Answers to questions raised in Forum 1 and requests for further information

Some questions were asked in Forum 1 that were similar to questions asked previously, to which the Water Corporation has already provided answers. Information or answers that we have previously provided have been *italicised.*

Is the water treatment plant really necessary?

Disinfection facilities have existed at Mundaring Weir for many years but the water is not filtered yet. A water treatment plant is needed to introduce the filtration process for all water from Mundaring Weir to provide the best possible drinking water to over 100,000 people dependent on this source.

Filtration also has a major role in maintaining the disinfectant residual throughout the pipe network. It filters out the natural organic matter in the source water which would otherwise react with the residual disinfectant chemicals, leaving no active disinfectant left to fight any new micro-organisms.

Mundaring Weir is the primary source of drinking water to people in the Hills suburbs (east of Hardey Road, Glen Forrest) and those served by the Goldfields and Agricultural Water Supply Scheme (G&AWSS) in the area between Toodyay, Dalwallinu, Beacon, Koolyanobbing, Kalgoorlie, Norseman, Marvel Loch, Corrigin, Quairading, Beverley and Mundaring.

Water collected from the Mundaring Weir and Lower Helena Catchment Areas is the most marginal quality of all the Hills dams. This is because of some natural factors and man-made developments within the catchment area. Some natural swampy areas along contributing streams add a lot of natural organic matter. The main factor, however, is that about 105 square kilometres of land in the catchment area is privately owned and used for intensive agriculture, animal grazing, orchards, vineyards, horticulture, hobby farms, unsewered residential areas, pine plantations etc. In addition, due to its proximity to Perth there are lots of authorised and unauthorised recreation activities taking place in the catchment including car rallies, off-road vehicles and trail bikes, hunting, marroning and rubbish dumping.

Aesthetic water quality issue in Mundaring Weir has been an increasing problem in recent years with low water levels, caused by drought conditions, and development in the catchment.

At times, the Water Corporation has had difficulty maintaining compliance with the Australian Drinking Water Guidelines. The proposed Mundaring Water Treatment Plant is required to filter all water from Mundaring Weir, prior to disinfection, to ensure reliable compliance with the Australian Drinking Water Guidelines and to keep pace with improving water quality standards.

The Water Corporation is a strong supporter of water catchment protection and works in partnership with the Department of Water to assess and manage catchments to minimise potential risks from local activities and land uses. The Department of Water is preparing a Water Source Protection Plan for the Mundaring catchment, which will result in better protection of this water source. The Water Corporation supports this process of water

source protection and will assist in catchment protection through processes such as buying properties in the Mundaring catchment (when the opportunity arises) with the view of protecting water quality.

However, as surface water catchments (and particularly the Mundaring catchment) are exposed to a variety of polluting sources and are easily contaminated, it is necessary to treat water from these systems. Improved catchment management will only reduce, not eliminate, the risks in the Mundaring Catchment. The level of treatment can vary, with some systems requiring only disinfection (which currently occurs at Mundaring). However, catchments with contamination risk, such as Mundaring, will require multiple treatment, by processes such as filtration, as well as standard disinfection practices.

One of the most important principles for protecting drinking water quality is that of the multiple barrier approach. It is important to use a number of barriers, including catchment management, detention in protected reservoir or storages and water treatment to protect drinking water quality.

Protection of the source, such as through catchment protection, remains important and is part of the multiple barrier approach but cannot guarantee the protection of the health of the public. Treatment of the water is an important part of the multiple-barrier approach, to prevent reliance on one process. If one barrier fails in the multiple-barrier approach there remains further barriers to provide protection to the consumers.

Has the Water Corporation investigated other options aside from a water treatment plant? Why doesn't it upgrade the existing water treatment plant at the Weir?

A number of alternatives have been considered. These include:

- *Taking Helena Reservoir out of service from May to December (when water is generally of lower quality) and finding an alternative water supply for the Goldfields and Agricultural Water Supply Scheme (G&AWSS). Or taking the Lower Helena Pumpback Scheme out of service and finding an alternative water supply for the G&AWSS. The Helena Reservoir and Lower Helena Pumpback dam has poor quality water as the catchment is heavily compromised by development and uncontrolled land use. However, it is far more cost effective to treat Helena and Lower Helena water than to develop new sources. The Lower Helena Pumpback dam currently supplies about 4.6 gigalitres a year into the G&AWSS.*

- *Imposing greater restrictions on land use within the Helena and Lower Helena catchment areas would help, but not solve the water quality issues. The Department of Water (formerly part of Department of Environment) is preparing a draft Drinking Water Source Protection Plan for the Mundaring Weir Catchment Area.*

- *Installing more water disinfection plants along the Goldfields Pipeline. However, it is considered far better to improve water quality at the source, for the benefit of local users, as well those along the pipeline route. Higher quality water will reduce the amount of re-chlorination necessary for disinfection.*

- *Doing nothing is not an option because the existing water quality is marginal and even higher standards of Australian Drinking Water Guidelines are likely to be imposed in the future.*

There is insufficient space at the existing disinfection facilities below Mundaring Weir, on the north side of the Helena River (in the Shire of Mundaring), for a new water treatment

plant including filtration. Existing facilities are only for disinfection, fluoridation and pumping.

That area has important heritage values and contains a public museum. Even if there was enough space it would not be prudent to site more chemical treatment facilities in an area which is so accessible to the public. One of the reasons for a new Mundaring water treatment plant is to remove chemicals from public areas below the Weir as far as possible.

Space on the south side of the Helena River (in the Shire of Kalamunda) has been considered as Site Option No. 1. Even that has insufficient area for the proposed plant and would require clearing of about 6 hectares elsewhere for residual drying beds.

Why can't the water treatment plant be located further to the east? What other options are there other than a single water treatment plant - consider option of main plant at Northam Industrial Estate for the Goldfields; does Greater Mundaring need a new plant?

- The option of a water treatment plant at Northam is conceptually similar to the option of a water treatment plant at Chidlow except that it is likely to be more expensive than the option at Chidlow because of the greater distance between the water treatment plant and the water source. A new plant is not needed at Greater Mundaring. Instead, treated water would need to be transferred westwards from the water treatment plant at Northam to supply Sawyers Valley, Greater Mundaring, Chidlow and all services located between Chidlow and Northam.

- The option of installing water treatment plants at each township along the Goldfields Pipeline has been considered. There are 58 assessable townships in the Goldfields and Agricultural Water Supply Scheme and it has been estimated that a total of more than 20 water treatment plants will be required. This option is very costly to implement and to maintain. It is best to treat the water at the source.

We want more details on the project costs

Currently, the costs provided are estimates based on the conceptual level of planning carried out for the 11 sites.

Projected Summary of Costs – Mundaring Water Treatment Plant

Group	*Site Options*	*Capital $M*
Below Weir	*Paull's Valley Site – 1km below Weir*	*$121*
	Site 1 – below Weir in Heritage Area	*$118*
Between Weir and Sawyers Valley tanks	*Site 2*	*$151*
	CALM Land	*$156*
	Plantation	*$162*
	Site 3	*$171*
	Site 4	*$165*
	Site 5	*$132*
	Site 7	*$190*

East of Sawyers Valley Tanks	*Site 19*	*$192*
	Site at Chidlow	*$202*

These costs are considered sufficient to allow initial filtering of the sites to a more manageable number for detailed analysis. Current costs exclude land purchases and offsets, but once we have narrowed down the sites to a smaller number, the Corporation will undertake more detailed costings including costs of land purchases, offsets, etc.

A similar cost has been assumed for the treatment plant at all sites. The cost differences for the sites are due to the requirements of various other associated infrastructures such as the lengths of pipe, number of tanks and pumping stations.

Some indicative operating costs are provided below. Further refinement of costs will be provided at a later forum.

- The cost to treat the water is estimated to be about 17cents/kilolitre (kilolitre = 1,000 litres) based on the average of historic running costs for the Integrated Water Supply Scheme conventional groundwater treatment plants. After allowing for the additional cost to remove natural organic matter, we estimated that the treatment cost will be about 20cents kilolitre.
- The current Goldfields and Agricultural Water Supply Scheme demand is 28 gigalitres a year (a gigalitre = 1,000 million litres) and the cost to treat this amount of water at 20cents a kilolitre is about $5.6M.
- Pumping cost is also a component of operating costs.
- The estimated cost to lift 28 gigalitres a year of water from Mundaring Weir to Sawyers Valley Tanks ranges from $2.7M to $3.0M depending on water treatment plant site locations. Generally, pumping cost will be more expensive for sites that are located further away from the Mundaring-Kalgoorlie pipeline, further east of Sawyers Valley or further away from the water source.

Is it possible to use other means of water treatment? What is best practice treatment from around the world?

Conventionally drinking water is treated using a combination of the processes of coagulation, flocculation, sedimentation (or flotation) and filtration to remove particles. There have been advances in water treatment, but generally these have not altered the basic processes for removing particulates from water but rather improved the efficiency of the existing processes. For example, one of the most important advances in water treatment in recent years has been through the use of membrane filtration as an alternative to conventional media-based (such as sand) filtration processes. Membrane filtration involves filtering the water through tiny holes (pores) in a membrane wall and is generally more effective at removing microorganisms (including pathogens). There are a number of kinds of membrane filtration, including microfiltration, ultrafiltration, nanofiltration and reverse osmosis. The two former processes are used for the removal of particulates in water while the latter two are for the removal of dissolved substances (i.e. salts).

Irrespective of whether filtration is implemented as a membrane process or conventional media based filtration, a number of chemicals need to be added to condition the water prior to filtration. Thus, in the case of Mundaring, adopting a microfiltration process will not eliminate the need for upstream chemical addition.

In addition to new technologies for particulate removal, a number of new technologies have emerged for the advanced treatment of water beyond merely particle removal. These technologies are additional to the basic particulate removal technologies and are used where the quality of the raw water dictates they are needed. For example, if the raw water has a significant organic content, technologies such as Magnetic Ion Exchange (MIEX) or alternatively ozonation and activated carbon filtration can be used (in conjunction with conventional processes) to further reduce the organic content of the water.

Disinfection

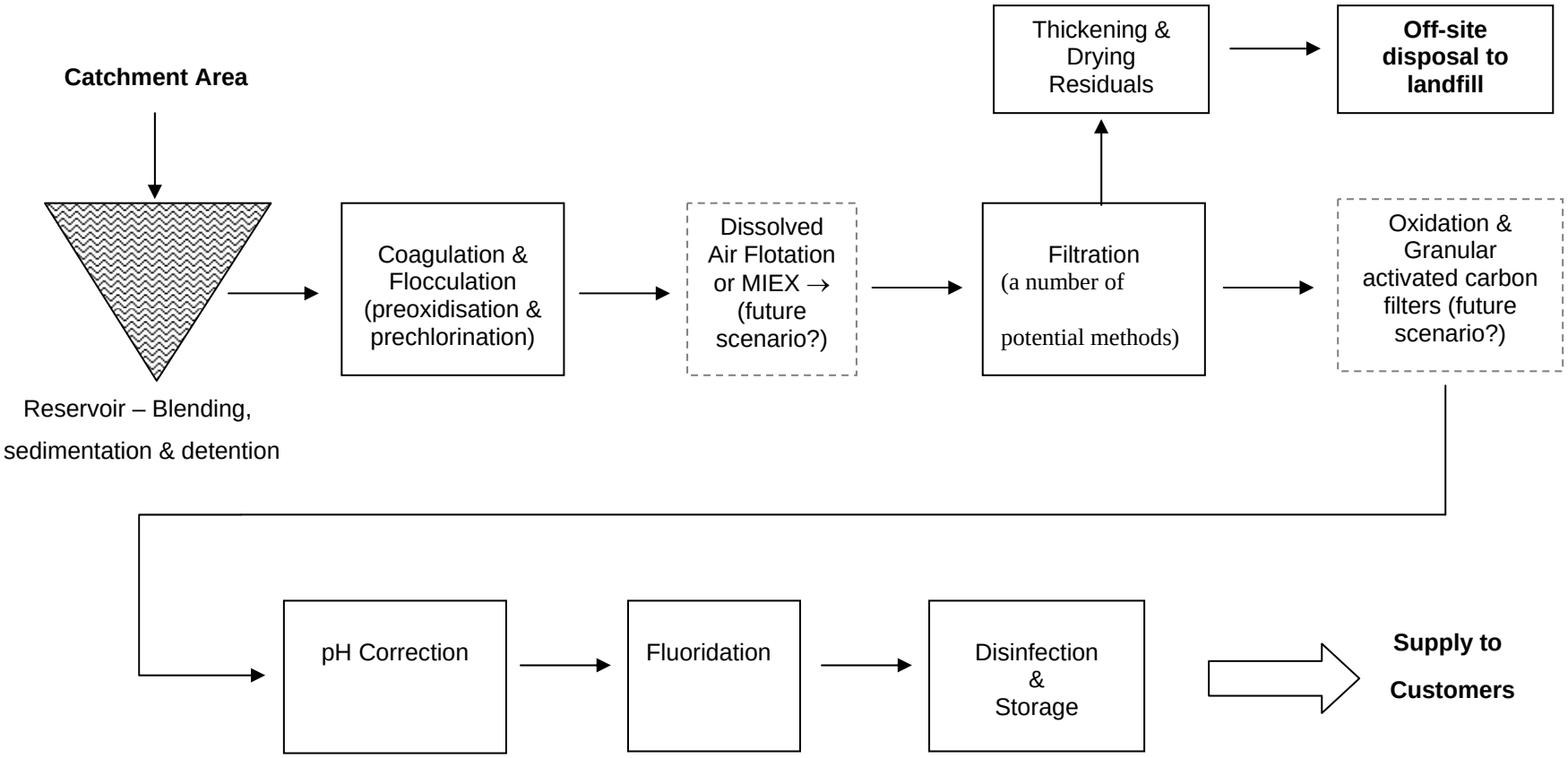
Following particulate removal processes water is disinfected to kill any pathogens in the water. Traditionally disinfection has occurred by chlorination or chloramination; and these processes are still preferred as they not only inactivate pathogens at the source of application but also provide a disinfectant residual that can persist in the water throughout piping systems. There are a number of other disinfection methods including the use of ozone and Ultra-Violet (UV), but these are normally only used in combination with chlorination or chloramination. These newer treatments may be necessary where a water source of inferior quality is used. While these new processes may offer some advantages over traditional disinfection, there remain disadvantages and operating peculiarities that need to be addressed. In addition, these new processes may not be most suitable in all cases. In the original *Mundaring Water Treatment Plant: Design Summary Stage* that was completed by Egis Consulting (in 2001), it was recommended that chloramination disinfection be used, being the most suitable method for the Mundaring situation.

Water Corporation

Water Corporation has a long and distinguished history as being at the forefront of innovation and improvement in water treatment processes. The Water Corporation has won a number of awards for innovation, including for large scale works such as for Beenyup Wastewater Treatment Plant (this was for wastewater not drinking water). Water Corporation has implemented microfiltration at the Harding Dam Water Treatment Plant in the Pilbara, which is one of Australia's largest microfiltration water treatment plants. The Wanneroo Groundwater Treatment Plant uses the innovative MIEX $\rightarrow$ DOC (magnetic ion exchange – dissolved organic content) process for organic removal and was the world's first large scale MIEX facility. Neerabup groundwater treatment plant uses a lime crystallisation process for water softening process, which is the first application of this technology in the southern hemisphere.

These examples indicate the commitment of the Water Corporation to new technologies and the search for innovative and improved water treatment processes. The final choice of water treatment processes at Mundaring Water Treatment Plant will be determined in the detailed design stage and will reflect world's best practice drinking water treatment. However, it remains equally important to use the most appropriate processes to address the local water quality situation, not just the 'best' available treatment.

The Water Corporation normally seeks proposals from its pre-qualified water treatment design panel to carry out definition and design of a major water treatment plant. The Corporation will select the consultant which demonstrates it has the best resources and experience to complete the task in accordance with world's best practice. The design consultant engages a third party reviewer to review all designs and report on the outputs of the design job. For example in 2001, the Egis Consulting design work for the Mundaring Water Treatment Plant was reviewed by a panel of six international experts on water treatment issues.


Catchment Area
Reservoir – Blending, sedimentation & detention
Coagulation & Flocculation (preoxidisation & prechlorination)
Dissolved Air Flotation or MIEX → (future scenario?)
Filtration (a number of potential methods)
Thickening & Drying Residuals
Off-site disposal to landfill
Oxidation & Granular activated carbon filters (future scenario?)
pH Correction
Fluoridation
Disinfection & Storage
Supply to Customers

Where does Mundaring Weir water come from?

Historically the Mundaring-Darlington area and the rest of the Goldfields and Agricultural Water Supply Scheme was supplied from Helena River water stored behind Mundaring Weir and the Lower Helena Pump Back Dam. Almost half of the water behind Mundaring Weir was contributed by the Lower Helena Pump Back scheme.

However, the recent drought due to climate change has drastically reduced streamflow into these dams and the Corporation has needed to pump up water from various Perth sources. These have included treated groundwater from shallow and deep aquifers on the Swan Coastal Plain and surface water from several other Hills dams. Soon treated water from the Perth Seawater Desalination Plant will be added to the mix.

The mix proportions from the various groundwater and surface water sources change continually as the Water Corporation strives to optimise system performance. The majority of water in Mundaring Weir at present has been pumped up from the Perth system.

Explain the difference between the Perth water service and the country service

The main difference is that Perth water is only disinfected with chlorine, while water supplied to Mundaring and country areas by the Goldfields and Agricultural Water Supply Scheme (G&AWSS) is disinfected with both chlorine and ammonia. Chloramination is the process of disinfecting drinking water with chloramines (compounds formed from the reaction of chlorine and ammonia). Chloramines are a longer-lasting disinfectant than chlorine alone, which is important due to the vast size of the G&AWSS, many above-ground pipes, high water temperatures and long detention times in some farmland pipelines.

Where is the Mundaring Weir water used?

Information to come.

Will a new water treatment plant improve the water quality in Mundaring?

Yes. Fewer chemicals will be required for disinfection and a reduction in the potential of Trihalomethane (an undesirable by-product of chlorination) formation. Water taste and odour for the local Hills community will be greatly improved. The risk of microbiological regrowth in the
thousands of kilometres of water pipes in the Goldfields and Agricultural Water Supply Scheme will be reduced. The risk of naeglaria amoeba in swimming pools will be diminished. Episodes of discolored water that sometimes affects clothes washing will be greatly reduced. Also, more of the water at the bottom of Mundaring Weir will be available for use as the treatment plant will remove any traces of sediment.

Also, importantly, water will comply with the Australian Drinking Water Guidelines at all times.

Is there an alternative to alum to treat the water? Many people are concerned that aluminium leads to Alzheimer's disease.

Alum is a chemical approved for use in water treatment by the National Health and Medical Research Council. The Australian Drinking Water Guidelines advise that recent studies indicate that aluminium in drinking water is not associated with increased risk of Alzheimer's disease.

What type of water treatment plant is planned?

The processes and technologies of water treatment are similar all around the world. The standard process is a combination of some or all of coagulation, flocculation, sedimentation and filtration. Following these processes water is disinfected to ensure protection against potential pathogens that may survive the treatment process or be introduced after the treatment process.

The proposed Mundaring Water Treatment Plant will play a major role in prolonging the life of the residual disinfectant. The process will reduce the natural organic matter in the water, which would otherwise react with the residual disinfectant, leaving no active disinfectant to fight new micro-organisms. Extending the life of the residual will mean that less additional disinfection plants are required along the pipeline to Kalgoorlie, thus the overall quantity of disinfectant chemicals will be reduced. Reducing the natural organic matter in the water will also reduce the potential of forming undesirable disinfection by-products (such as Trihalomethanes).

The water at Mundaring Weir is currently being disinfected. What the proposed water treatment plant will do in addition to reducing the natural organic matter in the water is remove particles (using the processes described above), making the disinfection process more effective.

The Mundaring Water Treatment Plant will incorporate a number of treatment processes in order to provide effective multiple barriers to the entry of contaminants in the supply system. While the treatment processes at Mundaring will follow the process outlined above, there are a number of details of the water treatment plant that cannot be determined until the detailed design stage, which cannot occur until a site has been selected.

The type of water treatment plant detailed above is the general water treatment plant expected for Mundaring. As basic water treatment principles are generic and applicable to any water treatment plant, and advances in water treatment generally just improve these processes, advanced technologies and improvements can be incorporated into the detailed design stage where relevant. Details on the type of water treatment plant will be determined by:

- The characteristics of the raw water and the types of water quality problems present;
- Constraints on the water treatment plant from its siting, area or changed environmental, social conditions;
- Any advances in technology.

What are drying beds and why are they necessary?

When raw water passes through various treatment processes such as sedimentation, coagulation, flocculation, filtration, adsorption, oxidation etc, the undesirable organic and inorganic particles are separated from the drinking water. Eventually, a thickened slurry of residuals is piped to drying beds where it is dried by solar energy ready for trucking to an approved off-site landfill.

The residuals are mostly fine soil and humus washed from the catchment area, together with the added coagulant, aluminium sulphate (alum). The residuals are dark brown in colour and do not smell. During cleaning out with a loader and truck there is some benign dust generated which can be blown around on a windy day. However this dust quickly settles well within the plant boundaries.

The proposed drying bed design for the Mundaring Water Treatment Plant consists of a number of sealed, shallow, rectangular ponds with vertical reinforced concrete block sides. The maximum depth of residual is 700 mm with additional freeboard to prevent overflowing in case of heavy rain. The pond bottom consists of a 200 mm layer of filter sand sitting on an impervious plastic liner with a geotextile fabric underlay for protection from sharp stones underneath. Periodically there are 250 mm wide by 250 mm deep underdrainage trenches lined with the impervious membrane and underlay containing 100 mm diameter slotted agricultural drainage pipe, surrounded by 10 mm blue metal screenings. The underdrainage (or supernatant) will be pumped by a duty/standby pump set either back to Mundaring Weir for dilution and detention, or recycled to the start of the water treatment plant (after further treatment and disinfection) to go through full treatment cycle again.

The drying beds are filled sequentially, going through a cycle of filling with residual slurry, drying in the sun, cleaning out with a loader and truck and refilling etc.

Comparison with other drying methods

There are a number of other methods of dewatering the residuals, including mechanical dewatering by plate and frame presses, belt filter presses or centrifuges, and thermal drying, which uses heat to dry the residuals. These methods require less space than drying beds; however, these methods have their negative aspects as well, such as energy requirements.

Consultants (Sinclair Knight Mertz) prepared a report on “Mundaring Water Treatment Plant – Residuals Treatment” in 2002 which compared suitable options for dewatering and disposing of thickened residuals with minimum environmental impact. The three options that were compared were:

- Residual drying beds;
- Mechanical drying (centrifuge and belt filter presses); and
- Thermal drying.

This report recommended that the drying beds option be implemented for Mundaring Water Treatment Plant as it was the most cost effective option with similar environmental impacts to the mechanical options. While mechanical drying requires a smaller plant footprint (and thus, potentially less clearing) greater energy is consumed in the dewatering and transport of the residuals in the mechanical option. It was determined that thermal drying was the most expensive with the most negative impact on the environment due to the high energy requirements.

The report looked at the potential beneficial reuse of the dried residual from the water treatment plant but concluded that no suitable commercial applications had yet been developed around the world.

In the report and recommendations of the Environmental Protection Authority (EPA) for the Mundaring Water Treatment Plant and Sawyers Valley Water Storage Tanks, the EPA considered the consultant's assessment of alternatives to be acceptable.

Drying beds were the recommended option for Mundaring water treatment plant and the site selection process will assume this method. However, if technological advancements or other considerations mean an alternative method may be more suitable this will considered in the future.

More information needs to be provided on the water treatment plant structure and 'footprint'

Based on the preliminary design of the water treatment plant, the proposed height for the main buildings/structures of the water treatment plant and its related supply system are as listed below:

Buildings/structures	proposed height (m)
• Control/operation building	4m with roof pitch at about 5.5m
• Chlorination building	6.8m
• Lime mixing room	10.20m
• Lime storage cylindrical tank	22m (4.6m diameter.)
• Lime water clarifier	7.5m
• Alum/polymer/potassium permanganate/fluosilicic acid storage room	5m
• Carbon dioxide storage tank	7.3m
• Rapid mixing tank and delay tank	6 to 7 m
• Clear water/Filter backwash supply tank	10m
• Aqueous ammonia storage tank	4m
• Pump station	6m - 8.8m
• Surge vessel	11.3m

Light *– Adequate and proper lighting will be provided at the gate and the plant compound for security during night time. Every effort will be made to keep lighting low level. There is not expected to be any significant light 'overspill'.*

Noise *- Depending in the location, there may be some controlled blasting of rock during the earthworks and pipe laying stages. However, most excavation should be accomplished with conventional equipment and rock breakers. Any blasting will comply with all relevant regulations to control noise and vibrations. No noisy operational processes will be included in the water treatment plant and it will be subject to Environmental Protection (Noise) regulations.*

Odour – Water treatment processes are virtually odourless. No smell can be detected off-site.

Smoke, Fumes, Dust – Water treatment processes do not emit smoke, fumes or dust. Minor dust generated from periodic cleaning out of residual drying beds with loaders and trucks will not blow off-site.

Security *- High level security precautions will be used to prevent damage from vandalism, theft and to protect the site. Sensitive and hazardous facilities, equipment and chemicals will be housed in locked buildings. Electrified security fences, razor wire, electronic alarm systems, video surveillance, security patrols and appropriate signage*

will help secure the site. Water Corporation rangers and plant operators living locally at Mundaring Weir can respond quickly to alarms.

The Water Corporation has a infrastructure protection program for all its assets, which continues to evolve in a dynamic and sensitive external security environment.

***Traffic –** During water treatment plant operations, there will be on average less than one truck visit a day, either transporting chemicals to site or solid waste away to landfill. At least seven days storage (at peak flow rate) will be provided for all major water treatment chemicals to be used. In addition there will be several movements per day of passenger vehicles and light trucks driven by Water Corporation personnel working at the water treatment plant.*

Can the water treatment plant be compressed to take up less land?

The proposed water treatment plant layout planning is primarily driven by the process requirements. The process units have been arranged in such a way to minimise major pipe and cable runs. Chemical dosing facilities have been located as close to the various dosing points as possible.

The Water Corporation would like to "compress" the water treatment plant layout and reduce the area of land needed to be cleared. However, the design of the water treatment plant layout is governed by safety standards and guidelines. For example; the chlorine building must be separated from the operation building by at least 50 metres to comply with safety requirements. Separation from other dangerous goods facilities must be at least 15 metres.

For safety reasons, Water Corporation design standard has adopted a chlorine buffer zone of 250 metres. A more detail quantitative risk assessment will be conducted once the water treatment plant site is confirmed, which may or may not reduce the buffer required.

Due to the difficulties in obtaining all the necessary approvals for a water treatment plant site and the effect the site selection has on the design and construction of associated water infrastructure within the region, it would be extremely short-sighted to choose the smallest possible site. A treatment plant for Mundaring Weir will probably always be required and so sufficient land (20 – 25 hectares) should be set aside now to provide for the future.

Extra land may be needed for increased capacity, new and improved technology and to achieve higher water quality standards. The plant layout needs to be able to accommodate new process modules with minimum disruption and impact on the initial facilities.

Some allowance of space will be needed around the corners of internal access roads to cater for manoeuvre of the maintenance trucks and the chemical delivery trucks. Space is also needed to satisfy the fire break requirement when designing the water treatment plant layout.

A study has been carried out to compare the mechanical dewatering systems which required a smaller footprint (and thus, potentially less clearing) with the sludge drying beds. The result of the study recommends that the drying beds option to be implemented for Mundaring Water Treatment Plant as it was the most cost effective option with similar environmental impacts to the mechanical options.

We want more details on the water treatment plant at the different sites

At this stage Water Corporation is not able to give specific details for each site option. However, the main components of works for the 11 options identified by Water Corporation have been broadly defined. The 11 options have been categorised into three main groups (as presented in the forum on 8 May 2006) as below:

Group 1 - Site below the Weir (cheapest and simple to operate).
This includes Site 1 and the site 1km below the Weir

Group 2 - Site between the Weir and Sawyers Valley Tank.
This includes Site 2, 3, 4, 5, 7, CALM land and the pine plantation next to CALM airstrip.

Group 3 - East of Sawyers Valley Tank
Site 19 and private property in the conceptual location east of Chidlow.

The main components of works for the water treatment plant and its related transfer system for each of the above groups are as follows:

Group 1

a. Raw water pipeline from Mundaring Weir to the water treatment plant site
b. Water treatment plant
c. Treated water pump station at water treatment plant site
d. Treated water pipeline from pump station to the existing twin pipelines to Sawyers Valley Tank (Mundaring-Kalgoorlie pipelines)

Group 2

a. Raw water and potable water pump stations at the Weir
b. Raw water pipeline from the Weir to the raw water pump station
c. Raw water pipeline from raw water pump station to the existing twin pipelines.
d. Raw water pipeline from the existing twin pipelines to the water treatment plant
e. Suction tank at the Weir and its associated pipeworks to the potable water pump station and overflow pipeworks to the weir
f. Potable water pipeline from the pump station to water treatment plant.
g. Water treatment plant
h. Treated water pump station at water treatment plant site
i. Treated water pipeline from treated water pump station to existing twin pipelines to Sawyers Valley or to the existing 50 megalitre (million litre) storage tank if the water treatment plant is located at Sawyers Valley Tank site.

Group 3

a. Raw water and potable water pump stations at the Weir
b. Raw water pipeline from the Weir to the raw water pump station
c. Raw water pipeline from raw water pump station to the existing twin pipelines.
d. Suction tank at the Weir and its associated pipeworks to the potable water pump station and overflow pipeworks.
e. Potable water pipeline from the potable water pump station to one of the existing twin 9 megalitre (million litres) storage tanks at Sawyers Valley
f. Potable water pipeline from the existing twin 9 megalitre (million litres) storage tank to water treatment plant
g. Treated water pump station
h. Treated water pipeline from the treated water pump station to one of the existing twin storage tank at Sawyers Valley

i. 50 megalitre (million litres) service reservoir beyond Chidlow
j. Treated water pipelines to and from (one each) the 50 megalitre (million litres) service reservoir to the existing Mundaring – Kalgoorlie pipeline.

In addition to the above there will be upgrading works for the Mundaring Weir outlet structures and decommissioning of the two existing pump stations. These works are needed for all the three groups.

What is the effect of slope on the site for water treatment plant?

The site slope has a number of impacts on the site's potential use as a water treatment plant.

The topography of the site can impact on the effectiveness of the water treatment plant, with plants often requiring a difference in height between the water level at the head of the treatment processes and at the end of the treatment processes. The topography of the site can also impact on the costings of the site as the large amounts of earth works that may be required to make the site suitable for the treatment plant can significantly increase costs.

Drying beds are best sited on level ground where they can be approximately square (which minimises construction cost). If drying beds are sited on a slope they need to be long and narrow following the contours across the slope (which increases the length and cost of side walls). Long beds would also make the cleaning out process less efficient. It is best if the hill does not shade the ponds from sunlight in the morning or evening, or shelter the ponds from prevailing winds.

The site slope can also impact on aspects including visual impact. Sites on a slope or on a hill may be more visually intrusive than sites at a low point. However, this is also dependent on where the site can be viewed from and the screening available. Site slope also impacts on environmental considerations, such as the risk of erosion across the site.

Explain further the issues with the Weir Site (Site 1)

Site 1 was the initial choice for the water treatment plant due to its position at the source of water. It was originally costed as the cheapest site.

In late 1999, following representations from the Shire of Mundaring, the National Trust of Australia (WA), the Mundaring Tourism Association and then local member June van de Klashorst MLA, the then Minister for Water Resources and the Corporation decided that the site below Mundaring Weir was unacceptable for aesthetic, heritage, recreation and tourism reasons.

In July 2003 a letter from the CEO of the National Trust to Water Corporation stated "The Trust is strongly protective of the nationally significant heritage values inherent in the Mundaring Weir precinct. Having stated that, it is totally unacceptable for the proposed water treatment plant be located in this precinct."

There are currently plans for a tourist precinct being instigated at Site 1.

Why is a third water pipe required from the Weir to the water treatment plant?

For security of water supply to over 100,000 people in the Goldfields and Agricultural Water Supply Scheme it is important, in case of a water quality or quantity issue at Mundaring Weir or the Mundaring Water Treatment Plant, to have a back-up source of water which can quickly be brought on-line. The obvious back-up is from Perth and the Integrated Water Supply System (IWSS).

The two existing water pipelines between Lower Helena Pump Station and Sawyers Valley Tanks are already at close to maximum capacity. If in the future they are normally used to convey untreated raw water from Mundaring Weir to the proposed Mundaring Water Treatment Plant they would be contaminated with micro-organisms. The Corporation's current disinfection guidelines for water mains requires that a raw water pipeline be cleaned, disinfected and tested for micro-organisms prior to being used for conveying drinking water to customers. This thorough procedure normally takes 5 – 6 days to complete.

To ensure the bypass is available within minutes or hours of a problem developing, it seems desirable at the planning stage to construct a third main from Mundaring Weir to the water treatment plant site. Then one of the three mains will always be used for conveying Perth drinking water only.

Current Corporation practice is to construct new mains underground to keep water temperatures down, so there would not be an adverse visual impact from the third water pipeline.

How were the sites chosen from the aerial photographs?

As part of our preliminary investigations into a possible site for the water treatment plant, the Water Corporation conducted a 'desktop' assessment of land in the general area of interest using aerial photographs. Using these photographs, the Water Corporation simply looked for patches of land that appeared large enough to accommodate a water treatment site and for areas that were not undisturbed bushland.

There were a number of sites that the Water Corporation did not consider warranted further investigation and they were deemed on the map as 'not meeting initial criteria'. This was primarily because of:

- *Number of land owners impacted*
- *Suitable chlorine buffer distance available*
- *Distance from the Mundaring - Kalgoorlie Pipeline*
- *Return distance from the Sawyers Valley water storage tanks*
- *Size of site (up to 25ha)*

What are the risks from accidents and chemicals stored at the site? How much chemical (chlorine and ammonia) is stored at Mundaring Hill? How much chemical (chlorine and ammonia) will be stored at the proposed water treatment plant? What are the risks involved eg. trucking chemicals? List the chemicals.

There are no chemicals currently stored at Mundaring Hill. There are only three tanks containing drinking water (with very low levels of residual disinfectant).

Chemical dosing currently takes place below Mundaring Weir. The chlorine storage shed on the south side of the Helena River is licensed for up to twelve 920 kg drums of liquefied chlorine gas. Aqua ammonia is stored in a 17.5 cubic metre tank inside a concrete bund on the north side of the Helena River.

There is a very low risk of harm to the public from the trucking of chemicals. The four most hazardous chemicals (rated Red on the Chem Alert Colour Rating System) currently planned to be used at the proposed Mundaring water treatment plant are already being trucked to Mundaring Weir in similar quantities (chlorine, ammonia, fluorosilicic acid and sodium hydroxide). Therefore the proposed plant is unlikely to add significantly to the risks. Chemical suppliers and emergency services have safety and operations plans to minimise risks and to respond appropriately to any emergency.

The typical chemicals stored at a water treatment plant are:

- *Chlorine*
- *Ammonia*
- *Carbon dioxide*
- *Aluminium sulphate*
- *Calcium hydroxide (lime)*
- *Potassium permanganate*
- *Activated carbon*
- *Fluorosilicic acid*
- *Polyacrylamide type polyelectrolyte.*

All the chemicals will be handled and stored in accordance with Water Corporation Standards and Guidelines, which have been developed in accordance with national and state regulations.

The water treatment plant is in the planning and definition stages and the treatment processes will not be finalised until the detailed design stage, about 3 years before project completion. Water treatment technology is advancing rapidly due to research and development. The capital and operating costs of different treatment processes are also changing both quantitatively and relatively. Consequently the following list of process chemicals is based on current water treatment practice. These chemicals are used in water treatment processes and are suitable for human consumption at the very low concentrations employed.

The chemicals listed below may be used at Mundaring Water Treatment Plant. The chemicals are used in drinking water treatment processes and are suitable for human consumption at the very low concentrations employed.

Chemical Name	Synonym/Physical State	Concentration	Chem Alert Colour Rating *	Storage Vessels	Maximum Quantity to be Stored On Site	Current Supplier
Chlorine	*Liquefied Gas*	*100%*	*Red*	*14 x 920 kg*	*12.88 tonnes*	*Wesfarmers CSBP*
Ammonia	*Solution*	*25%*	*Red*	*Tanks 1 & 2*	*30 kL*	*Klen*
Fluorosilicic Acid	*Solution*	*22%*	*Red*	*Tanks 1 & 2*	*20 kL*	*Wesfarmers CSBP*
Hydrochloric Acid	*Solution*	*32%*	*Red*	*Tank*	*1.5 kL*	*Wesfarmers CSBP*
Sodium Hydroxide	*Caustic Soda Solution*	*50%*	*Red*	*Possible*	*TBA*	*Orica*
Hydrogen Peroxide	*Solution*	*50%*	*Red*	*Possible*	*TBA*	*Klen*
Sulphuric Acid	*Solution*	*98%*	*Red*	*Possible*	*TBA*	*Coogee*
Carbon Dioxide	*Liquefied Gas*	*100%*	*Amber*	*Vessels 1-4*	*100 tonnes*	*Air Liquid*
Aluminium Sulphate	*Alum Solution*	*50%*	*Amber*	*Tanks 1-3*	*252 kL*	*Coogee*
Calcium Hydroxide	*Lime Hydrated Powder*	*85%*	*Amber*	*Silos 1 & 2*	*180 tonnes*	*Cockburn Cement*
Potassium Permanganate	*Condy's Crystals*	*100%*	*Amber*	*Hopper*	*3 tonnes*	*Redox*
Polyaluminium Chloride	*PAC Liquid* *Flocculant*	*83%*	*Amber*	*Hoppers 1 & 2*	*2 tonnes*	*Hardman Australia*
Ferric Chloride	*Solution*	*42%*	*Amber*	*Possible*	*TBA*	*Orica*
Sodium Bisulfite	*Solution*	*35%*	*Amber*	*Possible*	*TBA*	*Redox*
Ferric Sulphate	*Solution*	*40%*	*Amber*	*Possible*	*TBA*	*Process Chemicals/Orica*
Sodium Hypochlorite	*Solution*	*12.5%*	*Amber*	*Possible*	*TBA*	*Wesfarmers CSBP*
Ozone	*Liquefied Gas*	*100%*	*Amber*	*Possible*	*TBA*	
Carbon, Activated	*Powdered or Granulated*	*60%*	*Green*	*Hopper*	*80 m3*	*Activated Carbon*
Carbon	*Anthracite Coal Filter Medium*	*90%*	*Green*	*12 x 99 x 1.5 m3*	*1782 m3*	
Sodium Bicarbonate	*Soda Ash Powder*	*100%*	*Green*	*Possible*	*TBA*	*Redox*
Sodium Hexametaphosphate	*Calgon Powder or Flakes*	*100%*	*Green*	*Possible*	*TBA*	*Albright & Wilson*

** Chem Alert Colour Rating System is a quick and easy way to describe the hazardous nature of a chemical product: Red: High Hazard; Amber: Moderate Hazard; Green: Low Hazard*

Generally, all dangerous chemicals except alum (NB. Alum is not a dangerous good) will be housed in buildings. Liquid alum will be stored in tanks located in a bund. All chemicals which are classified as dangerous goods will be handled and stored in accordance with the respective Australian Standards.

A chemical spills and waste management plan will be in place where the chemical storage and preparation areas will be bunded and drained to sumps. Sumps will be provided with alarms to indicate that spillage or water ingress has occurred, requiring the operator to attend the area and check the sump water quality before deciding on the manner of its discharge to the plant drainage system (for very small quantities [10 litres] after neutralisation) or by pump out for controlled disposal. In addition, allowance will be made on site for truck delivery spill bunds.

Risk of Incident

In the past seven years, the Water Corporation has recorded only four incidents that have resulted in emergency response activities. Only one (at Albany) needed to be notified to the Department of Minerals and Petroleum Resources. The Albany incident was a significant leak and the only impact on the community was that the odour of chlorine was detectable about 200 metres from the facility. The Albany plant has since been upgraded.

Chlorine is the most cost effective way of disinfecting water and has been used by the Water Corporation and its predecessors since the end of World War 1 without any recorded community impact that has resulted in injury or illness. Through its "Chlorine Hazard and Safety Management System", modern designs and appropriate siting of facilities, the Water Corporation aims to continue its unblemished record.

The Water Corporation will prepare a Hazard Management Plan to address the handling, storage and disposal of all hazardous materials at the site. The plan would be developed in consultation with and on the advice of the Department of Consumer and Employment Protection prior to commissioning.

What is a Chlorine Buffer Zone?

The minimisation of safety risks associated with the use of chlorine gas has been based on assessment of the "inherent risk" (the potential to cause a fatality). The assessment method most commonly employed to assess "inherent risk" is the Quantitative Risk Assessment (QRA) which estimates the risk associated with the operation of a facility, calculates the likely frequency, and gauges the severity of an incident for a range of distances from the facility. The area enclosed by these risk contours are commonly known as "chlorine buffer zones". They take into account factors such as prevailing winds and topography. Chlorine gas is heavier than air and usually drifts downhill and downwind. The further away from the source of the leak the lower the chlorine concentration and the lower the risk, due to dilution in the atmosphere and reaction with vegetation or other material in its path.

The Corporation commissions a QRA from experts in the field during the design of the layout of a major water treatment plant using chlorine. The Corporation ensures that the risk contour for a ten in a million chance per year of a fatality from a chlorine accident is entirely enclosed within the perimeter security fence so that no member of the public is exposed to that risk level.

A larger area, enclosed by the risk contour for a one in a million chance per year of a fatality from a chlorine accident, is generally referred to by the Corporation as the "chlorine buffer zone". It should not include private residences or areas frequented by the general public, but is not always fenced off. To put it in perspective, the risk of a pedestrian being knocked down and killed by a car is about 100 in a million chance per year. Therefore a person taking a walk through the chlorine buffer zone and crossing a road is 100 times more likely to be run over than gassed by chlorine.

During the planning phase before a QRA is done for the selected site, normal practice is to use a circular chlorine buffer zone with a radius related to the number of chlorine drums proposed to be stored on site. For the Mundaring Water Treatment Plant a chlorine buffer zone of 250-metre radius has been used for planning purposes.

These are only theoretical risk potentials and are not based on historical data. Due to stringent safety standards and practices in Australia there have not been any chlorine fatalities to date.

In the event of a serious accident or event, how far would the chlorine plume go and what would be the risk to residents?

Chlorine drums are extremely strong and unlikely to rupture in road accidents. Transport of dangerous goods is strictly regulated in Western Australia by the Department of Consumer and Employment Protection. Further information on risks and safety precautions is available on the Department's website.

The absence of fatalities in Australia related to the use of chlorine gas may be attributed to the rigorous safety practices, "Hazop" and Quantitative Risk Assessment, employed by manufacturers, distributors, regulators and users of chlorine gas.

The United Nations Environment Program website

http://www.uneptie.org/PC/apell/disasters/lists/cstransport.html

lists major accidents during the transportation of hazardous materials throughout the world since 1974. Only eight accidents involving chlorine transport are listed, the majority are in developing countries or involve bulk transport by rail. There was one accident quoted from a developed country (Ahlsfeld, Germany, 1990) which involved the release of chlorine from a truck. More than 182 people were exposed to some chlorine gas and were listed as injured, but no-one died.

The quantity of chlorine being transported through the Mundaring Shire will not change significantly because of the new water treatment plant. The chlorine dose rate should reduce slightly after the water is filtered, however allowance has to be made for growth in water demand, and hence chlorine use, over the life of the plant. Only the local roads being used for chlorine transport may change, depending on site selection.

Chlorine becomes the responsibility of the Water Corporation after it is delivered onto our premises.

How will the chemicals be transported?

Various trucks will be used to transport various chemicals in accordance with all applicable Australian and State Laws, Regulations and Codes of Practice. This is not the responsibility of the Water Corporation. Chlorine only becomes the responsibility of

the Water Corporation after it is delivered onto our premises. However, we have agreements with our chemical suppliers that require them to comply with relevant health and safety regulations.

Seismic data is needed. What risks are posed by an earth tremor. What would be the worst case scenario if the tanks ruptured or leaked?

During the design phase of the water treatment plant a geotechnical investigation will be commissioned by the Water Corporation. Geotechnical investigations usually include the assessment of the soil, rock and groundwater. An engineering evaluation will typically outline any adverse geotechnical features across the site. Geotechnical evaluations typically involve the assessment of subsurface conditions and include an evaluation of excavation conditions, foundation/settlement issues and slope stability assessments. In areas of known high seismic activity an assessment regarding the potential for seismic disturbance may be included.

Once a select number of sites for the water treatment plants has been chosen, a preliminary geotechnical investigation could aid in site selection by determining any adverse geotechnical features, that may affect the design and cost associated with the construction of the water treatment plant.

We need more details on the environmental impacts

There is a lot of information on environmental features and potential impacts at the various sites that needs to be considered in the site selection process. There is information available, in the form of figures and associated details about the environmental constraints in the Mundaring area, which will be provided to the forum when it is required for use in the site selection process (this could be from Forum 2 onwards). More detailed information (such as the amount of land clearing required) will be made available once we have narrowed down the initial sites into a more manageable number (ie. the 11+ sites to be worked out at Forum 2).

Through the forum process we aim to get down to 3 – 4 sites that we can then assess in greater detail. An assessment of potential environmental impacts will be conducted for these sites and the information obtained from these assessments will be used in the final selection process. At this stage it may be necessary to conduct field surveys, such as Flora and Fauna surveys and Heritage surveys.

A recommended site will be selected through a sustainability assessment, which means that environmental, social and economic issues associated with the sites will be considered and the site will be selected with the aim of avoiding, or minimising impacts on these considerations.

Once a site has been determined, and the project has progressed to the design stage, the final site will be subject to a complete Environmental Impact Assessment, which would be referred to the Environmental Protection Authority for assessment. The Environmental Impact Assessment will evaluate the potential effects of the water treatment plant on the environment and will include potential mitigation and management of these effects. The final water treatment plant design will take into account site-specific environmental factors to minimise any impacts on these features.

It is understood that some environmental impacts from the water treatment plant may not be able to be avoided, minimised or effectively managed for example vegetation

removal. Unavoidable environmental impacts may need to be addressed by the provision of offsets. Environmental offsets should be considered as a 'last line of defence' for the environment, when other options have been considered and exhausted. The Water Corporation operates in accordance with Environmental Protection Authority position statement #9. For this project we will determine how environmental impacts can be avoided, minimised or reduced before we begin considering environmental impacts that cannot otherwise be avoided. Offsets should be used with a goal of achieving a *'net environmental benefit'.*

Direct offset options include restoration or rehabilitation of existing degraded ecosystems, re-establishing desirable ecosystems, purchase and protection (ie. addition to the conservation estate) of other locations with a similar ecosystem, or implementation of agreed recovery plans for species. Environmental offsets should ideally be 'like for like or better', which means that the offset should counterbalance the loss of a system at a site, and protect same type of ecosystem elsewhere, and should aim for improvements beyond what is required for 'like for like'. An environmental offset package may be considered where adverse residual environmental impacts are significant, but not significant enough to make the project unacceptable. Where offsets are to be provided, these offsets must be agreed with either the EPA or relevant government agencies (such as the Department of Conservation and Land Management (CALM).*

Potential environmental impacts during construction and operation will be mitigated by the preparation of a comprehensive environmental management system, which will be developed in conjunction with the CALM and the Department of Environment, etc…. It will cover issues such as salinity, erosion, site hygiene (CALM guidelines to control spread of dieback and weeds); fire management (in conjunction with CALM, Fire and Emergency Services Authority (FESA) and local volunteer fire brigades); and traffic, noise, light, vibration and dust management and monitoring.

*If anyone seeks further information on offsets the EPA's *Position Statement No. 9: Environmental Offsets* is available on the EPA's website.

How will the waste issues be resolved?

There is not a significant waste issue associated with a water treatment plant. The residuals are mostly fine soil and humus washed from the catchment area, together with the added coagulant, aluminium sulphate (alum). The residuals are dark brown in colour and do not smell. During cleaning out with a loader and truck there is some benign dust generated which can be blown around on a windy day. However this dust quickly settles well within the plant boundaries.

By 2040 it is estimated that only 2253 cubic metres (113 truck loads) of dried residual will be produced per year. Non-recoverable waste will be responsibly disposed of. For example, the dewatered (spadable) filter residual solids (>35% dry solids content), which will be predominantly alum sludge, will be trucked to the Red Hill landfill site via main roads as far as possible. A representative from the Red Hill landfill had indicated that the nature and quantity of the solid waste will be acceptable and there is plenty of spare capacity available.

If the beds are emptied three times per year then each time there would be 10 truckloads per day for three day.

All rubbish and litter generated during construction and operations will be placed in approved receptacles and regularly carted away for reuse to an approved landfill site.

Potential social issues

The sites all have potential social impacts; however, the extent of the impact depends primarily on the positioning of the site and the land use of the area in which it is located. Sites that are not in residential areas may not have any direct impacts on properties but may impact residents in other areas, such as through visual pollution.
As part of the site selection process we will investigate the potential impacts on residents and the number of residents affected for the various sites. The impact on residents may be measured by potential visual impacts, noise, traffic etc.

The site will be selected based using a sustainability assessment that incorporates social, economic, and environmental factors. Social issues will be considered along with economic and environmental issues.

What potential visual impacts may the water treatment plant have?

Adequate and proper lighting will be provided at the gate and plant compound for security during night time. Every effort will be made to keep lighting low level. There is not expected to be any significant light 'overspill'.

The site will be selected using a sustainability assessment that incorporates social, economic, and environmental factors. Social issues will be considered along with economic and environmental issues. Visual impact and aesthetic concerns form part of the social issues that will be examined when selecting the site.

Will private property be considered?

The Minister for Water Resources has the power to compulsorily acquire land for the provision of essential community services such as water infrastructure, but there was never any serious consideration of exercising this right in relation to the proposed Mundaring Water Treatment Plant. Should the community consultation process recommend privately owned land as a possible site, the Corporation will contact the affected land owners to discuss their interest in selling.

There needs to be more information on sites and the criteria that will be used to make the assessment

Yes, there needs to be more information on the sites and criteria presented to the forum. We plan to introduce this information at Forum 2 and onwards. There is a large amount of information that needs to be presented and understood by the community forum so we plan to introduce this during the forums at the most appropriate moments so that this can be explained and discussed. As the forums progress it will be necessary to gather more data as required. This may include field investigations and obtaining feedback from a variety of stakeholders.

A full triple bottom line assessment will be undertaken during the facilitated workshops. This is such that the criteria by which the site options are assessed can be developed in conjunction with the community, rather than the Water Corporation deciding how to assess the sites. This assessment will be applied in stages, the first being by using "threshold criteria" to the 11 sites that are currently considered feasible. This will rule out sites that do not meet a particular "threshold" of acceptance. A reduced number of sites will then be subjected to the more rigorous full triple bottom line assessment against each of the sustainability criteria.

Will there be input by other stakeholders?

Yes, there are a number of stakeholders that will require input into the site selection process. It may be necessary to include these stakeholders into the deliberative forums, where possible, so that their views and feedback can be included in the site selection process. These stakeholders potentially include:

- Community
- Local Residents' and Ratepayers' Associations
- Department of Conservation and Land Management (CALM)
- Shire of Mundaring
- Department of Planning and Infrastructure
- Department of Environment
- Department of Health
- Department of Water
- Conservation Commission
- Conservation Council
- EARTH – Hills Community Environment Group
- Forest Products Commission
- Reserve Protection Group
- Department of the Environment and Heritage
- Proprietors of potentially affected businesses
- Mundaring Tourist Association
- Heritage Council of WA
- Relevant Aboriginal Groups
- Kalamunda Shire Council
- National Trust

Some of these stakeholders are currently involved in the community forum; input from other stakeholders will be sought in the future, where relevant.