what we put into our washing machines and so on. I do not see an alternative. It is not a scientific solution; it is an educative solution. So you will always run that risk.

CHAIR: So it is okay to go ahead with the project with the right education and choice of product?

Dr MERRICK: Yes. In those areas where direct disposal is not appropriate and you have to go through a storage tank I guess you get a second chance. You can address the detergent problem at that point.

CHAIR: Referring to storage, have you investigated the viability of grey water under storage and its potential for anaerobic breakdown or deterioration of the resource? Is that a perceived problem?

Dr MERRICK: I have seen a commercial system but it is only a fairly small tank. It probably holds about 2000 litres, or something like that. So you are really referring to after you apply it back to the lawn or whatever.

CHAIR: It is a product that degrades. There is bacterial build up in the product when it is stored, unless it is really clean before it goes into storage. If you have general public use of those systems it has been said in other evidence that they either have to be monitored by professionals or be self-regulating. It is the general habit of householders, for months or even years, to be enthusiastic about looking after these decentralised systems. But it can be dangerous, for example, in the septic tank episodes. Over many years they might not be functioning properly and they can become another source of pollution.

Dr MERRICK: Sure. My experience is that I have to pay someone to come in and check my Envirocycle system every three months. I think that is the way to proceed.

CHAIR: How long before the studies on the aquifers will be completed?

Dr MERRICK: The Southern Highlands ones?

CHAIR: Yes.

Dr MERRICK: And Leonay?

CHAIR: Yes.

Dr MERRICK: The modelling study is due for completion at the end of March. I think it will probably be a month later than that. I think June is the target for the release of the report on that area. The Leonay one is really fairly new, given that only two bores are down. At a guess, I think it might take 12 months before that is looked at properly. What is really exciting about the Leonay work is the logic behind the find. They deliberately went for an area at the foot of the monocline where they expected a lot of fracturing and a lot of headwater behind it in the mountains. They were successful straightaway. Because they were successful there is a very strong chance that you will get the same supply of water all the way along the monocline—all the way from Richmond to Camden. So there could be a massive resource there.

The Hon. HENRY TSANG: In your estimation, how long would the current source of ground water supply Sydney at today's current rate of consumption?

Dr MERRICK: Ground water on its own will only get you through for a week. Ground water is not—

The Hon. PATRICIA FORSYTHE: A substitute.

Dr MERRICK: Ground water is not a substitute. It allows you to work at the margins. It is a marginal resource. It is ideal as a drought back up but it is not a serious substitute in Sydney. Cities like Perth get 60 per cent ground water but we do not have those resources.

The Hon. HENRY TSANG: Could this source be extended if it were managed differently or better?

Dr MERRICK: Two weeks is not much better than one week, is it? No, the volumes are not there.

The Hon. HENRY TSANG: Only marginal?

Dr MERRICK: It is marginal, yes.

The Hon. RICK COLLESS: Dr Merrick, when we talk about recharging aquifers with treated wastewater, some filtrate must end up in the aquifer as a result. Is that a fair comment? If so, do they have a maximum amount of filtrate that they can absorb, rendering them useless for future filtration?

Dr MERRICK: I do not think they would destroy the aquifer, but you do have a problem with the bores, the infrastructure. You do get clogging. So any recharge episode using bores and every paper I have ever seen eventually has a clogging problem. Instead of having one bore for injection, you tend to have a series of them and you rotate them. So you take them out of action and have a maintenance program to clean up the previous one. It really is a very local clogging because of the growth of bacteria blocking up the holes in the well because there is a new environment. You have an aerobic environment mixed with an anaerobic environment at the wellhead or the casing. But it will not be substantial enough to destroy the aquifer itself, no.

Ms SYLVIA HALE: You said that 40 per cent of the Fairfield, Liverpool and Penrith areas are suitable for grey water usage, that is, grey water that is not being treated and that presumably just comes out and is immediately sprinkled. Elsewhere it would need to go into a storage tank and be treated in some way?

Dr MERRICK: That is right, yes. That is just on geological grounds, on the capacity of the material to take the water in and for the evaporation to discharge it through vegetation growth and so on. If we have a sufficient thickness of soil, the right type of soil and the right climate, which we have, we can be sure there is an active evaporation mechanism to keep the balance.

Ms SYLVIA HALE: Presumably these areas can be quite accurately mapped?

Dr MERRICK: Yes.

Ms SYLVIA HALE: For the remaining 60 per cent, would you specifically have to warn anyone who was thinking of re-using the grey water of the implications?

Dr MERRICK: That is right.

Ms SYLVIA HALE: Presumably that would be the responsibility of the local government because they now monitor acid sulphate soils, do they not?

Dr MERRICK: It would be a local government responsibility and they are probably not aware of these studies.

Ms SYLVIA HALE: How long have these studies been going on? Are they fairly recent?

Dr MERRICK: They are fairly recent, yes. I think the Fairfield-Liverpool one was done about three years ago. Nine huge volumes are sitting on my bookshelf. I do not know what to do with them.

Ms SYLVIA HALE: Who commissioned the study?

Dr MERRICK: It was just an idea from the previous director of our centre. He thought it would make a good student project. There was communication with councils at that time and they got copies of the reports. I am not sure whether they, like me, were scared off by the size of the volumes.

Ms SYLVIA HALE: But it would be critical information to make available if there were successful campaigns to encourage people to re-use their grey water?

Dr MERRICK: Yes. It is very good data source. It is all mapped out, the soils are mapped out in each council area and you are told, "You can do it here but you cannot do it there."

Ms SYLVIA HALE: I am not sure whether I heard you correctly before when you referred to the remainder of Sydney and said, "Wherever there is incipient salinity problems do not use grey water". You thought that would apply to 75 per cent of Sydney, or was it 25 per cent of Sydney?

Dr MERRICK: No. The figures of 25 per cent and 75 per cent were for grey water application in sandstone country. The study was done in the Sutherland shire. I think those figures were extrapolated across Sydney. In those areas you do not have a salinity problem at all. That was purely on the depth to rock and the slope of the land. We have salinity problems further west in the Cumberland Plain where we have clay and shale soils. I do not think that the student who did the grey water study, with his 30 per cent to 40 per cent uptake, took into account the possibility of urban salinity. I think that would drop his percentages down to a lower amount.

The Hon. HENRY TSANG: Professor, what would you like to see come from this inquiry—perhaps one strong recommendation you would make to the Committee for consideration of the Government?

Dr MERRICK: I would highlight that the Botany sands is an underutilised resource. In the past, it used up to 50 megalitres a day, and now uses about 20 megalitres a day. So it has gone backwards. I think there is a scare that it is all contaminated, but it is not, and more than half is quite good. So I would like to see placed on the table the opportunity to investigate that not only as a direct resource but also as an underground dam, essentially for treated sewage or treated waste water.

CHAIR: I would like to ask one brief question on that issue in the time remaining—and I see hands shooting up, indicating that members would like to ask more questions. The Botany decontamination process that is occurring is fair enough when it is dealing with an acute toxic problem, but how would it rate in terms of energy consumption if eventually a great part of its activities were to be transferred, for example, to processing effluent and such like? Are we looking at a process that is as energy intensive as is the desalination plant?

Dr MERRICK: I imagine it would be.

CHAIR: So, if we were considering a component of aquifer waters and a component of sewage, are we looking at a de facto desalination plant?

Dr MERRICK: That is what it is—it really is, except that someone else has built it, and it is there.

Ms SYLVIA HALE: Is it technically very difficult to feed the material that is being discharged through the Malabar outfall into the Botany sands, or would that be a fairly straightforward process?

Dr MERRICK: It is not going to be simple. You have a distribution problem: you have to get the material into the right place. Then you have to find lands, preferably public lands, for the injection of it. Then you have to decide whether you are going to do it through bores or through open

pits. Then you will need good security over those, as well as ongoing maintenance. It is not simple. I am only coming at it from a feasibility point of view; I am not looking further down the track to the economics and chemistry and so on. But South Australia is doing this all the time with aquifer storage and recovery, as they call it, which was developed by the CSIRO and Flinders University. They have a lot of applications, in new subdivisions in particular. It is still expensive, but they have solved the scientific problems.

Ms SYLVIA HALE: What was the source of the big stink that they had a problem with a couple of years ago? Was it related to injection?

Dr MERRICK: I am not sure of that event, but they were taking sewage from the Bolivar treatment plant.

Ms SYLVIA HALE: I think it was near Glenelg that there was a big political problem for the Government at the time because of the smells that were emerging.

Dr MERRICK: It might not have been treated enough then.

CHAIR: What sort of longevity does that Orica plant have? Is it any different, given that it is dealing with such toxic materials, in terms of the membrane technology? Are we seeing a limited life for that plant as a result?

Dr MERRICK: I have not heard any estimates of that at all. I am not in a position to comment on that. I really do not know.

CHAIR: If you are agreeable, there may be other questions that could arise before we proceed to deliberations that we might wish to send to you for a reply in writing.

Dr MERRICK: That is fine.

CHAIR: Thank you. The Committee certainly appreciates your valuable input this afternoon. We will be able to use quite a bit of that material, particularly on the aquifers, on which we had not had any conclusive information so far. That was very educational for us.

Dr MERRICK: I expect you will get an update next day from Graham Head of the Sydney Catchment Authority, who will be more up-to-date than I am on the progress made with those new groundwater resources.

CHAIR: Thank you very much for appearing today.

(The witness withdrew.)

DONALD CHARLES ALEXANDER HECTOR, Co-chair, Metropolitan Water Options Project, Warren Centre for Advanced Engineering, sworn and examined:

CHAIR: Mr Hector, what is your occupation?

Mr HECTOR: Engineer.

CHAIR: In what capacity are you appearing before the Committee—that is, are you appearing as an individual or as the representative of an organisation?

Mr HECTOR: I appear as a private citizen, requesting the standing Committee to note that I act in an honorary capacity with the Warren Centre for Advanced Engineering, co-chairing the Metropolitan Water Options project.

CHAIR: Are you conversant with the terms of reference for this inquiry?

Mr HECTOR: Yes.

CHAIR: If you should consider at any stage that certain evidence you wish to give or documents you may wish to tender should be heard or seen only by the Committee, please indicate that fact and the Committee will consider your request.

Mr HECTOR: Thank you.

CHAIR: Before we ask questions, would you like to make a statement on the issues?

Mr HECTOR: I would, if I may.

CHAIR: Go right ahead.

Mr HECTOR: This submission relates to three clauses of the standing Committee's terms of reference: (b) the environmental assessment process associated with the proposed desalination plant; (e) practices concerning the disposal of trade waste; and, most particularly, (g) any other relevant matter. The provision of water, sewerage and drainage infrastructure for a city the size of Sydney is an enormously complex problem. Although technology is important, the main determinants are political, regulatory, institutional, economic, public health, environmental and social.

The Warren Centre project Metropolitan Water Options is attempting to engage a wide and diverse constituency of interests representing the full range of stakeholders relevant to the water subsystem for the city of Sydney. The aim is to identify the issues that need to be addressed if the requirements of all stakeholders are to be satisfied. The project is well under way, with about 60 people involved, in unpaid capacities, across all dimensions of the problem.

Looking back over the last 160 years or so since Sydney was formally proclaimed a city, there have been a number of occasions—usually precipitated by a lack of water or poor sanitation—where public concern has been so great as to initiate institutional reform. I believe we are now in such a situation. The written submission made by the Warren Centre for Advanced Engineering is intended to engage and inform the Parliament of New South Wales regarding the Warren Centre project. I look forward to responding to any questions the standing Committee might have regarding the project.

CHAIR: I thank you for your very comprehensive written submission on this matter. It is historical material that makes good reading.

Mr HECTOR: It is interesting.

CHAIR: And it certainly does put things into perspective. There has been in this inquiry so far some discussion about trade waste agreements, which you mentioned you would like to raise. Historically, there have been arguments that the ocean sewage outfalls are in part a convenient way of dealing with trade waste and trade waste agreements in the Sydney basin. Could you give an opinion

on that, and speak about the limits on trade waste going into the system, how effective that system is, and the nature of the effluent to be dealt with in our outfall system at the present time? Is this outfall discharge something that can be reused and recycled, or do we still have a major problem with trade waste?

Mr HECTOR: I should note that I am not expert in water technology, or trade waste disposal, or most of the other technological aspects of this issue. The project of the Warren Centre has taken the view that this is an immensely complex system, and that one of the real difficulties in dealing with this issue is that many of the issues are being considered in isolation, and not as part of a system. One of the things that we are trying to do in the Warren Centre project is to characterise the water subsystem, which includes sources, distribution, reuse and eventual recycling of water as an integrated subsystem within the entire social system of the Sydney metropolitan area and the areas impacted by Sydney.

I do not believe I can give you a good answer to your question because at this point our project is still working on those issues, and by the time we come to our first major working session—which is scheduled for 11 May—we anticipate we will have a fairly good understanding of the way in which the elements of sources, reuse, disposal and so on, as I mentioned a moment ago, will integrate into a subsystem, and the interrelationships between those various elements of the subsystem. So the work that we are doing in the Warren Centre at the moment is really to first of all characterise the water subsystem. At the same time, we have a group of people who are looking at all of the other dimensions of the problem across regulation, political issues, institutional issues, social issues, and seeing if we can characterise the Sydney system as such, and then the part that the water subsystem will play in that.

So, without being too verbose about it, what we aim to achieve over the next nine months or so is a much better understanding of the way in which these elements and subsystems integrate, and to then recommend what major changes can be made to that system to resolve these problems, which have been very difficult to resolve in the context of looking at them individually and as elements.

CHAIR: What problems are you referring to?

Mr HECTOR: If you look back over the historical aspect, we normally get to a point in Sydney where some major crisis, often driven by climate or perhaps some other issue that affects the water subsystem, makes it difficult for government or for the regulators to really implement change. Without wanting to pre-empt the outcome of the project, it is more than likely that the Warren Centre project will suggest that there has to be change across most of the dimensions of the problem, and that will almost certainly lead to some sort of major institutional reform.

CHAIR: When you say major institutional reform, are you referring to the activities to date of Sydney Water?

Mr HECTOR: Yes. For example, if I could refer back to some of the historical developments that have happened over the years. Many of the institutions that have been developed in Sydney have been as a direct consequence of water issues. The Sydney City Council originally was established to ensure a good water supply to the city. That was as a consequence of the city nearly running out of water in the 1840s. Another severe shortage led to a royal commission in 1868-69, and there was significant reform as a consequence of that. The precursor of the current Water Board was established as a consequence of that inquiry and a subsequent inquiry. Further reform was made following a royal commission in 1902-03, and there have since been a number of royal commissions which resulted in quite significant changes to the Act that governs what used to be the Metropolitan Water, Sewerage and Drainage Board, and is now Sydney Water, and the catchment authorities.

I think our view is that the deliberations that have taken place across the spectrum over the last 15 years or so do not appear to respond to what is now an extraordinarily complex social system that forms part of Sydney. The city is now much bigger than it was when the Warragamba system was built. Almost certainly the technical solutions will be complex, and the social, political and institutional solutions will be complex.

CHAIR: How consequential to this historical progression of the water utilities have been the ocean outfall extensions and where does that fit today in terms of where do we go from here? Has that locked Sydney into a certain future direction, or are we able to depart from what appears to be a cultural continuum of pipes to ocean engineering solutions to Sydney's sewage problem, as part of Sydney's water problem?

Mr HECTOR: I would be surprised if, ultimately, the solution to Sydney's water, drainage and sewerage problem is not an amalgam of a range of different solutions. I do not think there is one solution. Usually this type of problem is so complex that there is not a right or wrong answer. Generally there is what ends up to be a good or bad answer and, usually, once a decision is made everyone works very hard to make it a good answer because after you have put a piece of expensive infrastructure in it is very difficult to move it or to change it. I think it was very largely the recognition of that that drove the people who commenced this project—the Warren Centre, the Australian Academy of Technological Sciences and Engineering, and Engineers Australia—to recognise this complexity and the place that it relates to in relation to what is now an extremely metropolitan area, and that the solutions would not be simple solutions.

The Hon. PATRICIA FORSYTHE: When the Government says, "We will have a desalination plant because that will be a solution to some of the problems we are facing", do I take it that the response of the Warren Centre is that there never can be just one simple project or idea that will be a solution?

Mr HECTOR: I think that would be the general feeling within the project team at this point, that there is no single answer to this, that it will be a combination of things.

The Hon. HENRY TSANG: Following up on that, do you have the impression that the Government is saying that a desalination plant is the only answer, or that the Government is saying it is one of the answers?

Mr HECTOR: The impression we have is that the Government's position would be that that is part of the solution, not the solution. We have a very large amount of money, of capital infrastructure in place already in Sydney in terms of dams, distribution and so on. Clearly, that has to prove a part of the solution as well.

CHAIR: Getting back to that infrastructure that was augmented in the late 1980s with the deep ocean outfalls, are you saying that that will provide an ongoing portion of the solution or do we need to turn that around to recreate an infrastructure that will allow for reuse and recycling?

Mr HECTOR: I think the position that we were headed towards in the project, and it is still fairly early days yet, is that in order to satisfy all of the stakeholder needs in this, and I emphasise it is not a technological issue but a very wide-ranging social, political, institutional issue, I think the sense of the people working on the project would be that there will be a combination of technological solutions that are acceptable to the community of Sydney and all of the stakeholders that have moral standing in the project or problem.

The Hon. HENRY TSANG: A lot of overseas visitors have commented that the ocean outfall is a very good piece of infrastructure. I keep saying that it helps to keep our beaches clean and our harbours clean. In retrospect is that a mistake?

Mr HECTOR: I am not sure that I am qualified to comment on whether the technological facilities in the ocean outfalls are good or a bad. My expertise in this project is looking at highly complicated problems and figuring out a means to reach a good solution to the problems. I cannot really comment too much on the technical issues. I do not think I am qualified to do it.

The Hon. RICK COLLESS: A lot of what you just said, you may not be able to answer this either, but I have a technological question I would like to explore. What sort of life expectancy would you consider reasonable for some of the underground network of both supply and sewerage systems?

Mr HECTOR: You are right, I am not sure that I can answer it completely, except to say that I understand Sydney, like most cities that put into place major sewerage and drainage

infrastructure in the second half of the nineteenth century, are facing the same problems as Sydney is with that infrastructure starting to age and needing significant work.

The Hon. RICK COLLESS: It will be an enormous job to start replacing that, will it not, given its extensive nature?

Mr HECTOR: I would expect that ongoing maintenance of that would continue to increase. Yes, the cost will continue to increase.

The Hon. RICK COLLESS: In terms of managing reform that you were talking about, and we can look at the social aspects of the reform such as getting people to use recycled water and all those sorts of things, we require some engineering reforms in terms of putting in third pipes, upgrading the system and mains replacement as I was suggesting, and then trying to work out how that is paid for. How do you think we go about initiating or managing that as a process?

Mr HECTOR: I think the general answer to that question relates not just to water infrastructure but to most of these highly complex issues in big cities, and that is that the problems tend to be quite long-term problems. Whatever institutional change is necessary must recognise that this is not a three or a five-year program and it is fixed. It is a program probably that goes over 20, 30 or 50 years and as you are halfway through it you realise that it has to go over another 20, 30 or 50 years, and it never ends. I think the real challenge is to maintain the economic balance, the social balance and environmental balance. I hesitate to use triple bottom line analogy because I am not sure that it is entirely valid, but it is not a bad sort of starting point. It is a matter of making sure that all of those things are kept in line and we can afford the economic aspects and, at the same time, about the environmental issues and the social issues that are important in a city like Sydney

Ms SYLVIA HALE: If you are looking at a 20 or 50-year program, and it is not suggested just in terms of water supply, but also long-term planning for Sydney requires equally long time frames, you are also asking a lot of governments as well as other entities. What moral suasion do you think you will be able to bring to bear to convince them of the correctness of your approach?

Mr HECTOR: I would imagine the electorate ultimately would answer that.

Ms SYLVIA HALE: Presumably at the end of the project there will be a variety of practical outputs and recommendations. How will you promote those to the community as a whole?

Mr HECTOR: Our intention with the project at this point is to have the groups that we have formed to date, which are 11 teams, across the dimensions of the problem and the technological issues of the problem where we have a methodology that we are following, which I outlined in the attachment. Without going into the details of that what we have two major working sessions planned, one on 11 May and the second one on about 17 July, and we then anticipate having a public conference at which the outcome of those can be discussed and put before the community to which we expect to invite anyone who is interested to come. We hope that will be a two-day conference and we hope to be able to produce a very wide-ranging critique of the problem and some of the issues. Taking on board, then, the community response to that work we would expect to have the report documented within three to four months within the conclusion of that conference, which is scheduled for late September at this point. It is still in the planning stages, but that is our hope. At that point we would anticipate by the first quarter of next year to have the issues clearly identified on the project teams that have worked and then to have had some critique by the community at large.

Ms SYLVIA HALE: It will be immediately before the next State election?

Mr HECTOR: It would be of that sort of time frame I would think, yes. If I could perhaps add to my answer, if I may, I want to emphasise very strongly that the work being done by the Warren Centre, the Academy and Engineers Australia has no political motivation. We are a group of engineers who feel that leadership on this issue is something that is very important and we want to take some professional leadership in trying to identify solutions to this extremely complex issue.

Ms SYLVIA HALE: I suppose it is something of a break for engineers because I suppose they are seen traditionally as coming up with high-tech solutions that they hope will stand alone and

solve the problem in themselves, whereas you are saying that the difference with this project is that it is taking a much more finely grained view of the project?

Mr HECTOR: If you go back to the nineteenth century, just to give another example from the history of the water supply, there was a very serious typhoid outbreak in Sydney in around about 1890. The construction of the sewer outfalls had already commenced, but it was not going to be ready for years. It was going to take 10 or 12 years to complete. A rather foresighted public works commissioner, I think he was, said, "The solution to this is to clean the streets." A lot of water was coming in from the newly constructed dams. He made the decision to put street drainage in as a matter of urgent priority. A lot of the stormwater drainage around what is now the inner part of Sydney was constructed in the period from 1890 to 1900. The water from the newly constructed dams then was used to wash the excrement, particularly hoarse excrement and human excrement, from the streets and the incidence of typhoid, cholera and a number of other communicable diseases was cut by anything up to 80 and 90 per cent. That really was the foresight of one engineer saying, "We have to fix this problem."

If you look back in that period, engineers really were quite highly regarded because of the sorts of solutions they brought to society. But we tended to trust engineers in those days. There have been a lot of incidences in the last 50 years, because of the increasing complexity of society and the increasing complexity of technology, there have been some unfortunate mistakes and engineers generally have been held responsible for those. The consequence of that is that engineers now tend to take a backseat. A group of us felt that that was not a good thing and we decided that we wanted to adopt something more of a leadership role in society, as had been the case in the nineteenth century, because we think that the challenges that face the world community nowadays, but particularly Australia and more particularly Sydney, are immensely complex and they cannot be resolved just by taking a backseat. You have to take initiative and try to drive forward with problems. The problem is now, though, they are highly complex problems of the nation that I have described in my paper. Those are the sorts of issues that we need to deal with. We need to engage all elements of the community in the resolution of those issues.

The Hon. HENRY TSANG: What kind of support has The Warren Centre received from the State and Federal governments, and what result would you like to see come out of this inquiry and from your study into water services?

Mr HECTOR: At this point, it has been all in-kind support. There has been some from both State and Federal governments, but there has been no financial support. We believe the project will ultimately need in the order of several hundred thousand dollars, for us to do the things that we need to do. We believe that if the State and Federal governments were to give us some initial funding, we would not have any difficulty in getting private-sector funding as well, to help support that. That would all be on a purely beneficial basis; there would be no ties to the funding that we would expect to get from the private sector. But we think that if some initial funding came from the State Government, and perhaps the Federal Government, we believe we could take this project through very strongly.

The Hon. HENRY TSANG: What sort of outcome do you think should derive from this inquiry, and perhaps from your study?

Mr HECTOR: What The Warren Centre would like to see from this inquiry is that all representatives of both the upper and lower Houses of the Parliament of New South Wales are in strong support of the project that we have under way. We think it is a very important project for Sydney. We think it is not really something which is a political issue, because of its importance and the very long nature of the issues that are in train here. If you look back to the times when Sydney has provided solutions to its water supply—and that has happened three or four times over the history—it has generally been when many parties have been in support of the issues and putting into place the necessary institutional change and the reform that is needed to take the problem to its solution.

CHAIR: In your written report you talk about Greater Metropolitan Sydney being a very large, complex social system, obviously with a very multicultural social fabric. I wonder whether that is taken into account with your group's assessments in terms of how to progress the debate regarding reuse, how the different communities use the resources, and how you educate them in terms of

conservation and so on. Appreciating that you have not yet finished your deliberations, has your group been able to come to grips with what is a very intricate problem, in terms of giving information so that we can move ahead, both respecting the resource and being mindful of its impact on the sewerage system and so on? Have you locked horns with that complication?

Mr HECTOR: We have, indeed. In relation to the community group that we have working on the area, which is going to engage in a lot of those issues, we deliberately put in place a philosopher to lead that team. We did that deliberately because we wanted to get this very strong engagement from a wide group of people. One thing we recognise is that engineers tend to think much the same—and I think that is probably one of our deficiencies—so we deliberately engaged people beyond the engineering profession so that we could address the very issue you have identified.

We are trying to get people from all social perspectives across all the dimensions of the problem, irrespective of whether or not they have any technical understanding of the issues, because those perceptions in regard to the issues are all very important perceptions. In these situations you often get people who have different perspectives on different sides of the coin. For example, someone may be a passionate gardener and not want to have to take out his rhododendrons; on the other hand he might be an absolutely devoted environmentalist and not want to see a dam built on the Shoalhaven River.

So there are these tensions across the whole gamut of the problem, which is really what makes it so complex. You identify a solution to what you see as a solution to part of the problem, and in fact it becomes a manifestation of another part of the problem.

CHAIR: Taking the gardening styles analogy, are you seeking to impact on the culture to make it more relevant, so you have a cultural input into the type of gardens, what is perceived to be enhancing our physical environment in suburban areas by moving towards something that is more sustainable, in keeping with being able to use less water on those sorts of projects? Is that part of the mix between culture and the physical necessity to be more water conscious?

Mr HECTOR: The first step is that we are seeking to understand the perspectives. Then, when we start getting into the critique of the issues that we have identified, I think we are going to find that there will be no right or wrong solutions to any of these issues but ultimately these things will end up being compromises of one sort or another and we, as a community, will have to navigate our way through those issues and ultimately agree on what we are going to put in place to supply Sydney with water, and we are going to have to agree in one way or another as to how much water we are going to be able to supply.

CHAIR: I note that you are from the Department of Chemical Engineering, is that correct?

Mr HECTOR: I am privately employed, but I am doing a PhD on complex problem structuring in the Faculty of Engineering, through Chemical Engineering.

CHAIR: Do you have anything to contribute to this Committee in terms of, historically, the trade waste agreements, the amount of chemicals in the system, and the impact that has had on the direction of sewerage flow and the lack of reuse in the past, where that is up to at the present time, and whether that is having a significant impact in terms of future strategies for dealing with what is at present treated as a waste and could be treated as a resource?

Mr HECTOR: As I said before, I am not expert in water technology. I believe there are a number of people within chemical engineering who would have the expertise to comment on those issues, but I not able to myself, unfortunately.

(The witness withdrew)

(The Committee adjourned at 5.18 p.m.)