



Department of Planning and Infrastructure

MAJOR PROJECT ASSESSMENT
Western Sydney Recycled Water Initiative
– Replacement Flows Project

Director-General's
Environmental Assessment Report
Section 75I of the
Environmental Planning and Assessment Act 1979

May 2007

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EXECUTIVE SUMMARY

Sydney Water Corporation (the Proponent) proposes to construct and operate an Advanced Water Treatment Plant and associated works (known as the Replacement Flows Project) within Western Sydney as part of the Western Sydney Recycled Water Initiative, a component of the 2006 Metropolitan Water Plan. The Replacement Flows Project involves treatment of existing tertiary treated effluent from Quakers Hill, St Marys and Penrith sewage treatment plants at a new Advanced Water Treatment Plant to produce high quality recycled water. The recycled water would be substituted, as replacement flows, for water that is currently released from Warragamba Dam for this purpose thereby saving valuable drinking water each year. The project would involve the construction and operation of a number of pipelines to transfer the treated effluent to the new plant, to transfer the replacement flows back to the Hawkesbury Nepean River system at Boundary Creek and to transfer concentrate from the reverse osmosis process from the plant to the Northern Suburbs Ocean Outfall Sewer for treatment at the North Head Sewage Treatment Plant.

Only one submission from a private individual was received in response to the public exhibition of the Environmental Assessment from a total number of 20 submissions received. Most of the submissions were from Government authorities although a number of submissions were also received from special interest groups such as the commercial fishing industry and irrigators. Of the total number of submissions received 25% objected to the project, 20% supported the project and 55% neither supported or objected to the project but provided issues of concern regarding the construction and operation of the project. The key issues raised in submissions focussed on water quality and river health issues (including aquatic ecology impacts), water quantity impacts and reduced flows in South Creek and potential impacts from the project to irrigators.

Following the exhibition period and a review of the submissions, the Proponent modified the alignment of the concentrate pipeline between Seven Hills and where the pipeline would connect to the existing Northern Suburbs Ocean Outfall Sewer at Vineyard Creek. The changes were outlined and assessed in a Preferred Project report which was also reviewed by relevant authorities as part of the assessment process.

The Department has undertaken a comprehensive assessment of the technical merits of the proposal and associated infrastructure, and based on this assessment, as detailed in this report, has recommended that the Minister grant approval to the construction and operation of the project. Through its assessment, the Department has determined that the key assessment issues for the proposal relate to water quality and river health impacts (including ecological impacts) and water quantity impacts. Other issues considered in this assessment report relate to the treatment process, terrestrial flora and fauna, impacts to the fishing industry, impacts from the construction of the pipeline route and impacts to irrigators.

The conditions of approval recommended by the Department have been carefully drafted to ensure that a comprehensive environmental framework is established, with a particular focus on ensuring that impacts to water quality and river health (including aquatic ecology) are minimised. The conditions of approval recommended by the Department would ensure that the quality of the replacement flow is as good or better than predicted as part of the Environmental Assessment documentation. The recommended conditions also require the Proponent to undertake a number of monitoring programs and studies to provide important information about the characteristics of the Hawkesbury Nepean River and to ensure that the project adequately protects the environment. The project would have the greatest effect on the reaches of the Hawkesbury Nepean River downstream of the Warragamba Dam junction by reducing the concentration and loads of nitrogen and phosphorus and thereby improving water quality within the river.

The Replacement Flows Project would utilise recycled water and effectively replace releases from Warragamba Dam which would save up to 18 billion litres of drinking water each year by 2015. The Department considers that the project, together with other river management initiatives being implemented as part of the 2006 Metropolitan Water Plan, will importantly conserve potable water which is a significant step towards securing Sydney's water supply for the future.

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1. BACKGROUND

1.1 Location

Sydney Water Corporation (the Proponent) proposes to construct and operate an Advanced Water Treatment Plant (AWTP) and associated works within Western Sydney as part of the Replacement Flows Project. The project involves treatment of existing tertiary treated effluent from Quakers Hill, St Marys and Penrith sewage treatment plants (STPs) at a new AWTP to produce up to 50 million litres per day (ML/day) of high quality recycled water. The recycled water would be substituted, as replacement flows, for water that is currently released from Warragamba Dam for this purpose saving up to 18 billion litres of drinking water each year by 2015 and making a significant contribution to conserving Sydney's water supply.

The project comprises the new AWTP as well as associated pipelines which would transfer the tertiary treated effluent from the three STPs to the AWTP for further treatment. A pipeline would also be required to transfer the recycled water from the AWTP to the existing outlet at Penrith STP and a separate pipeline to transfer concentrate from the AWTP to a storage pond at Quakers Hill STP and then to the Northern Suburbs Ocean Outfall Sewer. The project is known as the Replacement Flows Project which is part of the Western Sydney Recycled Water Initiative which forms a component of the 2006 Metropolitan Water Plan (refer Section 1.2 below).

The project would be constructed and operated within four local government areas (LGA), namely:

- Penrith LGA;
- Blacktown LGA;
- Baulkham Hills LGA; and
- Parramatta LGA.

The AWTP would be located within the site of the St Marys STP in the Blacktown LGA. The pipelines would be generally located between the Quakers Hill STP, the St Marys STP and the Penrith STP.

As part of a Preferred Project Report prepared for the project in accordance with Section 75H of the Environmental Planning and Assessment Act 1979 (EP&A Act), a Pilot Plant is also proposed to be constructed and operated within the boundary of the St Marys STP to demonstrate the performance of the treatment technology. This facility would be temporary and will be operated on the site for a minimum period of four months.

1.2 The 2006 Sydney Metropolitan Water Plan

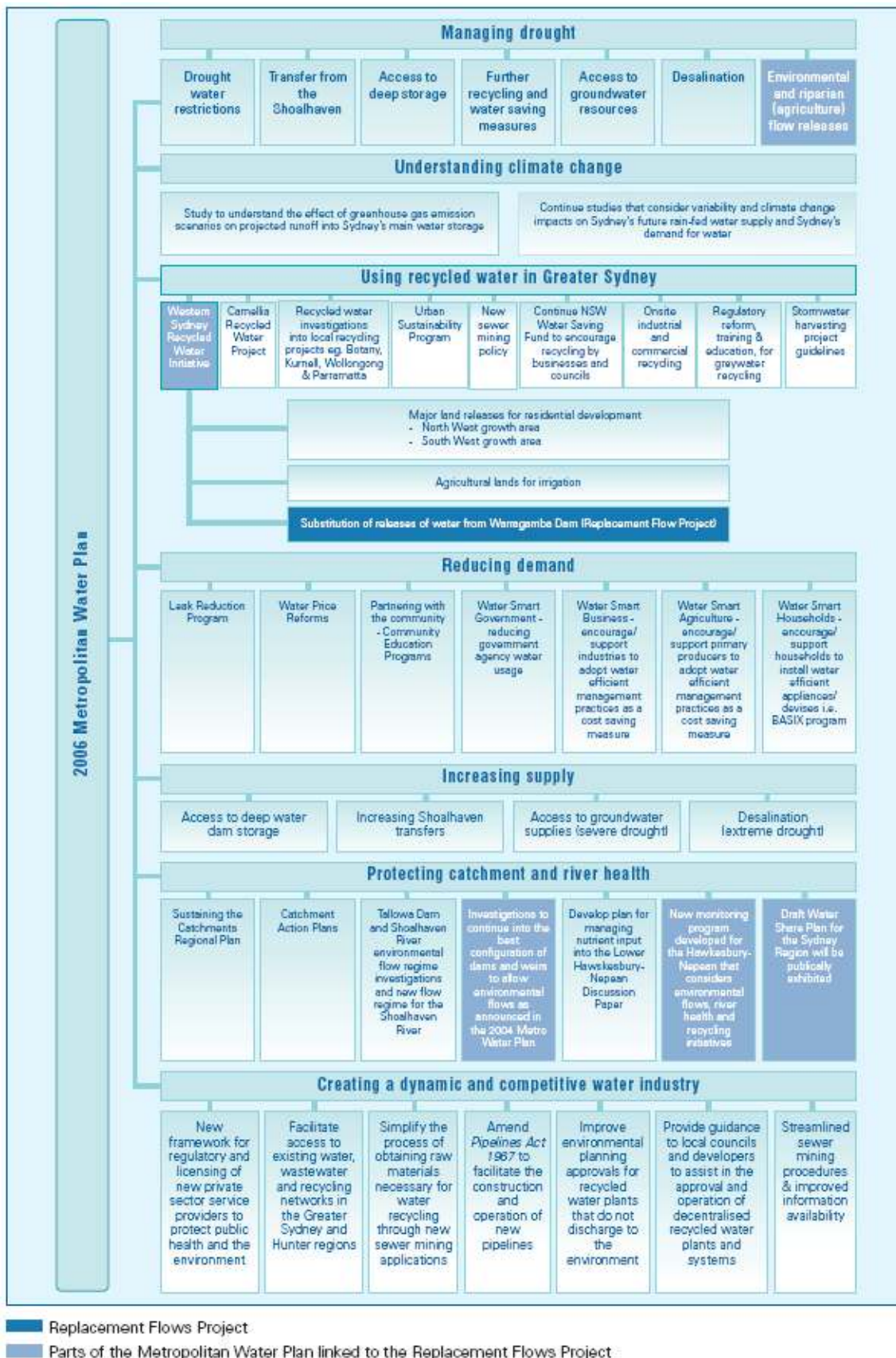
The *2006 Sydney Metropolitan Water Plan* details how the NSW Government will secure Sydney's water needs over the next 25 years. The Plan outlines strategies to balance demand for water with a sustainable supply as outlined in Figure 1. The objectives of the Plan are proposed to be achieved by:

- providing a secure supply of water that can meet the long term needs of Sydney;
- ensuring that water supplies are adequate during drought; and
- minimising costs to the community and the environment.

A general layout of the Replacement Flows Project is shown on Figure 2 in the context of the Western Sydney Recycled Water Initiative.

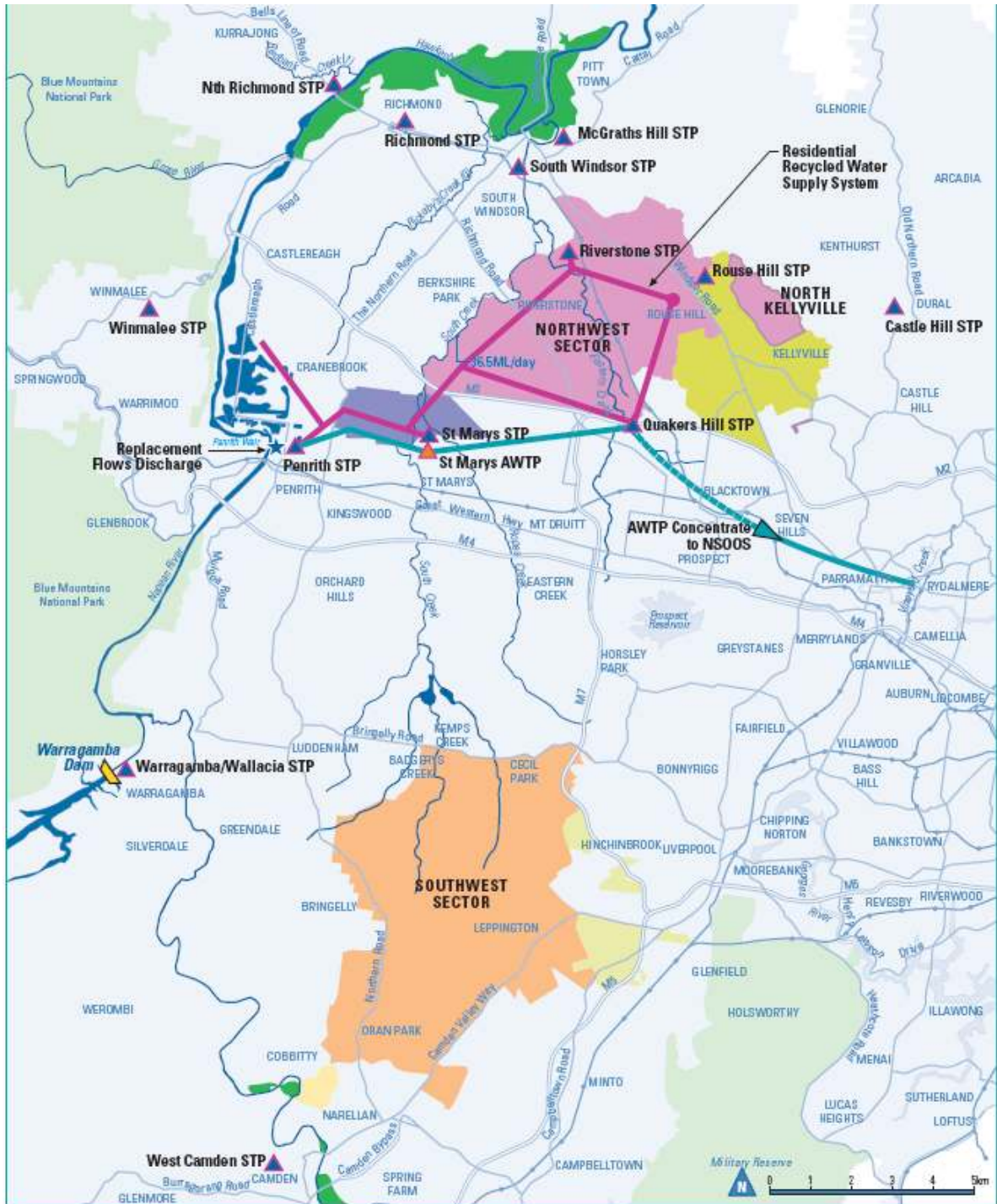
Recycled water is a key focus of the 2006 Metropolitan Water Plan. The Proponent has developed a number of initiatives, including the Western Sydney Recycled Water Initiative to deliver potential savings of up to 70 billion litres of water per year by 2015 through the use of recycled water. When fit-for-purpose recycled water is used for non-potable uses, it reduces the demand on the drinking water system thus boosting water availability. The Proponent has also indicated that recycling can also deliver substantial river health benefits by reducing the load of nutrients discharged by STPs. Recycled water, being a non-rain dependent supply option, can also reduce the impact of future droughts by reducing demand pressures from rain-fed storages such as Warragamba Dam.

Figure 1 – 2006 Sydney Metropolitan Water Plan



Source: Figure 2-1 of Proponent's Environmental Assessment (SWC AND SKM, 2006)

Figure 2: Western Sydney Recycled Water Initiative



- | | |
|--|--|
| <ul style="list-style-type: none"> Residential Recycling Former ADI Development Camden Greenfield Development Hoxton Park Development Northwest growth Sector Southwest growth Sector Rouse Hill Project Area Replacement Flows Discharge Point Residential Recycled Water Supply System Replacement Flows Project | <ul style="list-style-type: none"> Agricultural Recycling Agricultural land Sewage Treatment Plant (STP) Advanced Water Treatment Plant (AWTP) General Features Major Roads Railway lines Rivers Lakes/Dams National Park or Reserve |
|--|--|

Source: Figure 2-3 of Proponent's Environmental Assessment (SWC AND SKM, 2006)

1.3 Western Sydney Recycled Water Initiative

The Western Sydney Recycled Water Initiative forms an important component of the 2006 Sydney Metropolitan Water Plan. The Proponent has indicated that its implementation of the initiative will contribute to maximising the beneficial use of recycled water for residential, industrial, agricultural and environmental purposes. The initiative provides for significant uses for recycled water as shown on Figure 2:

- major land releases for residential development (including the North West and South West Growth Centres) whereby both centres are expected to be supplied with recycled water from tertiary treated effluent suitable for reuse for non-drinking uses;
- irrigation of agricultural lands; and
- substitution of releases of water from Warragamba Dam (the Replacement Flows Project).

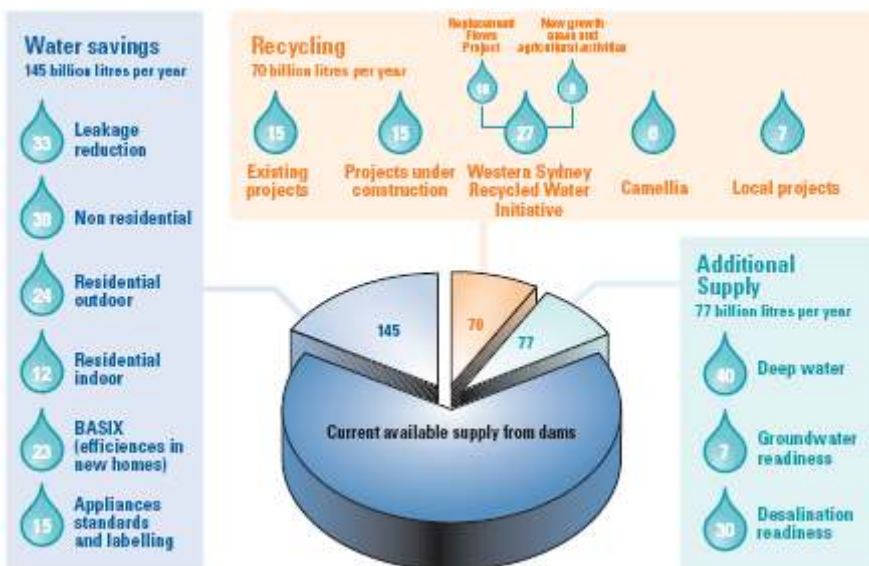
The Western Sydney Recycled Water Initiative is expected to make available an extra 27 billion litres of water per year by 2015. These savings would be made up of 18 billion litres per year from the Replacement Flows Project (the subject of this assessment) with the remainder (9 billion litres per year) being from the use of recycled water as part of the growth centres and from the irrigation of agricultural lands.

The Proponent outlines that the North West Growth Centre will be the first area to receive recycled water as there are already several STPs in the region that produce tertiary treated effluent suitable for reuse. Future development plans for the South West Growth Centre are still being finalised and a south west recycling scheme is proposed to be implemented as development proceeds.

The North West Growth Centre will be supplied with recycled water from the existing Sydney Water STPs in the area. The recycled water from these STPs will need to be shared amongst the markets identified in the Western Sydney Recycled Water Initiative – residential development, substitution of Warragamba Dam releases (i.e. the Replacement Flows Project the subject of this assessment) and for agricultural irrigation. Based on population projections for the North West Growth Centre, the Proponent has calculated that there is, and will continue to be sufficient tertiary treated effluent produced by St Marys, Penrith and Quakers Hill STPs to satisfy all current and future recycled water demands, including the Replacement Flows Project.

The water savings provided by the Western Sydney Recycled Water Initiative are outlined in Figure 3 in relation to the overall water savings that are expected as a result of the implementation of other elements of the 2006 Metropolitan Water Plan.

Figure 3: 2006 Metropolitan Water Plan – Water Savings



Source: Figure 2-2 of Proponent's Environmental Assessment (SWC AND SKM, 2006)

1.4 Nepean River Pump and Pipeline

The Department has received a separate project application from Penrith Lakes Development Corporation who is proposing to develop a water pipeline and associated pump infrastructure to provide a secure long term water supply to the Penrith Lakes Scheme in western Sydney. The Corporation proposes to construct a new 4.3 km pipeline to extract a maximum of 86 megalitres (ML)/day of water from the Nepean River during high flows from a point upstream of the Penrith Weir to the Scheme site. The extracted water would be pumped from the Nepean River and used to fill five lakes, two of which would be used for recreational purposes. Once completed, the Penrith Lakes Development Corporation estimates that the lakes would hold approximately 35,000 ML of water. The Corporation expects that the lakes will take between two and three years to fill.

Pumping of Nepean River water will only commence when flows exceed 500 ML/day over Penrith Weir and would cease when flows fall to 350 ML/day. The Environmental Assessment for the project was exhibited between 25 September and 30 October 2006 and a total of six submissions were received.

The Department has assessed the proposed Nepean River Pump and Pipeline Project concurrently with the proposed Replacement Flows Project. The Department does not consider that the Nepean River project would have any impact on the subject proposal as it will only involve water extraction during high flows.

2. PROPOSED DEVELOPMENT

2.1 Project Description

The Proponent proposes to implement the Western Sydney Recycled Water Initiative – Replacement Flows Project which aims to replace up to 50 ML of water per day currently released from Warragamba Dam to maintain environmental flows and to supply water for river users, with highly treated effluent from three STPs in Western Sydney.

The project comprises the following components:

- a new AWTP on the existing St Marys STP site and a temporary pilot facility;
- effluent transfer pipelines and pumping stations to convey existing treated effluent from the Quakers Hill, Penrith and St Marys STP to the AWTP for further treatment;
- a pipeline and pumping station to transfer brine from the AWTP to a holding pond at the Quakers Hill STP site, for buffering prior to discharge to the Northern Suburbs Ocean Outfall Sewer at Vineyard Creek, Dundas; and
- a treated water transfer pipeline from the AWTP to the existing effluent outlet at Penrith STP into Boundary Creek, which discharges into the Hawkesbury-Nepean River below Penrith Weir.

It should be noted that the Environmental Assessment prepared for the project and the resultant prediction of impacts has relied on a number of other water initiatives being undertaken as part of the 2006 Metropolitan Plan and the Western Sydney Recycled Water Initiative. These initiatives include:

- increase to Upper Nepean Dam (Avon, Cordeaux, Cataract and Nepean) releases to up to 68 ML/day in 2009 under the direction of the Sydney Catchment Authority;
- West Camden STP upgrade, amplification and reuse scheme;
- decommissioning of the Warragamba STP;
- construction and operation of a new STP at Wallacia;
- Riverstone STP upgrade and reuse scheme;
- South Creek Servicing Strategy; and
- implementation of the Water Sharing Plan being developed by the then Department of Natural Resources (which includes defining the releases of environmental flows from dams and weirs, defining maximum extraction limits for individual licences and defining a low-flow level where extraction would be prohibited).

During the assessment of the project, the Proponent made the Department aware that due to a significant heavy rainfall occurring at the West Camden STP site on 11 and 12 February 2007, serious structural damage occurred to the newly constructed Intermittently Decanted Aerated Lagoon (IDAL) tanks being constructed as part of the West Camden STP upgrade. Given the damage, the Proponent has indicated that completion of the West Camden STP upgrade, amplification and reuse scheme is expected to be delayed until the end of 2009.

2.1.1 Advanced Water Treatment Plant

The AWTP would be housed in a single building (approximately 10 metres internal height). It is proposed to be located in the north-west corner of the existing St Marys STP site within the existing site boundary as shown on Figure 4. Approximately 65 ML per day of treated effluent from Quakers Hill, Penrith and St Marys STP would pass through the AWTP yielding up to 50 ML per day of highly treated recycled water, approximately 8 ML per day of recovered concentrate and 7 ML per day of backwash from the pre-treatment process. Backwash would be returned to the inlet of the St Marys STP for further treatment.

The tertiary treated effluent would undergo a range of treatment processes, shown on Figure 5, as follows:

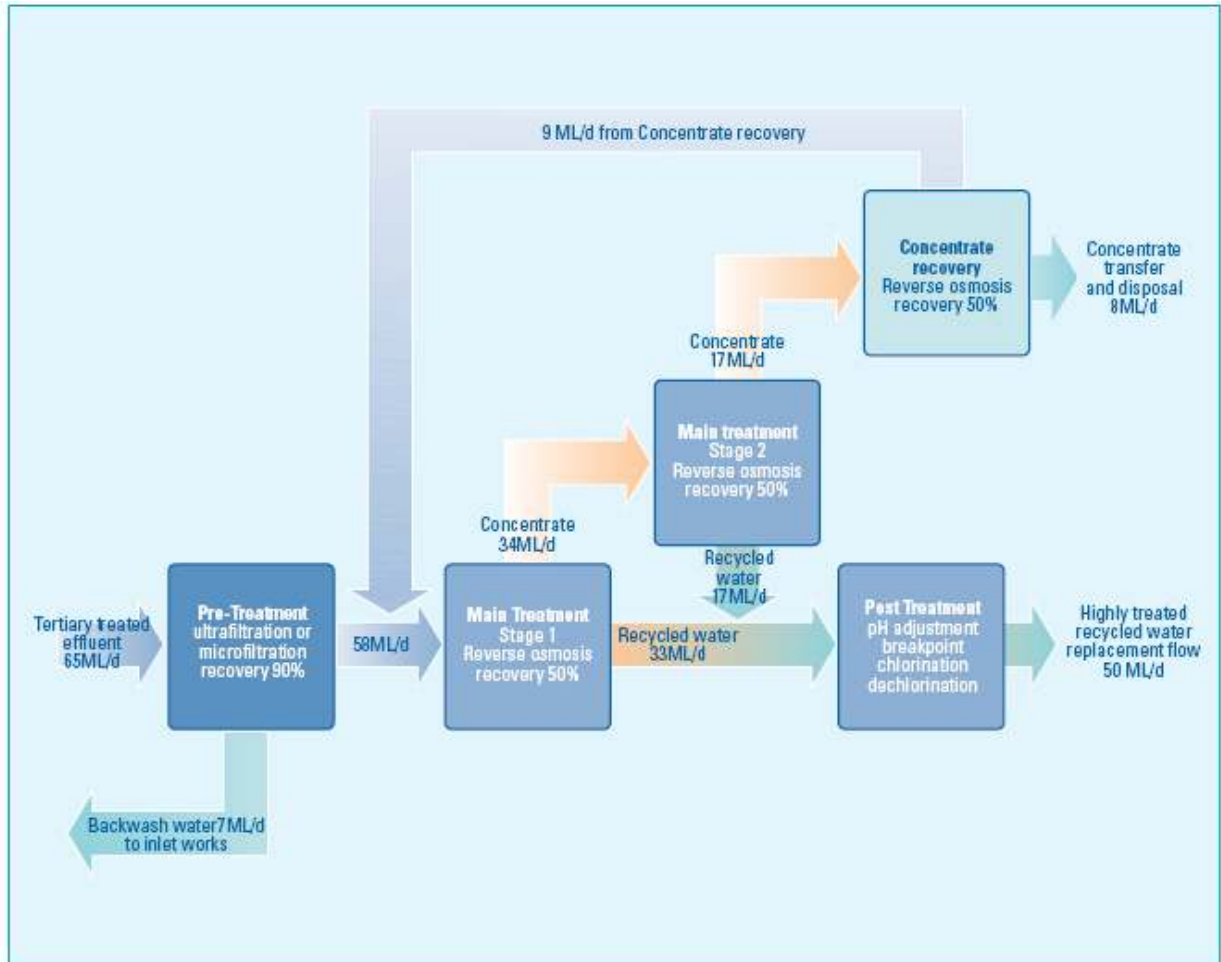
- pre-treatment – comprising mechanical strainer, ultrafiltration or microfiltration and chemical dosing systems;
- main treatment – comprising single pass, two stage reverse osmosis for product water and single stage reverse osmosis for concentrate volume reduction; and
- post-treatment – including pH adjustment, breakpoint chlorination and dechlorination.

Figure 4: AWTP Site and Layout



Source: Figure 3-3a and b of Proponents Environmental Assessment (SWC AND SKM, 2006)

Figure 5: Water Treatment Process and Flow Balance



Source: Figure 3-4 of Proponent's Environmental Assessment (SWC and SKM, 2006)

The Proponent's Environmental Assessment indicates that the recovery rate of the process to be approximately 85%, i.e. for 1000 litres of tertiary treated effluent, approximately 850 litres of recycled water and 150 litres of concentrate would be produced. Following treatment, the recycled water would be discharged into the Hawkesbury-Nepean River via Boundary Creek as replacement flows as shown on Figure 6.

The AWTP is proposed to operate 24 hours a day, seven days per week, except for periodic maintenance and possible shutdown during prolonged periods of wet weather.

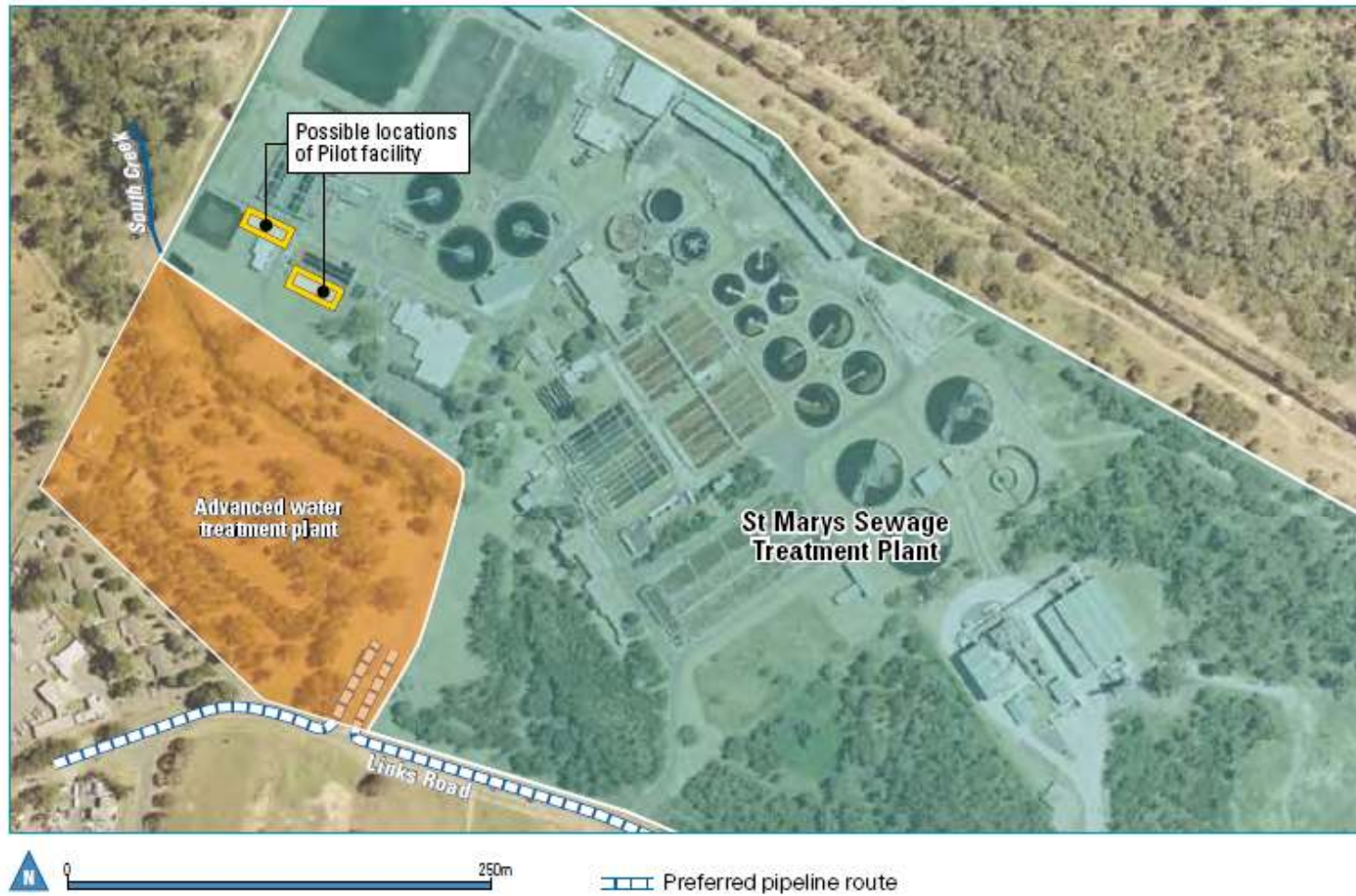
A pilot facility is proposed to be established on the St Marys STP site to demonstrate the performance of the treatment technology. The pilot facility would be located to the north and adjacent to the new AWTP to provide easy access to tertiary treated effluent. Possible locations for the pilot plant are shown on Figure 7. The Proponent has indicated in its Preferred Project Report that the pilot facility would replicate the main process components of the proposed full-scale AWTP in its entirety and would process 0.8% or 0.55 ML per day of treated effluent and produce approximately 0.07 ML per day of concentrate. The pilot facility would be temporary and would be operated for a minimum period of four months. All testing is proposed to be completed prior to finalising the design for the AWTP. At the completion of testing, the pilot facility would be relocated to the AWTP site and the area rehabilitated.

Figure 6: Discharge from Penrith STP



Source: Figure 3.7 of Proponent's Environmental Assessment (SWC and SKM, 2006)

Figure 7: Possible locations for the Pilot Facility at St Marys STP



Source: Figure 4.2 of Proponent's Preferred Project Report (SWC and SKM, 2007)

2.1.2 Pipelines

Two effluent transfer pipelines would be constructed as part of the project – one would be located between Penrith STP and St Marys STP (8 km) and the other would be located between Quakers Hill STP and St Marys STP (12 km) as shown on Figure 8 and Figure 9. Both pipelines would be approximately 500 mm in diameter and located underground. An internal pipe system would transfer the effluent from the St Marys STP to the new AWTP within the site.

A recycled water pipeline would be required to be constructed between the AWTP and Penrith STP adjacent to the effluent transfer pipeline to transfer the recycled water to Boundary Creek (which flows into the Hawkesbury-Nepean River) via the existing outlet at Penrith STP. The Proponent has indicated that the recycled water pipeline would be about 750 mm in diameter and have a nominal capacity of 50 ML per day.

In addition, a 375 mm diameter pipeline for the transfer of concentrate from the AWTP to the Quakers Hill STP would be required. A new pump station to be located at the Quakers Hill STP would then pump the concentrate to Seven Hills via an existing 300 mm diameter pipeline. During times of wet weather when transfer of concentrate to the Northern Suburbs Ocean Outfall Sewer would not be possible, the concentrate would be stored with a concentrate storage pond to be located within the site boundary of the Quakers Hill STP.

The Environmental Assessment indicated that a new 12 km section of 375 mm diameter pipeline would be constructed to transfer the concentrate from the existing pipeline to the Northern Suburbs Ocean Outfall Sewer at Vineyard Creek at Dundas. Since the Environmental Assessment was prepared, the Proponent has reviewed the submissions received from the public exhibition period and has decided to modify the route of the concentrate pipeline from Seven Hills to Vineyard Creek. The land use along the revised route of the pipeline is similar to that of the original route but unlike the original route, the revised route does not pass beside or through any railway land. Figure 10 shows the original and revised pipeline route from the existing pipeline at Seven Hills to the Northern Suburbs Ocean Outfall Sewer at Vineyard Creek.

Balance storage tanks and pumping stations would also be required as part of the project at Quakers Hill, St Marys and Penrith STPs. A 10 ML per day pumping station may also be required at Seven Hills to pump the concentrate along the new pipeline to connect with the Northern Suburbs Ocean Outfall Sewer at Vineyard Creek.

Construction of the project would start in mid 2007 with completion scheduled for the end of 2009. The majority of the pipelines would be constructed by trenching methods, however, small sections of the route would be directionally drilled. Directional drilling of the pipeline would only be undertaken under sensitive surface features such as watercourses, significant vegetation, potential archaeological deposits, major roads, railways and other areas to avoid impacts. The Proponent expects that the effluent, recycled water and concentrate transfer pipelines would require a combined 2 to 3 m wide trench and be about 2 m deep. The 32 km of pipelines is expected to take approximately 12 months to construct with each section completed progressively.

Construction would be undertaken during normal construction hours although the Proponent has indicated that night-work may also be required where the pipelines cross major roads or intersections to minimise impacts on traffic.

The Proponent has estimated that the capital cost of the project is in the order of \$265 million.

Figure 8: Pipeline from Penrith STP to St Marys STP



Source: Figure 3.5a of Proponent's Environmental Assessment (SWC and SKM, 2006)

Figure 9: Pipeline from Quakers Hill STP to St Marys STP



Source: Figure 3.5b of Proponent's Environmental Assessment (SWC and SKM, 2006)

Figure 10: Comparison of Original and Revised Concentrate Pipeline Routes



Source: Figure 4.1a from Proponents Preferred Project Report (SWC and SKM, 2007)



Source: Figure 4.1b from Proponents Preferred Project Report (SWC and SKM, 2007)

2.2 Project Need

The Department considers that the Environmental Assessment has adequately outlined the need for the project.

In terms of the *2006 Metropolitan Water Plan*, the main objective is to provide a secure supply of water to meet the long term needs of Sydney. In addition, the Plan states that the Proponent needs to ensure that the water supplies are adequate during periods of drought and that the supply of water minimises costs to both the community and the environment. The Replacement Flows Project would save up to 18 billion litres per year of current Warragamba Dam discharges thereby providing more potable water for Sydney. In addition, the project would reduce the discharge of nutrients from the existing Penrith, St Marys and Quakers Hill STPs into the Hawkesbury-Nepean River and the South Creek systems. As an example, the project would reduce the total nitrogen concentrations currently discharged from Penrith STP by 14% and total phosphorus concentrations by 75%.

Currently, water suitable for drinking is released from the Warragamba Dam to maintain river health and a portion provides for extraction by irrigators downstream. In non-drought conditions, the Proponent has indicated that 33 ML per day is released by Sydney Catchment Authority (SCA) as part of its Water Management Licence as base flow and another 10 ML/day is released for agricultural and irrigation purposes. Under current drought conditions, SCA releases 22 ML/day although additional releases can sometimes be required to ensure that a minimum flow of 50 ML/day is maintained over the Penrith Weir (a requirement which dates back to the Dam's construction).

The project would therefore use treated effluent that has been further treated in the AWTP to provide high quality recycled water to be released at Boundary Creek adjacent to Penrith Weir thereby replacing potable water that is currently released from Warragamba Dam with highly treated replacement flows, saving up to 18 billion litres of drinking water each year.

The project is to be undertaken in combination with other planned river management changes, one of which includes increased releases from the Upper Nepean Dams and the use of recycled water in new development areas. The Proponent therefore considers that the project would ensure that the substitution of Warragamba Dam releases with replacement flows would deliver an equivalent or higher level of environmental benefit to the river and maintain water for irrigation/agriculture, recreation needs and for aquatic life.

2.3 Alternatives Considered

Water Treatment and Discharge Location

The Environmental Assessment outlines the alternatives that were considered for the project. Alternatives were considered for two key aspects:

- treatment options for the AWTP; and
- recycled water discharge locations.

The main issue in the selection of a preferred water treatment process and a discharge location was dependent on the nutrient levels and loads in the recycled water that could be achieved and the avoidance or prevention of any increased eutrophication downstream of the discharge location. The main treatment processes considered as part of the Environmental Assessment were:

- nanofiltration;
- ion exchange;
- denitrification; and
- reverse osmosis.

Reverse osmosis was selected as the preferred treatment process as it would achieve the goals of removing nutrients from the tertiary treated effluent, in particular the bioavailable forms of phosphorus and nitrogen. In addition, the Environmental Assessment stated that reverse osmosis also provided a barrier to pathogens as it would remove complex chemicals such as pesticides, herbicides and pharmaceuticals within the effluent stream.

A number of further options were also considered for the main treatment process including:

- denitrification only;
- single pass reverse osmosis only;
- single pass reverse osmosis with denitrification;
- two pass reverse osmosis;
- two pass reverse osmosis with denitrification; and
- options listed above with breakpoint chlorination.

From the analysis undertaken as part of the comparison of options and the comparison of a combination of options, the Proponent decided on single pass reverse osmosis with breakpoint chlorination as this would achieve total nitrogen and total phosphorus loads equivalent to or better than the base case in 2009. Either microfiltration or ultrafiltration would be used as the preferred pre-treatment options, subject to final design requirements.

Two options were considered for discharge of the recycled flow to the Hawkesbury-Nepean River system:

- discharge from Penrith STP via the existing discharge point into Boundary Creek which flows into the river downstream of Penrith Weir; or
- discharge near where the Warragamba River flows into the Nepean River. This option would have required an additional pipeline to be constructed from the AWTP at St Marys to the Nepean River at Wallacia Bridge.

The assessment of the above options concluded that based on the increased costs for the higher treatment options that would have been required to discharge at Wallacia Bridge and the additional construction impacts and costs associated with 20 km of new pipeline between St Marys and Wallacia Bridge, the discharge into the Nepean River downstream of the Penrith Weir was selected as the preferred discharge option. In addition, the risk of transferring increased nutrient loads into the Penrith Weir Pool would not occur for the preferred discharge option.

Pipeline Routes

Three different pipelines would be required as part of the project – one for the transfer of tertiary treated effluent from Penrith STP and Quakers Hill STP to the new AWTP at St Marys STP, one for highly treated recycled water to be conveyed from the AWTP to the discharge point at Boundary Creek, and a pipeline to transfer concentrate from the storage pond at Quakers Hill STP to the Northern Suburbs Ocean Outfall Sewer at Vineyard Creek, Dundas. Options for pipeline routes were also considered as part of the alternatives assessed during the preparation of the Environmental Assessment. The criteria that were assessed for the location of pipelines took into account engineering factors, social and economic issues (traffic impacts, access to private property and heritage impacts) and potential impacts to the natural environment.

A number of options were considered for each of the pipeline locations as shown on Figures 11, 12 and 13.

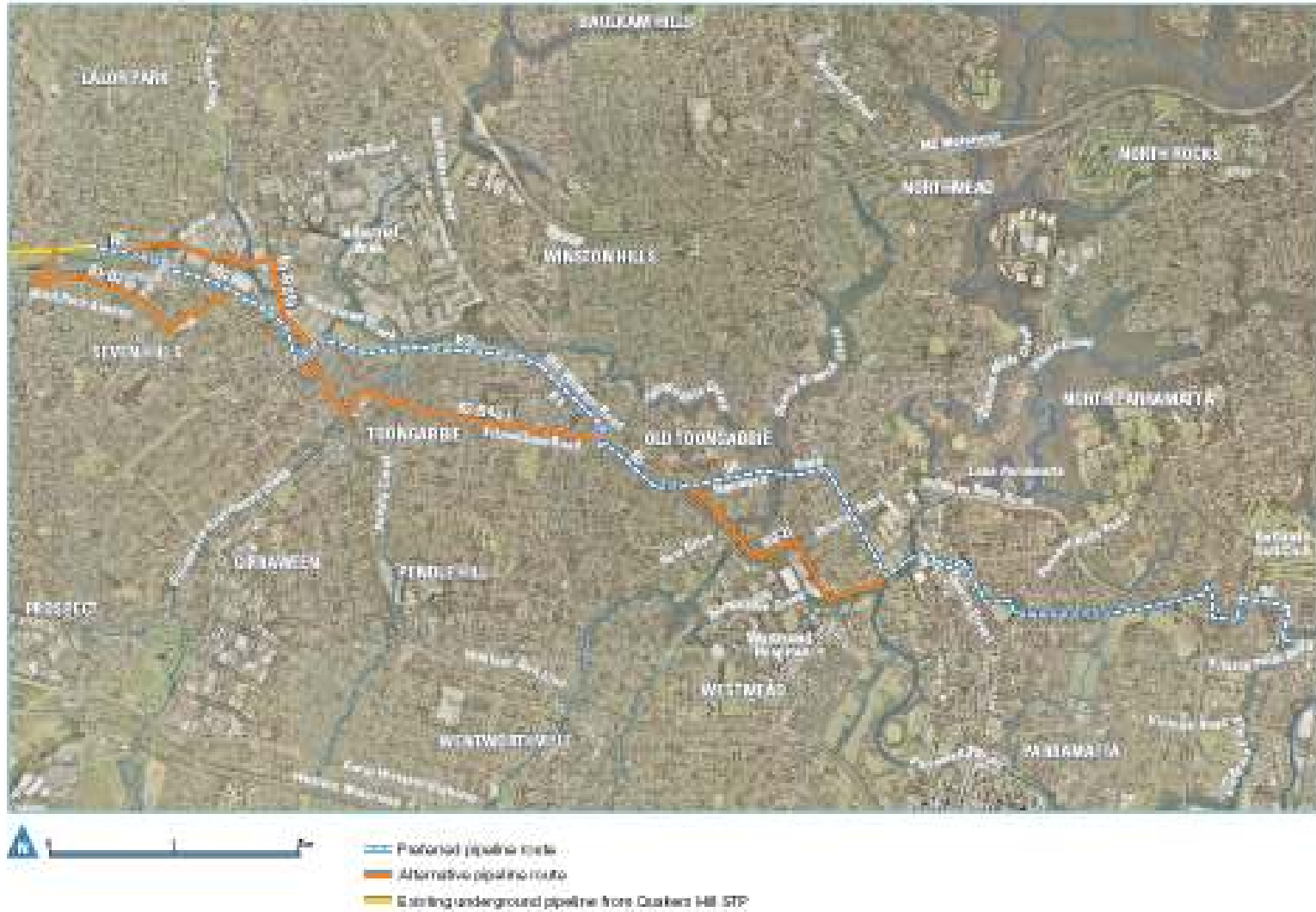
The pipeline route comprising SP1 and QS1 was chosen for the transfer pipeline between St Marys and Penrith STPs as it would be located on the northern edge of existing residential development in areas that have been cleared for use as road reserves or asset protection zones. The Environmental Assessment indicated that Option SP1 was chosen as the preferred option between Quakers Hill and St Marys STPs as the route avoids significant urban areas, schools and community facilities. The preferred option for the concentrate pipeline comprised sections B1, B2, B3, B4, B5, B6, B7 and B8. Since the Environmental Assessment was exhibited and submissions received, the Proponent has revised its concentrate pipeline route as outlined in its Preferred Project Report as previously shown on Figure 10.

Figure 11: Alternative Routes Considered for the Transfer Pipeline between St Marys STP and Penrith STP



Source: Figure 4.1a from Proponent's Environmental Assessment (SWC and SKM, 2006)

Figure 13: Alternatives Considered for the Concentrate Pipeline Route



Source: Figure 4.2 from Proponent's Environmental Assessment (SWC and SKM, 2006)

3. STATUTORY CONTEXT

3.1 Major Project

An Order, published in the Government Gazette, declaring the development to be a project under Part 3A of the *Environmental Planning and Assessment Act 1979* was made by the Minister on 23 October 2006. The project is therefore subject to determination by the Minister for Planning.

The Director-General's requirements for the preparation of an Environmental Assessment were issued on 1 September 2006.

3.2 Permissibility

The project is located within four local government areas. The local environmental plans (LEPs) relevant to the project include:

- Penrith LEP 1996;
- Blacktown LEP 1988,
- Parramatta LEP 2001; and
- Baulkham Hills LEP 2005.

The AWTP is located with the boundary of the St Marys STP within the Blacktown LGA and is zoned Special Uses. The AWTP is permissible with development consent within this zoning.

The construction and operation of the proposed pipelines are permissible under all local land zonings with the exception of "Public Transport Corridor (Church Street) Clause 13" under the Parramatta LEP. Public utility undertakings are also prohibited in a number of precincts through which the concentrate pipeline is proposed to pass under Sydney Regional Environmental Plan No. 18 (SREP 18) – Public Transport Corridors. In addition, public utility undertakings are prohibited in precincts 4 and 7 of Sydney Regional Environmental Plan No. 28 (SREP 28) – Parramatta. The concentrate pipeline is proposed to traverse both of the abovementioned precincts within the city of Parramatta. Overall, the sections of the pipeline that are prohibited by an environmental planning instrument only form a small proportion of the total pipeline length.

There are no State Environmental Planning Policies that apply to the proposal that substantially govern the carrying out of the development.

3.3 Exhibition and Notification

A review of the Environmental Assessment concluded that it met the Director-General requirements in accordance with section 75(2)(g).

The application and Environmental Assessment were placed on public exhibition from Thursday 2 November to Monday 4 December 2006 and submissions invited in accordance with Section 75H of the Act. Exhibition locations were as follows:

- Department of Planning's head office in Sydney;
- Department of Planning's regional office in Parramatta;
- Penrith City Council;
- Blacktown City Council;
- Parramatta City Council;
- Baulkham Hills Shire Council;
- Hawkesbury City Council; and
- Nature Conservation Council.

The Environmental Assessment was also provided for download from the Department's internet site. The Proponent also made the document available on its website for download.

Notification of the exhibition period was made through advertisements in four local newspapers, and on two separate occasions in each (a total of eight advertisements):

- *Blacktown Advocate* (1 November 2006 and 15 November 2006);
- *Mt Druitt St Marys Standard* (1 November 2006 and 15 November 2006);
- *Parramatta Advertiser* (1 November 2006 and 15 November 2006); and
- *Penrith City Star* (31 October 2006 and 14 November 2006).

3.4 Objects of the Environmental Planning and Assessment Act 1979

Section 5 of the *Environmental Planning and Assessment Act 1979* details the objects of the legislation. The objects of the Act are:

- (a) to encourage:
 - (i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,
 - (ii) the promotion and co-ordination of the orderly and economic use and development of land,
 - (iii) the protection, provision and co-ordination of communication and utility services,
 - (iv) the provision of land for public purposes,
 - (v) the provision and co-ordination of community services and facilities, and
 - (vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and
 - (vii) ecologically sustainable development, and
 - (viii) the provision and maintenance of affordable housing, and
- (b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and
- (c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

Of particular relevance to the environmental impact assessment and eventual determination of the subject project application by the Minister are those objects stipulated under section 5(a). Relevantly, the objects stipulated under (i), (iii), (vi) and (vii) are significant factors informing determination of the application (noting that the project does not raise significant issues relating to matters such as community services or affordable housing). With respect to ecologically sustainable development, the *Environmental Planning and Assessment Act 1979* adopts the definition in the *Protection of the Environment Administration Act 1991*, including the precautionary principle, the principle of inter-generational equity, the principle of conservation of biological diversity and ecological integrity, and the principle of improved valuation, pricing and incentive mechanisms.

It is important to recognise, however, that while the *Environmental Planning and Assessment Act 1979* requires that the principles of ecologically sustainable development be encouraged, it provides other objects that must equally be included in the decision-making process for the subject project application. The Department has considered the need to encourage the principles of ecologically sustainable development in addition to the need for proper management of water resources, conservation of natural resources, and the provision of utility services as considered in Section 5 of this report.

4. CONSULTATION AND ISSUES RAISED

The Environmental Assessment was publicly exhibited between Thursday 2 November 2006 and Monday 4 December 2006. During this period, the Proponent continued consultation with the local community by conducting the following activities:

- information displays at four major shopping centres over three weekends;
- information displays at Sculpture by the Sea over a period of six days (three weekends);
- banner display and handout of information during the morning peak period at Seven Hills, Blacktown and Penrith train stations;
- meetings with stakeholder groups; and
- meetings with Government agencies.

Following the close of the exhibition period all submissions were collected and collated and the issues raised in submissions reviewed by the Department. A total of 20 submissions were received. Submissions were received from state and local government agencies, special interest groups and the local community. Of the total submissions received, five objected (25%), four supported (20%), and the remaining eleven submissions (55%) did not state a clear position although indicated that they had some concerns or comments regarding the proposal. All of the submissions comprised individual letters.

4.1 Nature of Submissions

Submissions were received from eight State government agencies, Hawkesbury City Council, Penrith City Council and Western Sydney regional Organisation of Councils (WSROC):

- NSW Department of Environment and Climate Change – **broadly supports the proposal** subject to a number of amendments being made to the Statement of Commitments. The DECC has indicated that these amendments could be made to the commitments put forward by the Proponent or alternatively be included as conditions of approval to the project.
- Roads and Traffic Authority – **does not state a clear position** regarding the proposal although it indicates that the proposal may be accommodated in principle in RTA's corridor lands provided the project is designed to minimise road safety and other impacts on the operation of existing roads and does not preclude options for the future development of road proposals. The RTA has indicated that further details are required prior to the RTA granting any easements to allow construction on land in its ownership or on any land for future roads. The RTA has specified particular concerns with respect to the Castlereagh Freeway corridor, the Werrington Arterial corridor and the Westlink M7 corridor.
- NSW Health Department – **does not state a clear position** regarding the project. The Department of Health provided a number of comments and additional recommendations in relation to the final treatment process to be employed by the AWTP, risk management strategies that could be implemented to resolve some of the uncertainties regarding the health risk assessment undertaken, the need for a pilot plant to be established to demonstrate the output quality of the tertiary treated effluent, and that a management strategy be developed to prevent potential odour impacts from the storage pond at Quakers Hill STP.
- NSW Department of Primary Industries – **supports the proposal** as a means to ensure the continuing health of the Hawkesbury-Nepean River system. DPI (Fisheries) is concerned that modified flows downstream of the Penrith Weir may lead to changes in water quality that could impact on migratory species such as school prawns. In addition, DPI (Fisheries) also has concerns regarding the effects of chemicals such as endocrine disrupting compounds on aquatic fauna in all life stages. DPI (Fisheries) also highlights its concerns with the reduction of flows proposed in South Creek and has recommended that a monitoring program be developed.
- Sydney Catchment Authority – **does not state a clear position** regarding the project. The Authority has made a number of comments in relation to the project particularly the impacts on water quality in the Warragamba River. In addition, the Authority considers that the study to determine the impacts of the project on the migration of fish needs to be completed as soon as possible so that it can be factored into the review of the Nepean weirs project. The Authority has indicated that any works related to the Replacement Flows Project need to be in place before SCA commences the new environmental releases from the Nepean Dams in 2009.

- RailCorp – **objects to the proposal** in its current form as the pipeline proposed to run along the rail corridor from Seven Hills Station to Abigail Street is considered to hinder future amplification works. RailCorp also has concerns with the proposed construction timeframe given that any works within the rail corridor can only be undertaken during a track shutdown period. RailCorp prefers option B1-B2(b) for the pipeline route as it does not restrict any future amplification of the rail network.
- The then Department of Natural Resources – **does not state a clear position** on the proposal however provides comments regarding the need to ensure that the project is consistent with water sharing principles currently being developed. The key issues of interest in relation to the project include volume/rate of discharges; timing of discharges, quality of discharges; alternation between natural and return flows depending on hydrological conditions, protection of river reaches between storages and return flow release points; and the possible socio-economic impacts of reducing the current STP discharges in South and Eastern Creeks and the Lower Nepean River.
- Hawkesbury-Nepean Catchment Management Authority – **does not state a clear position** regarding the proposal however provides comments regarding water quality objectives established as part of the NSW Government's Statement of Joint Intent for the Hawkesbury Nepean River System. The Authority is concerned should the drought persist, the environmental flow releases from the Nepean Dams may be delayed and therefore requests that the Proponent demonstrate that the Replacement Flows Project will not cause environmental or socio-economic impacts if it operates in the absence of environmental flows. The Authority indicates that it is not convinced that the project will provide long reaching environmental benefits. The Authority recognises that the project would mitigate against the impacts on the river from wastewater discharges however it does not appear to provide significant broader river health improvements.
- Hawkesbury City Council – **does not state a clear position** about the proposal, however it does not believe that the replacement of proposed flows from Warragamba Dam with treated effluent is an improvement to the current situation. Council states that the reduction of flow in the river by up to 15 ML/day when compared to the existing situation will not be sufficient to maintain a healthy river system and that the discharge may have an impact on aquatic ecosystems due to the elevated temperature of water discharged from the reverse osmosis process. Council is concerned that reduced flows in South Creek would also have an impact on existing abstraction licenses and subsequently on irrigation and the agricultural industry. Council considers that the project is heavily reliant on the releases of the Upper Nepean Dams and should not proceed until the flows from the upper reaches can be guaranteed as part of the Water Sharing Plan.
- Penrith City Council – **does not state a clear position** regarding the proposal although has outlined a number of concerns that it requested be addressed as part of the assessment. Council considers that the State Government should appoint a River Management Authority to be accountable for the health and management of the Hawkesbury-Nepean River. In addition, Council has requested that an on-going water quality monitoring program be developed and implemented with an emphasis on the maintenance of aquatic ecosystems, river health, water quality for recreational use and minimisation of weed growth. Council has requested that an aquatic weed harvester is required to be purchased and funded on an ongoing basis as compensation for the loss of environmental flow releases from Warragamba Dam. Council has also requested that the former Recreational Water Assessment and Monitoring Program be re-instated. Council would like the opportunity to provide comments on the Construction Environmental Management Plan and the Operational Environmental Management Plan prepared for the project.
- Western Sydney Regional Organisation of Councils – **supports the proposal** as part of the need to secure Sydney's water supply, however it has made a number of comments regarding the project. The organisation is concerned that there is no single entity with authority, responsibility and requisite funding to adequately manage the Hawkesbury-Nepean River system and this has contributed to poor water quality outcomes. It is stated in the submission that Sydney Water must monitor all areas affected by river management changes in order to obtain an accurate picture of the status of the river's health. Any deleterious effects should be addressed when the project is reviewed in 2009. An aquatic weed harvester is required to be permanently placed in the river to control aquatic weed outbreaks. The Organisation requests that opportunities for improving the health of South Creek be explored.

Submissions were received from the following special interest groups:

- Lower Nepean Hawkesbury Water Users Association;
- Nature Conservation Council;
- OceanWatch Australia Ltd;
- Recreational Fishing Alliance;
- Hawkesbury Prawn Trawl Fishers; and
- Hawkesbury Nepean Catchment Foundation.

The Tweed Heads Environment Group Inc. provided a late submission regarding the proposal.

The main issues raised by the abovementioned organisations and groups included the following:

Water Quality, Water Quantity, River Health (including Aquatic Ecology)

- reduction of flows into the river system and subsequent river health impacts;
- the resultant “health” of the replacement flow;
- the need for a detailed assessment of the quality of the discharged concentrate;
- need for detailed monitoring;
- replacement flows should be of superior quality, mimicking natural flows in terms of salinity, temperature, oxygen, pH, chlorophyll-a and complex chemical loads (removal of endocrine disrupting compounds and pharmaceuticals and personal care products);
- temperature of the discharge needs to be controlled such that it is the same temperature as the receiving waters;
- chemical composition of the concentrate in terms of endocrine disrupting compounds and pharmaceuticals and personal care products was not provided in the Environmental Assessment and the impact of discharging concentrate via the Northern Suburbs Ocean Outfall Sewer and ocean outfall was not considered to be adequately assessed;
- detailed risk assessment from the hydrological impacts from the project on Ropes, Breakfast, South and Eastern Creeks must be conducted. It is understood that The Proponent has acknowledged this at a recent meeting held in Windsor on 1 December 2006;
- impacts of the proposal on the migration of fish (including crustaceans such as prawns);
- monitoring is required to be undertaken in South Creek;
- reinstatement of variable flows is required for river health;
- impact of increased weed growth from reduction of flows, especially *Egeria densa*;
- impact of constant flows on the health of the Hawkesbury Nepean River;
- impacts from the reduction of flow in Warragamba River and the increased impact of the Wallacia STP; and
- impacts from increased nutrient concentration in the system that would result in degraded river ecosystems and low recreational value.

Impact on Irrigators

- impact of reduced flows on irrigators, specifically those that rely on flows from South Creek; and
- labelling the “replacement flow” as an “environmental flow” will preclude irrigators from accessing the water for food growing and general farm use thereby resulting in major economic and social impacts for the Sydney population.

Impact to Commercial Fishing

- impacts to commercial and recreational fishing;
- the Environmental Assessment has not adequately assessed the impacts of the project on the fishing industry, particularly with reference to the migration of fish and crustaceans, impact of endocrine disrupting compounds and pharmaceuticals and personal care products on fish and zooplankton, impact of weed growth on the industry and the timing of the commencement of the project; and
- poor consultation with the fishing industry undertaken and poor understanding of the industry's requirements.

Miscellaneous Issues

- outcomes of the Water Sharing Plan are yet to be determined;
- the success of the project depends on the releases from the Upper Nepean Dams and the amount of water that is to be extracted by irrigators which has yet to be resolved between stakeholders and the Department of Natural Resources;
- no mention of the new STP and AWTP proposed near Bringelly (known as the South Creek Servicing Strategy in the Environmental Assessment – the cumulative impact of the replacement flows project and the SCSS has not been assessed).

One private organisation made a submission regarding the proposal, from Lend Lease Development Pty Limited. Lend Lease Development Pty Limited represents the owner, St Marys Land Limited of the St Marys Development (referred to in the Environmental Assessment as the former ADI site). The company is mainly concerned about the route proposed for the pipeline between the St Marys STP and Penrith STP as it would impact on land zoned Urban and also Regional Open Space under *Sydney Regional Environmental Plan No. 30 - St Marys* and objects to any works or easement requirements that would undermine the company's ability to deliver works in accordance with the established planning framework for the site as part of its agreed commitments to the Commonwealth Government. A subsequent letter received by the company indicates that the proposed pipeline would have substantial impacts to a large number of proposed works to be undertaken on the site including future urban development. Lend Lease Pty Limited has indicated that all design and construction works associated with the proposed pipeline are to accommodate the company's proposed works at the Proponent's expense.

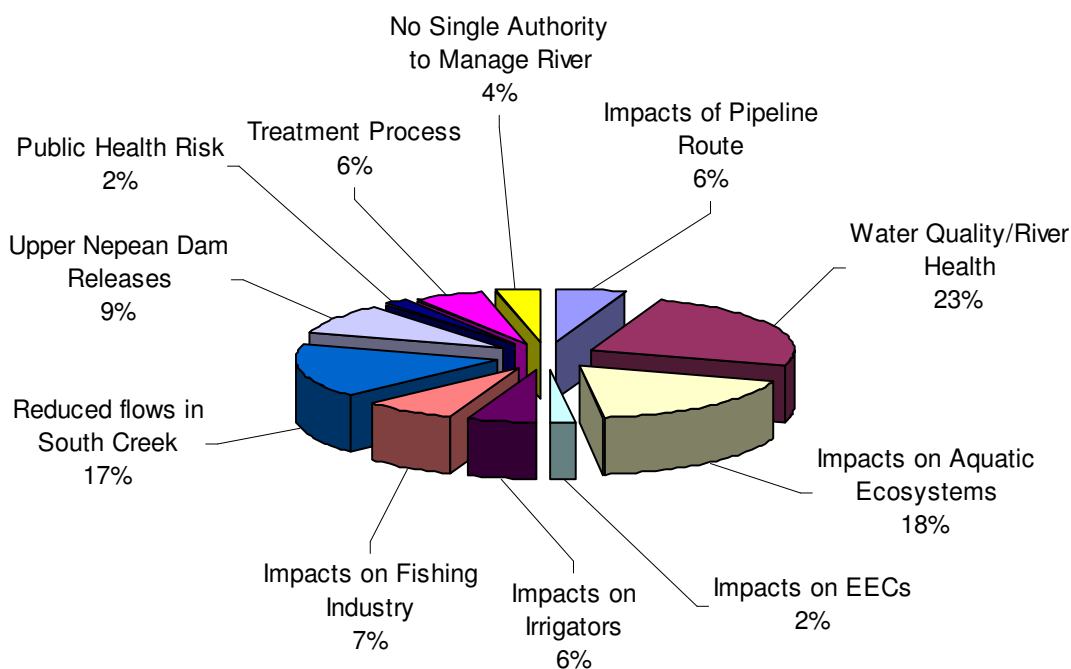
Only one private individual made a submission regarding the proposal. This submission objected to the project as a whole and specifically because of the reduced flows predicted for South Creek. Concerns were raised regarding the potential impacts to the health of the river system, the potential for weed growth and algal blooms to increase and the adverse impact to irrigators. A view also presented by this submission was that the project should allow a 1:1 release of water from Warragamba Dam for each litre of water "saved" through water recycling from the AWTP

4.2 Issues Raised

A breakdown of the issues raised in the submissions is presented in Figure 14. The frequency of each issue raised in submissions has been calculated based on its occurrence relative to the total number of issues raised, rather than the fraction of total submissions that raise a particular issue.

All of the issues raised in the submissions concerned issues related to the direct impacts of the proposal or its immediate environment. Water quality/river health impacts (comprising impacts to the Hawkesbury-Nepean River, Warragamba River and South Creek systems including impacts from changed nutrient concentrations and chemical components of the replacement flow) constituted the most frequently raised issue of concern at 23 % of all issues raised in submissions. Impacts to aquatic ecosystems (comprising impacts to migratory fish species, including prawns, potential for increased weed and algal growth and the effects of chemicals such as endocrine disrupting compounds and pharmaceuticals and personal care products on the life stages of aquatic fauna) comprised 18% of all issues raised. The reduction of flow to South Creek was an issue that was raised on a number of occasions and constituted 17% of all issues raised in submissions. Less frequent issues that were raised included the fact that the project has to rely on releases from the Upper Nepean Dams (9%), impacts from the proposal on the fishing industry (7%), impacts from the pipeline route (6%) particularly in relation to future development proposals, and impacts of the project on irrigators (6%). A number of submissions were also concerned with the treatment process being put forward by the Proponent (6% of all issues raised in submissions).

Figure 14: Issues Raised in Submissions



4.3 Further Assessment of Issues in Submissions

The issues raised in the submissions were compiled and categorised to enable the relative importance of key issues to be assessed. The Department recorded the number of times each main issue was raised in the submissions and the relative importance of each is outlined in Table 1. From the summary provided in Table 1 below, it can be said that a large number of submissions raised more than one issue of concern regarding the project. Table 1 also provides an indication of where each broad grouping of issues raised in submissions has been considered in more detail as part of this report.

Table 1: Relative Importance of Issues Raised in Submissions

Issue	Number of Submissions Raising Issue	Where Addressed
Water Quality/River Health	13	Section 5.1
Impacts on Aquatic Ecosystems	10	Section 5.2
Reduced flows in South Creek	9	Section 5.3
Upper Nepean Dam Releases	5	Section 5.4
Impacts to Fishing Industry	4	Section 5.5
Impacts to Pipeline Route	3	Section 5.6
Treatment Process	3	Section 5.7
Impacts on Irrigators	3	Section 5.8
No Single Authority to Manage River	2	The Department considers that the Proponent has adequately assessed this issue as part of its Preferred Project Report.
Public Health Risk	1	The Department considers that the Proponent has adequately assessed this issue as part of its Preferred Project Report.
Impact on Endangered Ecological Communities	1	The Department considers that the Proponent has adequately assessed this issue as part of its Preferred Project Report.

5. ASSESSMENT OF ENVIRONMENTAL IMPACTS

Key issues raised in submissions in response to the public exhibition of the project and/or identified during the Department's assessment included:

- water quality/river health;
- impacts on aquatic ecosystems;
- water quantity impacts (including reduced flows in South Creek);
- release from the Upper Nepean Dams;
- impacts to fishing industry;
- impacts from pipeline route;
- treatment process; and
- impacts on irrigators.

All other issues raised in submissions are considered to be minor and have been addressed as part of the Proponent's Preferred Project Report which includes the revised Statement of Commitments.

The Department believes that "water quality/river health" issues and "impacts to aquatic ecosystems" are not two separate issues that can be reviewed independently as part of the assessment of the impacts of this project. The health and diversity of the aquatic environment is directly related to water quality within the river system and any impacts to water quality would therefore consequently lead to potential impacts to aquatic ecology. Due to the inter-relationship that exists between water quality and aquatic ecology, the Department has therefore assessed these two issues together as part of the Director General Assessment Report. This view is also confirmed by the many submissions received that had concerns regarding the impact of the project on water quality and the resultant health impacts (in terms of aquatic ecological health) of the river system.

5.1 Water Quality/River Health and Impact on Aquatic Ecosystems

Issue

The project would be constructed and operated within the Hawkesbury-Nepean River system (refer Figure 15). The Proponent undertook an assessment of potential water quality impacts as part of the Environmental Assessment, based on existing water quality monitored over a period of six years between 2000 and 2006. Very low flow conditions were assessed as it is during these periods that the project and the existing STP discharges would have the potential to result in the greatest impact to water quality and aquatic ecology.

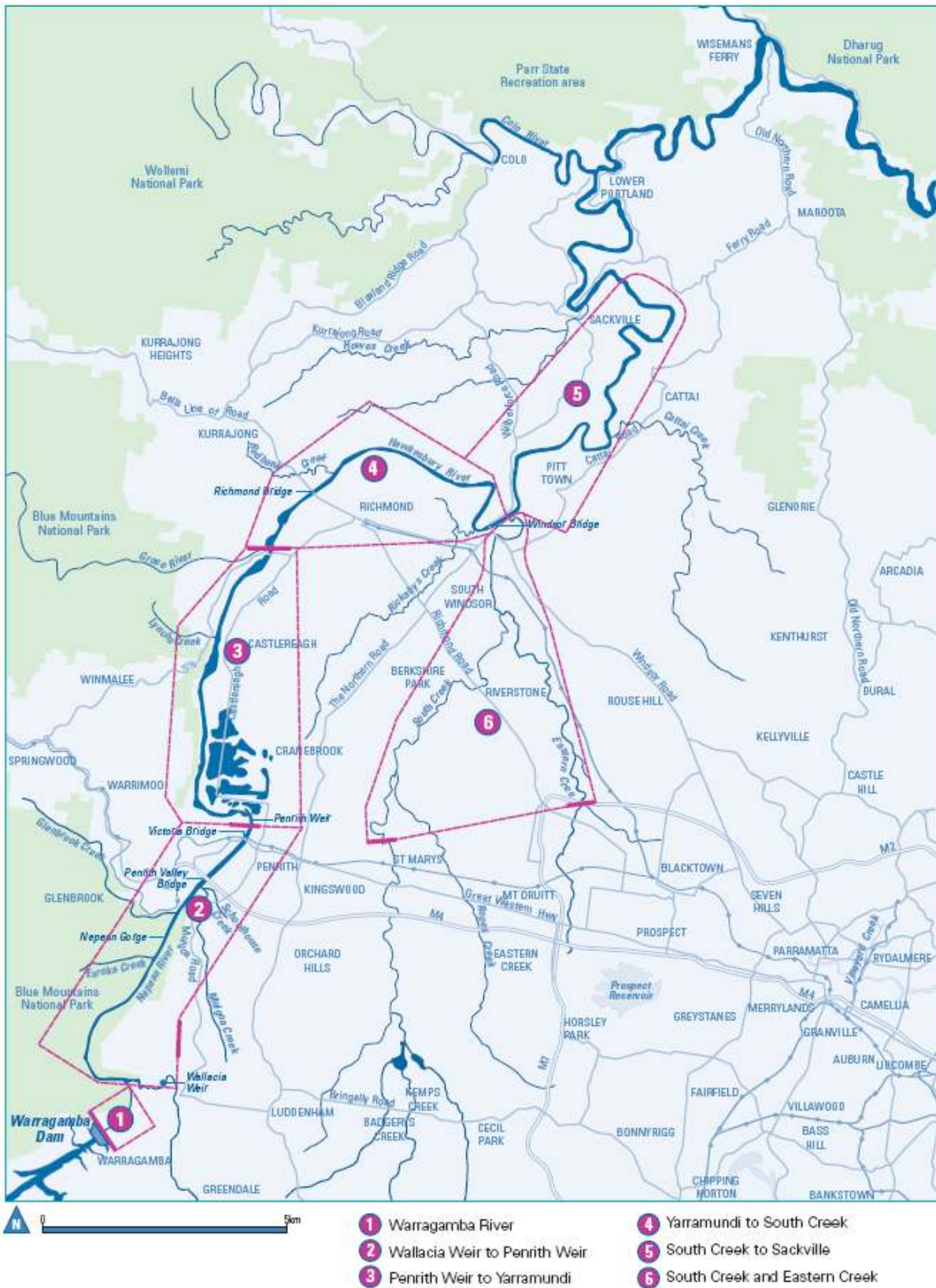
The Environmental Assessment outlined existing aquatic ecological conditions in the river system and assessed the impacts of the project on aquatic ecology. The Proponent did not undertake any new monitoring studies to characterise the aquatic ecology of the river system but rather relied on a large number of existing studies, some of which date back to 1993. Aquatic ecology in the study area is affected by flow and water quality changes as a result of catchment disturbance and runoff, the discharge of treated effluent from a number of STPs and flow regulation and modification. The key biological groups that were assessed as part of the study included aquatic flora (macrophytes and algae), fish, invertebrates and riparian vegetation.

The existing water quality and aquatic ecological characteristics of each section of the river and the expected impacts of the project as reported in the Environmental Assessment, are briefly outlined below.

Warragamba River

The Environmental Assessment indicates that current water quality in the river meets the Healthy Rivers Commission (HRC, 1998) objectives and the ARMCANZ/ANZECC (2000) guidelines for nutrient and chlorophyll-a concentrations. The new Wallacia STP is predicted to discharge 1.35 ML/day of tertiary treated effluent into the Warragamba River and this, together with 43 ML/day of environmental flow released from the dam (during non-drought periods), is expected to result in water quality meeting objectives outlined by the HRC.

Figure 15: River Reaches



Source: Figure 7.1 of the Proponents Environmental Assessment (SWC and SKM, 2006)

Large areas of *Salvinia molesta* (an aquatic noxious weed) was found near where Warragamba River inflows to the Nepean River. Fish species vary considerably between studies undertaken and include Australian Bass, European Carp, various Gudgeons and various species of Catfish. The abundance and diversity of macroinvertebrates is low and indicates mild to moderate impacts from the discharge of the former Warragamba STP into the river.

The project would result in the cessation of environmental flow releases from the Dam and therefore the dilution of the new Wallacia STP discharges would not occur with the operation of the project. The Proponent predicts that the cessation of flows would result in an increase in nitrogen and phosphorus levels in the Warragamba River and would create favourable conditions for the growth of exotic macrophytes and algae and impact on the health of aquatic native species. The Proponent has indicated that it is investigating options to reduce the impacts of the discharge of the recently commissioned Wallacia STP to acceptable levels to offset the impact of the cessation of flows from the Dam such as:

- reducing the amount of effluent discharged to the river through recycling;
- improving effluent quality by reducing nutrient concentrations;
- diverting discharges directly to the Nepean River; and
- release of periodic flushing flows from Warragamba Dam.

Wallacia Weir to Penrith (Nepean River)

Nitrogen levels in the upper section of the river are influenced by discharges from West Camden STP and are above the relevant water quality guidelines. By Penrith Weir, nitrogen concentrations decrease and comply with relevant guidelines. Total phosphorus and chlorophyll-a levels in this reach of the river also complied with the relevant HRC (1998) guidelines. The Proponent has stated that proposed improvements to West Camden STP and the implementation of a recycled water scheme would significantly reduce nutrient loads discharged upstream of this section of the river and has indicated that the project is not expected to impact on water quality in this reach.

Subsequent to the receipt of the Preferred Project Report, however, the Proponent has advised that the high rainfall received at the West Camden STP in February 2007 resulted in the serious damage to a large area of the already constructed IDAL tanks and as a result has delayed the completion of the West Camden STP Upgrade and Amplification project to the end of 2009. Therefore, the water quality predictions made in the Environmental Assessment with respect to the significant reduction of nitrogen concentrations as a result of the upgrade of the West Camden STP cannot be taken into consideration as part of the impact assessment for the project. The Department has taken into account the predicted delays associated with the upgrade of the West Camden STP as part of its consideration of the project (refer below).

Penrith Weir to Yarramundi (Nepean River)

The water quality in this section of the river is influenced by discharges of tertiary treated effluent from Penrith and Winmalee STPs. Nitrogen concentrations exceeded the guidelines in all sections of this reach of the river while phosphorus concentrations were low and were below the HRC (1998) guidelines (except for the median of all flow conditions downstream of Penrith Weir). Low levels of chlorophyll-a below the objectives were recorded for all water quality monitoring sites.

The project would result in a reduction in nutrient loads into the river compared with the current situation where all tertiary treated effluent from Penrith STP is discharged into this section of the river. A comparison of nutrient loads that would be discharged into the river, with and without the project, is provided in Table 2. Compared to the current discharge, the project would result in a reduction in total nitrogen concentrations of approximately 14% and a reduction in total phosphorus concentrations of 75%.

Modelling undertaken as part of the water quality assessment indicates that concentrations of all forms of nitrogen immediately downstream of the discharge of the replacement flows would be below ANZECC/ARMCANZ (2000) and HRC (1998) guidelines, except for oxidised nitrogen which would improve compared to the existing situation.

Table 2: Comparison of Loads Discharged Downstream of Penrith STP (2009)

Nutrient	With Replacement Flows (kg/day)	Without Replacement Flows Project (kg/day)
Suspended Solids	0	31
Oxidised Nitrogen	21	29
Total Nitrogen	39	46
Total Phosphorus	0.3	1.2
Ammonia	0	0.7

Note: The above values have been taken from a graph (Figure 7.7) in the Proponents Environmental Assessment (SKM, 2006) and are therefore approximate.

Yarramundi to South Creek (Hawkesbury River)

Concentrations of all forms of nitrogen and chlorophyll-a are currently higher than ANZECC/ARMCANZ (2000) and HRC (1998) guidelines, suggesting that this is the cause of algal growth in this section of the river. Total phosphorus concentrations were found to increase with distance downstream but were still below HRC (1998) guidelines.

The Environmental Assessment states that there would be decreases in total nitrogen concentrations at all monitoring sites within this reach of the river due to increased flows from upstream and reduction in nitrogen loads associated with the improved quality of the replacement flows and the reduction of tertiary treated effluent being discharged into South Creek.

South Creek to Sackville (Hawkesbury River)

This section of the river is tidally influenced although some sections of the river have salinity levels representative of freshwater systems. The inflow from South Creek influences nitrogen concentrations and oxidised nitrogen concentrations consistently exceed ANZECC/ARMCANZ (2000) and HRC (1998) guidelines at all sites. The Proponent predicts that the project would result in up to a 70% reduction in the total volume of tertiary treated effluent discharged from Quakers Hill and St Marys STPs into South Creek therefore reducing the impact of nutrients in this section. The modelling results indicated that total nitrogen concentrations would decrease and improvements in water quality would occur downstream of the South Creek inflow and continue to Sackville.

According to a study undertaken by the then DLWC in 1999, the riparian vegetation of the Nepean River was described as moderately stressed while the vegetation of the Hawkesbury River was described as highly stressed. The DLWC indicated that more than 50% of the riparian vegetation has been removed from the banks of the Hawkesbury River and this has disturbed shallow water ecosystems and resulted in a decline in aquatic fauna. A 1993 study by Recher (as quoted in the Environmental Assessment) indicated that the macrophyte species in the river has changed considerably as a result of eutrophication, habitat disturbance and alterations to the flow regime. The most abundant species include the exotic weed *Egeria densa* and the native Ribbonweed.

Based on fish surveys undertaken in 1983 and 1996, the river is characterised by both native and introduced species. Studies indicate that native fish species are declining and one study (NSW Fisheries and the CRC for Freshwater Ecology, 1997) contributes the decline to an increase in exotic species, poor water quality and low flows.

The Proponent predicts that the project would have a neutral effect on the aquatic ecology of the river between Wallacia Weir to Penrith Weir as it believes that the Penrith Weir pool would still largely control the water levels and the water quality. In low flow periods, there would be a decrease of about 5 ML/day near the Warragamba River and an increase in flow of approximately 5 ML/day over Penrith Weir which is not expected to impact on aquatic ecology. The higher flows predicted due to river management changes are expected to result in beneficial changes to native fish species and improve conditions for migratory fish species.

Between Penrith Weir and Yarramundi, the Proponent has predicted that the project (in conjunction with other river management changes) would have a beneficial effect on the aquatic ecology due to a reduction in nutrient levels and increased water flows. No change has been predicted to occur to macroinvertebrate species in the river nor to riparian vegetation. The reach of the river below Yarramundi to South Creek and the section from South Creek to Sackville is within the freshwater tidal pool and the Proponent expects that this section of the river would still be subject to bi-directional flow. The Environmental Assessment states that improved water quality,

especially near the South Creek inflows could lead to a reduction in the growth of exotic macrophytes for this section of the river.

South and Eastern Creeks

Water quality in these creeks was found to be poor due to stagnant conditions and low flow. High levels of nutrients, turbidity and low dissolved oxygen all result in the water quality exceeding the relevant guidelines. Phosphorus levels are high upstream of the STP discharge point and can be attributable to catchment sources such as agricultural uses. Nitrogen levels are high downstream of the STP, attributable to the discharge of tertiary treated effluent into the creek.

The Environmental Assessment states that the project would result in a significant decrease in nutrient loads discharged to South and Eastern Creeks. A comparison of nutrient loads that would be discharged into the creek, with and without the project, is provided in Table 3.

Table 3: Comparison of Loads Discharged into South Creek (2009)

Nutrient	With Replacement Flows (kg/day)	Without Replacement Flows Project (kg/day)
Suspended Solids	40	120
Oxidised Nitrogen	60	215
Total Nitrogen	85	275
Total Phosphorus	0.9	2.8
Ammonia	3.1	7.4

Note: The above values have been taken from a graph (Figure 7.8) in the Proponents Environmental Assessment (SKM, 2006) and are therefore approximate.

South Creek is a highly modified catchment as a result of agriculture and urban development. Discharges of effluent from STPs dominate the hydrology and water quality of the creek system downstream of the discharge locations and exotic macrophyte species dominate the waterway due to their tolerance of poor water quality. The system is highly disturbed and studies show that large fish species are absent with introduced species such as Mosquito Fish dominating the creek. Macroinvertebrate communities in the system are monitored by Sydney Water to assess the impact of effluent discharges from St Marys, Quakers Hill and Riverstone STPs and the results indicate that the system is highly disturbed.

The project will result in a major reduction in flow and nutrient load in South Creek downstream of the STPs. As stated in the Environmental Assessment, concentrations of phosphorus are expected to increase slightly and nitrogen levels are expected to decrease, however, the overall water quality would be relatively unchanged and therefore a neutral effect on aquatic ecology has been predicted by the Proponent.

Three threatened dragonfly species and two threatened fish species recorded in the Hawkesbury-Nepean River system could potentially be impacted by the project. A threatened species assessment was undertaken as part of the Environmental Assessment and concluded that the project was not expected to have a significant impact on these threatened species.

Management of Concentrate from AWTP

The Environmental Assessment described that approximately 8 ML/day of concentrate would be generated by the AWTP which would require disposal. The Proponent proposes to transport the concentrate to a storage pond at the Quakers Hill STP and then via pipeline to be discharged via the Northern Suburbs Ocean Outfall Sewer. The concentrate would mix and flow with other wastewater in the sewer system and then undergo treatment at the North Head STP prior to being discharged via the North Head deep ocean outfall. The Environmental Assessment states that the nutrient concentrations within the concentrate would be lower than wastewater inflow to the North Head STP, however total dissolved solids and sulfate concentrations would be marginally higher. The Proponent has indicated that the volume of concentrate (8 ML/day) would be significantly diluted by wastewater (3,390 ML/day) by the time it reaches the North Head STP and that there would only be negligible increases in the concentrations of these substances at that point as demonstrated in Table 4 overleaf.

Table 4: Comparison of Estimated Pollutant Concentrations

Analyte	Concentrate from AWTP (mg/L)	Existing wastewater at North Head STP (mg/L)	Combined concentrate and wastewater at North Head STP (mg/L)
Total Phosphorus	0.31	10.1	9.9
Total Suspended Solids	5	284	277
Total Nitrogen	32	>50	49
Total Dissolved Solids	3000	770	823
Sulfates	500	55	66

The Environmental Assessment states that the decrease in the concentration of pollutants from the combined concentrate and wastewater flow is expected to be so small that it would be unlikely to be detectable and the resultant impact from the discharge on the surrounding environment would be negligible.

Submissions

A large proportion of submissions received by the Department were concerned with water quality impacts or river health/aquatic ecological issues and the expected impacts from the project. Some submissions indicated that they were concerned with the river health impacts of the project and that there should be an escape clause factored into the conditions that allows fresh water to be released from Warragamba Dam if there are health issues associated with the Hawkesbury-Nepean River or if there is sufficient water in the Dam to return to previous water flow arrangements. Some submissions also indicated that with growth in the western and north-western sectors of Sydney continuing, increasing strain is expected in terms of increased sewage discharge and need for water extraction and therefore a long-term approach to improving river health was required.

The reduction of flow in the Warragamba River is of concern to many submitters as this would have the effect of increasing the impacts of the Wallacia STP on the health of the river and lead to increased weed growth and may impact on the breeding cycle of various fish species. Other equally important concerns which were raised in submissions included the following:

- the project's objectives should have been aligned with the water quality objectives established in the NSW Government's Statement of Joint Intent for the Hawkesbury-Nepean River System;
- nutrient concentrations in the replacement flow would place further stress on an already stressed Hawkesbury Nepean River;
- replacement flows are not equivalent to natural environmental flows in terms of chemical composition, nature and timing of dispersal;
- replacement flows should be of a superior quality to natural flows in terms of salinity, temperature (accounting for seasonal changes), oxygen, pH, chlorophyll-a and complex chemical loads (removal of endocrine disrupting compounds and pharmaceuticals and personal care products);
- constant flows are detrimental to the ecological health of the river system as indicated by the Healthy Rivers Commission inquiry into the Hawkesbury Nepean River and the work of the Hawkesbury Nepean River Management Forum which recommended the re-instatement of variable flows;
- impact of chemicals such as endocrine disrupting compounds and pharmaceuticals and personal care products on the reproduction and development of animals, particularly fish (including crustaceans);
- impact of the project on growth of exotic weeds, particularly *Egeria densa*;
- impacts to South Creek will be significant and monitoring is required; and
- chemical composition of the concentrate particularly in relation to endocrine disrupting compounds and pharmaceuticals and personal care products and its impact on the receiving environment.

Consideration

The Department has reviewed the Environmental Assessment and in particular assessed Appendix C which provided a detailed assessment of the water cycle, water quality and aquatic ecological impacts from the project. The Department considers that an adequate assessment has been undertaken by the Proponent and considers that the results of the water quality assessment provide adequate justification for recommending approval for the construction and operation of the project. The project (together with other river management changes) will involve a substantial reduction in nutrient (nitrogen and phosphorus) and chlorophyll-a levels in the river while

conserving potable water for Sydney's water supply. In comparison with the 2009 Penrith STP discharge of tertiary treated effluent in the absence of the Replacement Flows Project, the project would result in a reduction of 14% in the total nitrogen load discharged and a 75% reduction in the total phosphorus load. In terms of the overall reduction in total nitrogen and total phosphorus loads, the Proponent has calculated that the project would result in a reduction of 67% and 78% respectively compared with the current load of nutrients discharged into the river system from the three STPs. These levels however, would only be achieved if other planned recycling schemes and river management changes also go ahead.

The Department has recommended a number of specific conditions of approval be imposed regarding water quality/ water cycle management and the protection of aquatic ecology in the river system. Given that much of the existing aquatic ecological data relied on for the assessment was not recent, it nevertheless provides an indication of the aquatic ecological characteristics within the river system and would inform the detailed design process for the AWTP. The Department considers that the recommended conditions of approval are adequate and fully justified and would ensure that the objects of the Act are satisfied (refer Section 3.5), particularly object (i) (the proper management of natural resources), (vi) (the protection of the environment) and (vii) (ecologically sustainable development) which includes ensuring the threat of irreversible environmental damage is avoided and the conservation of biological diversity and ecological integrity.

These conditions include various studies to confirm the potential impacts of the project on fish attraction and on aquatic species in general as well as a comprehensive water quality and aquatic ecology monitoring program in consultation with the DECC, DPI (Fisheries) and NSW Health. A separate recommended condition of approval requires the Proponent to undertake a study on the conductivity of the recycled water from the reverse osmosis process and to evaluate its potential to impact on aquatic ecology in Boundary Creek. Challenge testing during the commissioning and proving period would also ensure that the AWTP effectively removes biological contaminants from the feed water. In addition, a recommended condition of approval outlines that the Proponent is to undertake an effluent management strategy and the implementation of associated measures to mitigate the impact of the cessation of flows from the Dam on the Warragamba River. In order to further protect water quality within the river, the recommended conditions also stipulate that the project cannot commence discharging replacement flows to the river without either continues flows from Warragamba Dam or increased flows from the Upper Nepean Dams.

Due to severe rainfall received in February 2007, the Proponent has advised the Department that the newly constructed IDAL tanks associated with the upgrade of the West Camden STP were severely damaged and will require reconstruction. However, the Proponent has also advised that the West Camden STP upgrade would be completed prior to the commencement of the Replacement Flows Project.

5.2 Water Quantity Impacts (including South Creek)

Issue

The impacts of the project on the hydrology of the Hawkesbury-Nepean River were assessed through hydrologic modelling undertaken as part of the Environmental Assessment. The modelling took into account planned changes in river management and environmental flow releases identified in the 2006 Metropolitan Water Plan including:

- increased environmental flow releases from the upper Nepean Dams;
- modifications to weirs in the upper Nepean River to allow environmental flows to travel downstream;
- protection of low flows through "cease to pump" rules for irrigators; and
- cessation of flows from Warragamba Dam.

Under current operating rules, Sydney Catchment Authority is required to make a constant interim environmental flow release equivalent to the 95th percentile of flow (which is 33 ML/day) and an additional 10 ML/day to provide for extractions by irrigators. Under current drought conditions, the environmental flow releases have been decreased to 22 ML/day. There is also a requirement to ensure that a minimum flow of 50 ML/day flows over Penrith Weir.

Currently, between the junction of the Warragamba River and Penrith Weir, the Nepean River receives inflow from a number of tributaries and surrounding catchment and very low flows (95th percentile) are approximately

62 ML/day over Penrith Weir. With the operation of the project, for very low flows (95th percentile) there would be a decrease in flows to 38.7 ML/day in comparison to the non-drought situation of 43 ML/day at the junction of the Warragamba and Nepean Rivers and very low flows would be approximately 67 ML/day at Penrith Weir which is marginally above the existing flows.

Immediately downstream of Penrith Weir, Boundary Creek flows into the Nepean River. This creek provides the discharge location for Penrith STP which currently discharges 22 ML/day of tertiary treated effluent into the creek. Existing flows in very low conditions (95th percentile) are in the order of 84 ML/day downstream of Penrith Weir. As a result of the project, the discharge from Boundary Creek would increase flows to 50 ML/day. Combined with the other river management changes, the Proponent has estimated that the flows downstream of Penrith Weir in very low flow conditions would increase from 84 ML/day to 117 ML/day.

Flows in the South Creek system are significantly affected by the discharge of tertiary treated effluent into the creek from Quakers Hill STP (31 ML/day), St Marys STP (34 ML/day) and Riverstone STP (2 ML/day). These STP discharges currently dominate the flow in the creek system especially during prolonged dry periods. With the operation of the project, significant volumes of tertiary treated effluent would be diverted from the Quakers Hill and St Marys STPs to the AWTP and then transferred to Penrith for discharge via Boundary Creek. For 2009 flows, the Proponent predicts that St Marys STP would still discharge 5 ML/day and Quakers Hill STP 19 ML/day into the South Creek system. Discharges from Riverstone STP are expected to increase as new development in the region continues.

Submissions

The loss of flows to South Creek was an issue of concern that was raised frequently as part of the submissions received. Submitters indicated that low flows would result in increased growth and spread of aquatic weeds within the creek and would result in the overall degradation of the creek environment and a potential detrimental impact on the downstream reaches of the Hawkesbury Nepean River system. The Department of Primary Industries indicated that the reduction of flows within South Creek is accepted as it believes that the reduction of effluent flows will benefit the system. However, the Department of Primary Industries states that the sudden reduction in flows may lead to some significant changes in the habitat available in the stream and it would expect the Proponent to undertake a monitoring program to monitor the effect of reduced flows on changes in habitat and water quality and implement mitigation measures as appropriate.

Water flow within the river system plays a significant part of the lifecycle and movement of aquatic species. With respect to the Hawkesbury Nepean River, a number of submissions stated that while the reduction in nutrient loads was welcomed, the issue of constant flows within the river would have the effect of increasing the prevalence of aquatic weeds and the reinstatement of variable flows should be considered.

Many of the submissions indicated that the project relies on outcomes of the Water Sharing Plan which have yet to be determined. One of the submissions expressed concern that the draft Water Sharing Plan had not been subject to extensive community consultation and therefore it was possible that the Plan may change with potential implications for the Replacement Flows Project (i.e. the potential for the release of increased flows from the Upper Nepean Dams could be delayed beyond 2009 if the drought persists). A recommendation made by many submitters was that the increased environmental flows should be in place prior to the project commencing operations. In addition, submitters stated that a large amount of water is extracted from the river by irrigators, with water extraction licences currently under review. This aspect is discussed further in Section 5.3 and 5.7.

Consideration

The Department considers that many issues raised by the submissions with regard to water quantity have been addressed by the Proponent in its Preferred Project Report. The Proponent has indicated in its report that consultation was undertaken with the then Department of Natural Resources during the preparation of the Environmental Assessment in relation to the Water Sharing Plan assumptions upon which the modelling and assessment of the project was based.

With regard to South Creek, the Proponent has stated that the Environmental Assessment used 2009 flow projections for the STPs associated with the South Creek system thereby taking into consideration increased

growth in the catchment and the demands for the delivery of recycled water to new development areas. The Department has reviewed the submissions, the Environmental Assessment and the Proponent's Preferred Project Report to gain an appreciation of the reduction of flows within the South Creek catchment. The Environmental Assessment indicated that South Creek was already a degraded environment and the removal of the majority of treated effluent from the system would return the creek to a more natural state. To ensure that potential adverse impacts to the creek are minimised to the extent practicable, the Department has recommended that the Proponent undertake a monitoring program to monitor the impacts of the proposal on South Creek and to investigate measures that could be implemented should adverse impacts occur. In addition, the Department has recommended, as a condition of approval, that until such time as there is a Water Sharing Plan, Ministerial direction made under the *Water Management Act 2000*, or other relevant instrument that approves or requires otherwise, the Proponent will be required to discharge a suitable volume of tertiary treated effluent from both Quakers Hill and St Marys STPs to ensure that regular flows are maintained within the creek as determined by DWE, DECC in consultation with the Proponent.

5.3 Upper Nepean Dam Releases

Issue

The Environmental Assessment states that the 2006 Metropolitan Water Plan reiterates the commitment of the 2004 plan to increase environmental flow releases from the Upper Nepean Dams (comprising Cataract Dam, Cordeaux Dam, Avon Dam and Nepean Dam). Current and predicted flows from these dams are outlined in Table 5.

Table 5: Interim Flow Releases from Hawkesbury-Nepean Dams

Location	Current Flows (ML/day)	2009 Predicted Flows (ML/day)
Warragamba Dam	43.3	0
Cataract Dam	1.3	Up to 16.5
Cordeaux Dam	1.9	Up to 12.6
Avon Dam	0	Up to 10.4
Nepean Dam	4.4	Up to 28.5

Table 5 shows that up to 68 ML/day would be able to be released from the Upper Nepean Dams in 2009, however, the Environmental Assessment indicates that this level would be subject to rainfall. In order to allow flows from these dams, reconfiguration or modification of weirs would also be required to allow the flows to contribute to the maintenance of river health upstream and downstream of Penrith Weir.

The Proponent expects that the Upper Nepean Dam releases would provide a significant increase in flow variability across all flow conditions in the river system and has based the assessment of impacts from the project on the definite releases from the Upper Nepean Dams taking place in 2009 and therefore coinciding with the expected commencement operational date for the project.

The Proponent's Preferred Project Report also states that changes to the environmental flow releases from the Upper Nepean Dams will occur concurrently with the project. The report further states that the then Department of Natural Resources is responsible for regulating environmental flow releases from the Upper Nepean Dams through water management licences and the Sydney Catchment Authority will be responsible for implementing the environmental flow releases and modification of weirs. The Preferred Project Report also states that the Proponent undertook its impact assessment for the project on the assumption that the modification of weirs and the environmental flow releases from the Upper Nepean Dams would be implemented before the project commences its operation.

Submissions

Many submissions highlighted the fact that the environmental assessment undertaken for the project relies on a number of river management measures taking place, most significantly the environmental flow releases from the Upper Nepean Dams and the associated modification required to a number of weirs to allow for the new flows of up to 68 ML/day. Changes are also being made to the Water Sharing Plan which is scheduled to be released for next year. Many submissions indicated that the Proponent should not be able to proceed with the project until the

negotiations surrounding the Water Sharing Plan have been resolved with stakeholders and the Department of Natural Resources who has to address the approval/licence to extract water by stakeholders. Many submissions also indicated that the same should also be applied to the proposed modification of upstream weirs – until this work is undertaken by Sydney Catchment Authority as part of the water user's agreement specific impacts to water quality cannot be accurately predicted.

It is understood that the precise quantity of water that will be permitted for extraction has yet to be resolved and therefore if it is any different to what has been predicted by the Proponent as part of its Environmental Assessment, then the health of the Hawkesbury-Nepean River may be affected and will need to be an issue of further discussion.

One submission indicates that the Environmental Assessment concludes that the project will not impact on the amount of water available for extraction as stated in section 7.8.1 because the project relies on the environmental flows expected from the release of water from the Upper Nepean Dams. The *Water Management Act 2000*, however, provides that environmental flow releases must be protected from extraction. A number of submissions stated that if the environmental flows from the Upper Nepean Dams are excluded from the assessment, the project would have the effect of reducing the volume of water in the Hawkesbury Nepean River by as much as 63 ML/day, within the river downstream of the South Creek confluence.

Consideration

The Department is cognisant of the fact that the Replacement Flows Project is reliant on a number of river management initiatives which are not directly controlled by the Proponent. Given the uncertainty regarding the timing of the increased releases from the Upper Nepean Dams, the Department has recommended as a condition of approval that the project is not permitted to release any replacement flow from the operation of the AWTP until such time as either the increased flow releases from the Upper Nepean Dams are implemented or an interim flow continues to be released from Warragamba Dam. The interim flow from Warragamba Dam will continue existing flow releases from the Dam and thereby protect any potential water quantity and quality issues surrounding the project in the event that the releases from the Upper Nepean Dams are delayed beyond 2009. This is important as it would ensure that the project will only operate once the conditions assumed in the Environmental Assessment are satisfied.

5.4 Impacts to Fishing Industry

Issue

The Environmental Assessment states that there are between 75 and 100 commercial fishing licences held for the Hawkesbury-Nepean River system, regulated by the Department of Primary Industries – Fisheries. Most of the fishing activities are undertaken in the saline estuarine and marine reaches of the Hawkesbury River downstream of the study area for the project. In 2004, this industry had a wholesale value of \$6.3 million per year (based on commercial fishery of fish, prawns and oysters).

The Environmental Assessment states that due to the location of the majority of commercial fishing operations, the project would not have any direct impacts on the industry. The document also states that the project would have a neutral impact on water quantity and a neutral to potentially beneficial impact on water quality of receiving waterways and therefore is not expected to have any impact to the lifecycle of commercial fish species that spend part of their life in the upper reaches of the river.

Submissions

A number of submissions strongly disagreed with the statements made in the Environmental Assessment regarding the potential impacts from the project on the commercial fishing industry. Some submissions indicated that an inadequate assessment was undertaken particularly with reference to the migration of fish and crustaceans, the impacts of endocrine disrupting chemicals or pharmaceuticals and personal care products on fish and zooplankton and the impact of weed growth on the industry. Additional consultation with the industry was a recommendation of a number of submissions.

Consideration

The Department considers that the Environmental Assessment and Preferred Project Report prepared by the Proponent adequately assessed the impact of the project on the fishing industry. Furthermore, the recommended conditions of approval to manage and minimise water quality and aquatic ecological impacts of the project would result in beneficial impacts to the health of the river system and reduce the potential impacts of the project on the commercial fishing industry. The specific condition which has been recommended by the Department to investigate the nature of fish attraction flows in Boundary Creek and the requirement of the Proponent to implement mitigation measures to minimise adverse impacts to fish attraction would further ameliorate any potential impacts from the project on the fishing industry.

5.5 Impacts from Pipeline Route

Issue

Tertiary treated effluent, highly treated recycled water and concentrate would be transported via pipelines proposed to be laid between the STPs. Where possible, the Proponent's Environmental Assessment states that the pipelines would be laid within the same trench to minimise the extent of excavation and tunnelling. A number of alternative options were assessed with respect to the location of the pipelines within the study area based on engineering factors, social and economic criteria (such as traffic impacts, private property access, amenity and heritage impact) and natural environmental criteria (such as the potential impact on flora, fauna and aquatic habitat). Between St Marys and Penrith STPs option SP1 was chosen as the preferred route and between Quakers Hill STP and St Marys STP, QS1 was chosen as the preferred pipeline route. These routes were chosen as the preferred routes for the project as they resulted in the least impact to urban areas and community facilities when compared to other options that were considered. A number of options were also considered for the concentrate pipeline located between Seven Hills and Vineyard Creek, however option B1, B2, B3, B4, B5, B6, B7 and B8 comprised the preferred route as this route minimised impacts on residences, traffic movements and watercourses.

Since the exhibition of the Environmental Assessment and as part of the review of submissions received, the Proponent was made aware of a number of issues associated with the preferred option for the concentrate pipeline route, specifically with regard to its impact on the existing railway corridor in the vicinity of Seven Hills Station. The Proponent prepared a Preferred Project Report which outlined the revised concentrate pipeline route and its potential environmental impacts. The revised route passes through similar environments to the original route proposed, however, avoids the rail corridor at Seven Hills and eliminates two rail line crossings in this location as well as minimises impacts to the Old Windsor Road corridor.

The Environmental Assessment presented the findings of the potential impact of the pipeline route within the study area on terrestrial flora and fauna, geology and soils, heritage, land use and tenure, visual amenity, air quality, waste management, traffic and hazardous materials. The Environmental Assessment states that the proposed pipeline routes have been located to minimise impacts to remnant vegetation, in particular, endangered ecological communities (EECs) including Cumberland Plain Woodland and River-flat Eucalypt Forest and mitigation measures to minimise the impact of construction on flora and fauna would be implemented as part of the project. The Environmental Assessment indicates that construction activities associated with the pipelines would result in impacts to the local acoustic environment, however, would only result in short-term nuisance given that the construction of the pipeline would not be stationary for extended periods of time. The Environmental Assessment stated that construction works would be unlikely to be adjacent to any residence for a period of more than a few weeks at a time.

An indigenous archaeological assessment of the study area was undertaken as part of the Environmental Assessment. The Environmental Assessment stated that construction of the pipeline would potentially disturb one site containing several indigenous stone flakes and five areas containing potential archaeological deposit (PAD). The Proponent has revised the location of the concentrate pipeline route (as indicated in the Preferred Project Report) such that it no longer directly impacts on any items, sites or PADs of indigenous heritage thereby representing a reduced impact compared to the original route.

In terms of European Heritage, the original project had the potential to disturb two Archaeological Management Units, AMU 2898 (Ritchie Bernaud Oval, single storey residence and surrounding open space considered to have high archaeological potential) and AMU 3167 (Old Salesyards Reserve which was considered to have little archaeological potential) as well as the Parramatta Goal which has heritage significance. The Proponent's Preferred Project Report outlines changes that have been made to the concentrate pipeline and the report indicates that the pipeline would still have the potential to disturb AMU 2898 and AMU 3167 although Parramatta Goal would be avoided. The revised route, however, passes through parts of the Toongabbie convict settlement, an item of high archaeological potential, but all works would be confined to the road which the Proponent considers is a previously disturbed environment.

The Environmental Assessment states that consultation with the Aboriginal community would be ongoing throughout construction works. Further investigation of the route would be required to be undertaken by a qualified archaeologist before construction commences to identify measures that can be implemented to reduce impact to any objects discovered. The Proponent has committed to undertake monitoring of construction works by an archaeologist through the two AMU sites and the Toongabbie convict settlement site to mitigate impacts from the project.

The proposed pipeline route would be located within the road reserve or would cross the following roads:

- Westlink M7 Motorway;
- Andrews Road;
- The Northern Road;
- Links Road;
- Forrester Road;
- Palmyra Road;
- Richmond Road; and
- Quakers Hill Parkway.

The revised concentrate pipeline route would be located in the road or road reserves or would cross the following roads:

- Prospect Highway;
- Kissing Point Road, Dundas;
- Station Street, Seven Hills;
- Powers Road, Seven Hills;
- Old Windsor Road;
- Pennant Hills Road;
- James Ruse Drive; and
- Church Street, Parramatta.

Construction of the pipeline has the potential to cause localised traffic impacts. To minimise impacts, the Proponent has indicated that it proposes to utilise underground boring techniques where pipelines cross major roads and it would also undertake consultation with the RTA and the local Council regarding works that may impact on roads such as proposed local traffic diversions or lane closures.

Submissions

With the exception of RailCorp, whose concerns regarding the concentrate pipeline route have now been resolved as a result of the Proponent modifying the route to avoid rail corridor lands (as outlined in the Proponent's Preferred Project Report), the only other submissions concerned with impacts from the pipeline comprised the NSW Roads and Traffic Authority, the then Department of Environment and Conservation and Delfin Lend Lease Pty Limited.

The NSW Roads and Traffic Authority has requested that further detail be provided regarding the proposed alignment (vertical and horizontal) of the pipeline infrastructure so that it can consider the granting of an easement to allow for the pipeline construction on its land or on any land for future road. The NSW Roads and Traffic Authority is primarily concerned with the Castlereagh Freeway, the Werrington Arterial and the Westlink

M7 road corridors. The Authority has also requested that all road crossings of roads by the pipeline under their maintenance be constructed using under-boring construction techniques. In addition, the Roads and Traffic Authority has stated that all pipelines should be designed to be maintenance free within motorway corridors, and that no access points for maintenance are to be provided within any motorway corridor lands.

The then Department of Environment and Conservation indicated in its submission that it concurs with Commitment 11 as outlined by the Proponent as part of its Draft Statement of Commitments (within the Environmental Assessment) to design infrastructure to avoid significant flora species and communities. It noted that two areas of land containing endangered ecological communities (Freshwater Wetland and Cumberland Plain Woodland) near the Penrith STP would still be directly affected by the construction of the pipeline. The DEC stated that the impact to these communities appears to be inconsistent with the Proponent's Commitment and a number of management proposals outlined in Section 8.2 of the Environmental Assessment.

The main issues of concerns raised by Delfin Lend Lease Pty Limited is the potential impact of the construction and operation of pipeline infrastructure on land zoned Urban and Regional Open Space under *Sydney Regional Environmental Plan No. 30 – St Marys*. The pipeline affects land to be developed for urban development and recreational purposes and the company has indicated that it reserves the right to seek compensation from the Proponent for any impact to their land. The company outlined a number of proposals that are being undertaken on their site which could be affected by the project including subdivision works adjacent to the St Marys STP site (Dunheved Precinct) and also within the central area of the site adjacent to the site's southern boundary (Central Precinct), construction of a new access road adjacent to the Forrester Road/Links Road intersection and the construction of major sporting and recreational facilities within land zoned Regional Open Space.

Consideration

The Department understands that the pipelines proposed as part of the project has the potential to result in amenity impacts to the surrounding environment, particularly during the construction phase. The Department notes that the route of the concentrate pipeline has been modified to avoid any impact to rail corridor lands and has taken this into consideration as part of its assessment of the project.

The proposal has the potential to result in noise and vibration impacts and potentially significant impacts to traffic and access within the study area. The Department has therefore recommended that a number of conditions of approval be imposed on the Proponent to ensure that noise and vibration impacts are adequately mitigated to the extent possible to protect the surrounding community. In this regard, the Proponent will be required to prepare a Construction Noise Management Plan to the satisfaction of the Director-General to detail the noise and vibration impacts associated with the construction of the project and to outline what mitigation measures will be implemented to minimise potential noise and vibration effects. During operation of the project, the recommended conditions require that the project be operated and maintained such that there is no increase in noise levels over those currently being emitted from each of the premises (St Marys STP, Quakers Hill STP and Penrith STP).

Similarly, the proposal has the potential to impact on threatened terrestrial species and two areas of land containing endangered ecological communities and therefore the Department has recommended that a condition be imposed on the Proponent which requires it to avoid direct impact to *Grevillea juniperina subsp juniperina*, the habitat of *Meridolum comeovirens*, *Litoria aurea*, *Miniopterus schreibersii* or Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains and Freshwater Wetlands on Coastal Floodplain endangered ecological communities. To further mitigate any impacts associated with the proposal on riparian vegetation within the study area, the Department has recommended as a condition of approval that the Proponent utilise under-boring construction techniques for all natural creek crossings (with the exception of ephemeral creeks and drainage lines) associated with the proposal to include the full width of the watercourse and any core riparian zone.

The construction of the proposal, especially the pipelines, would result in substantial traffic and transport disruptions and it will be prudent that traffic is appropriately managed by the Proponent or its Contractor. Given the number of roads that will require crossing by the pipeline and the potential impacts to existing traffic flows, the Department has recommended a number of specific conditions of approval to ensure that any adverse impacts associated with the construction of pipeline infrastructure within the study area are minimised to the extent

possible. Consultation with both the NSW Roads and Traffic Authority and each respective Council would be a requirement during the detail design stage of the project to ensure that the designs of each crossing are detailed to their satisfaction.

The Proponent has indicated that it would employ a qualified archaeologist to undertake the monitoring of construction to avoid any impacts to indigenous and non-indigenous heritage during construction of the project. The Department does not consider that the potential heritage impacts associated with the project are sufficient to warrant additional and specific conditions of approval in this regard. The Proponent has indicated in the Environmental Assessment and its Preferred Project Report that additional consultation would be undertaken with the local Aboriginal community during the detail design stage of the project and that additional assessment would also include sub-surface testing of areas identified as of moderate archaeological potential.

With respect to land use impacts, the Environmental Assessment states that route SP1 was chosen as the preferred route for the pipeline as it would be located along the northern edge of existing urban development in areas that have been "cleared for use as road and service easements or asset protection". On receipt of the submission from Delfin Lend Lease Pty Limited, a review of *Sydney Regional Environmental Plan No. 30*, and a review of the land zoning maps provided in Appendix A of the Environmental Assessment, it seems this is not entirely accurate. An assessment of the pipeline route by the Department indicates that the construction and ongoing maintenance of the pipeline could have potential impacts to urban development currently in various stages of planning, development and construction. It is expected that the Proponent would negotiate an easement of land from the company for the construction and operation of the project as would normally be undertaken for utility installations. In this regard, the Department does not consider that a specific condition of approval is warranted in relation to potential land use impacts regarding developing urban areas.

5.6 Treatment Process

Issue

The Environmental Assessment outlined the recycled water treatment process that is proposed to be used as part of the project as well as discussing the alternatives that were investigated and dismissed as part of the assessment. The Environmental Assessment states that the treatment process is likely to comprise pre-treatment (mechanical strainer, ultrafiltration or microfiltration, chemical dosing systems), main treatment (single pass two stage reverse osmosis for product water and single stage reverse osmosis process for concentrate reduction) and post-treatment (comprising pH adjustment, breakpoint chlorination, and dechlorination).

Reverse osmosis was identified as the preferred technology to achieve the project objectives. Alternatives that were considered included nanofiltration, ion exchange and denitrification and each of these processes were discounted as they did not perform as well in removing nutrients from the tertiary treated effluent as reverse osmosis. Reverse osmosis was also selected as the preferred treatment option as it provides a barrier to pathogens and it would enable complex chemicals such as pesticides, herbicides and pharmaceuticals to be removed from the tertiary treated effluent. Various combinations of reverse osmosis and denitrification options were also considered by the Proponent to achieve the target nutrient levels. The options that were considered included:

- denitrification only;
- single pass reverse osmosis only;
- single pass reverse osmosis with denitrification;
- two pass reverse osmosis;
- two pass reverse osmosis with denitrification; and
- the options listed above with breakpoint chlorination.

While both the single pass reverse osmosis with additional denitrification and the two pass reverse osmosis treatment with additional denitrification were both found to be suitable treatment combinations, the Proponent selected the single pass option as the preferred treatment option for the project as it would achieve the water quality objectives at the discharge location for the least cost.

Submissions

NSW Health highlighted some concerns regarding the reliability of full scale microfiltration and reverse osmosis plants when used over a long period of time and that the failure of the process could result in increased health risks as a result of membrane or process failures. Other submissions were concerned that the reverse osmosis process would not be effective in reducing chemicals. The Environmental Assessment states that small neutral molecules and ions “may be less effectively reduced”. One submission indicated that the potential risk of chemicals entering the river may result in impacts to the aquatic environment and therefore the combination of microfiltration/reverse osmosis and granular activated carbon should be investigated.

Consideration

The Department has reviewed the Environmental Assessment, submissions received and the Proponent's Preferred Project Report and considers that an adequate assessment of the treatment process has been provided. One of the recommended conditions of approval requires the Proponent to undertake appropriate testing of the AWTP and does not allow the project to commence discharge of replacement flow until it can demonstrate that the performance of the treatment technology is such that the nature of the replacement flow produced is equal to or better (in terms of nutrient and chemical contamination) to that predicted in the Environmental Assessment documentation. The Department considers that this condition will ensure that only the highest quality replacement flow is discharged into the Hawkesbury Nepean River system thereby protecting the surrounding water environment and the health of water users to the extent possible.

5.7 Impacts to Irrigators

Issue

The Environmental Assessment states that agricultural and horticultural water extraction from the Hawkesbury-Nepean catchment may be up to 100 billion litres per year. The rate of extraction is highly variable and it is only in extended dry periods that most irrigators take their full allocation of river water. The Environmental Assessment states that the value of agriculture and horticulture in the catchment is estimated at \$1.07 billion per year of which \$600 million per year is derived from irrigated agriculture. Licences for water entitlements for extraction for agricultural and horticultural uses are issued by the then Department of Natural Resources.

The Proponent states in the Environmental Assessment that the project would become operational in 2009 concurrently with the implementation of other changes to river management, specifically the increased environmental flow releases from the Upper Nepean Dams and the protection of low flows from extraction. The Environmental Assessment indicates that the stretch of the river between the Warragamba River to Penrith Weir (Nepean River) and also from the Penrith Weir to Sackville (Hawkesbury-Nepean River) would experience substantial increased flows purely from the increase in environmental flows planned for the Upper Nepean Dams and consequently the volume of water available for extraction for agricultural and horticultural uses would not be adversely affected by the operation of the project.

Within South and Eastern Creeks, existing water licences allow 7,997 ML/year to be extracted upstream of the St Marys and Quakers Hill STP discharge locations and 1,925 ML/year to be extracted downstream of these points. With the operation of the project, the majority of flows normally discharged to South and Eastern Creek would be diverted to the new AWTP for further treatment and discharge as replacement flows at Boundary Creek thereby substantially reducing the volume of tertiary treated effluent discharged from either St Marys or Quakers Hill STP discharge locations. The Proponent has estimated that approximately 5 ML/day (on average) and a peak demand of 9.3 ML/day is extracted from the creeks downstream of the STP discharge locations. The Proponent understands that the continued release of a proportion of the tertiary treated effluent from the STPs would be sufficient to meet the average and peak demands for water extraction within the creeks and therefore they do not perceive that there would be any adverse impact to irrigators from the project.

Submissions

A number of submissions were concerned with the impact the project may have on irrigators. The Lower Nepean Hawkesbury Water Users Association, for example, indicated its opposition to the project through its submission and outlined that the project confuses compensation flow (the 50 ML per day released from Warragamba Dam for

riparian, town water and irrigation) with environmental flow. The submission states that the compensation flow (an agreement made when the dam was built) has never been an environmental flow and referring to the replacement flow from the project as an environmental flow, irrigators under the Hawkesbury Nepean Water Sharing Plan may therefore have no access to it which would reduce the quantity of water in the river (including South Creek) available for irrigation. The submission states that the project would have a major impact to irrigators and therefore a major economic and social impact as a result of flow-on effects related to fresh food production and prices for the Sydney population.

One submission indicated that because the AWTP discharge will be of improved quality (as compared to existing tertiary treated effluent) consideration should be given to directly supplying irrigators with the water from the project.

Consideration

The Department has reviewed the Environmental Assessment regarding the impact of the project on irrigators and together with the information provided in the Proponent's Preferred Project report, the Department considers that an adequate assessment has been undertaken. Since the preparation of the Preferred Project Report, the Department has received further representations from the then Department of Natural Resources regarding the reduction of flows from both the St Marys and Quakers Hill STPs and the resultant impact to irrigators downstream. The Department of Natural Resources wants to ensure that the current irrigators downstream of St Marys and Quakers Hill STPs are not disadvantaged by the project. The Department understands as part of the Proponent's Statement of Commitments that a suitable volume of effluent would continue to be released from the St Marys and Quakers Hill STPs. To ensure that an adequate level of effluent is discharged from these plants, the Department has included as a recommended condition of approval, that until such time as there is a Water Sharing Plan, Ministerial direction made under the *Water Management Act 2000*, or other relevant instrument that approves or requires otherwise, the Proponent shall ensure that a suitable volume of tertiary treated effluent continues to be discharged into the South Creek catchment to provide adequate flows within the creek system for downstream irrigators.

6. CONCLUSIONS AND RECOMMENDATIONS

The Department has undertaken a detailed assessment of the Western Sydney Recycled Water Initiative – Replacement Flows Project, having regard to the Proponent's Environmental Assessment and Preferred Project Report, the issues raised in the 20 submissions received and the feedback received from government authorities from their review of the Preferred Project Report.

Based on its assessment, the Department is satisfied that the Replacement Flows Project could be undertaken within acceptable environmental limits. The project would utilise recycled water and effectively replace releases from Warragamba Dam which would save up to 18 billion litres of drinking water each year by 2015. The Department considers that the project, together with other river management initiatives being implemented as part of the 2006 Metropolitan Water Plan, will importantly conserve potable water which is a significant step towards securing Sydney's water supply for the future.

In addition, the project would result in substantial reductions in nutrient levels discharged to the river with the Proponent predicting that the project would result in the reduction of total nitrogen loads of 14% and the reduction of total phosphorus loads by 75% compared to existing tertiary treated effluent discharged from the Penrith STP below Penrith Weir and taking into consideration the increased releases from the Upper Nepean Dams and other river management changes identified as part of the 2006 Metropolitan Water Plan. The overall decrease in total nitrogen and total phosphorus loads within the Hawkesbury Nepean River is also substantial. The Proponent has calculated that total nitrogen loads in the river would reduce by 67% and that total phosphorus loads would decrease by 78% when compared with the current load of nutrients discharged from the three STPs.

The key issues assessed by the Department included water quality, river health and impact to aquatic ecology, water quantity impacts from the project (including the reduction of flows in South Creek), the reliance of the project on the Upper Nepean Flows and impacts on the commercial fishing industry and irrigators. The Department's recommended conditions of approval place a strong focus on best environmental practice and a detailed design, construction and operational process focused on minimising impacts to the greatest extent possible. The Department has recommended a number of specific conditions that require the Proponent to undertake monitoring and to ensure that the quality of the replacement flow is as good as or better than predicted by the Proponent.

The Department considers that the Proponent has undertaken an adequate and appropriate level of environmental assessment of the Replacement Flows Project, and therefore recommends that the project be approved, subject to a number of conditions.

The Department recommends that the Minister for Planning:

- consider the findings and recommendations of this report;
- approve the project application, subject to conditions, under section 75J of the *Environmental Planning and Assessment Act 1979*; and
- sign the attached project approval (Tagged "A").

APPENDIX A – RECOMMENDED CONDITIONS OF APPROVAL

APPENDIX B – STATEMENT OF COMMITMENTS

APPENDIX C – RESPONSE TO SUBMISSIONS

APPENDIX D – ENVIRONMENTAL ASSESSMENT
