Desalinated Water Delivery System: application for modification of conditions 2.18 and 2.19 of the Project Approval, relating to the Botany Bay Sector

for

Water Delivery Alliance

Sydney's Desalination Project

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GLOSSARY of TERMS

CSD	Cutter Suction Dredge
CSRP	Community and Stakeholder Relations Plan
DECC	NSW Department of Environment and Climate Change
DoP	NSW Department of Planning
DPI	NSW Department of Primary Industries
EA	Environmental Assessment
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environmental Protection Authority
FCSP	Framework Compensatory Seagrass Package
PASS	Potential Acid Sulphate Soil
PPR	Preferred Project Report
WDA	Water Delivery Alliance

Executive Summary

The Water Delivery Alliance (WDA) has been established to design, construct and commission the pump station and desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network at Shaft 11C, Erskineville.

Sydney Water has received Concept Approval for the desalination project and Project Approval for the desalinated water delivery system. These Approvals were granted following consideration of a number of supporting documents, including the Major Project Application, Environmental Assessments (EA) and Preferred Project Reports (PPR). These documents envisaged the need to optimise the design based on additional engineering and environmental information that was to become available during detailed design. Since receipt of the Project Approval, WDA has undertaken a range of engineering and environmental investigations to inform the detailed design. WDA has also prepared a number of consistency assessments as well as two applications for modifications to the Project Approval; relating to refinements to the route and changes to the construction method across the project.

This application for modification has been prepared to seek amendment of Conditions 2.18 and 2.19 of the Project Approval under Section 75W(2) of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). Condition 2.18 relates to the installation of silt curtains, while Condition 2.19 outlines the water quality monitoring requirements for the Botany Bay Sector works. This document also assesses the environmental impacts of the proposed amendments and concludes that overall, the proposed amendments will have no net change in environmental and social impacts, compared with the approved project.

1 Introduction

1.1 Background

The WDA has been established to design, construct and commission the pump station and desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network at Shaft 11C, Erskineville.

An EA was prepared by Sydney Water in November 2005 for the design, construction, operation and maintenance of the Sydney Desalination Project, consisting of the desalination plant, intakes and outlets, and water delivery system. In November 2006, Sydney Water received Concept Approval for the desalination project as a whole and Project Approval for all its components with the exception of the water delivery pipeline, as the system required further investigations and assessment.

An EA was prepared by Sydney Water in April 2007 for the design, construction and operation of the desalinated water delivery system from the desalination plant at Kurnell to Sydney's water distribution infrastructure system at Shaft 11C, Erskineville. The EA responded to the requirements of the Director-General of the Department of Planning (DoP).

Subsequent to the EA for the delivery system, a PPR was prepared to respond to issues raised in submissions made to the DoP during exhibition of the EA. The responses drew on the EA, new information gained since exhibition of the EA, and changes as a result of public inputs. The PPR also detailed refinements to the route and changes to the construction method made since completion of the EA and described the project for which approval was sought. The Minister for Planning granted Project Approval for the delivery system, subject to conditions, on 22 October 2007.

The Concept and Project Approvals were granted following consideration of the EA and PPR, and supporting documents. These documents envisaged the need to optimise the design based on additional engineering and environmental information that was to become available during detailed design.

Detailed design has been progressing and, where finalised, construction has commenced along parts of the route.

It should also be noted that consistency assessments have been prepared for other sections of the project where refinements to the route or changes to the construction method have been proposed. Those consistency assessments concluded that the proposed refinements/changes were generally in accordance with the Concept and Project Approvals. In addition, two applications for modification have been submitted to the DoP for:

- proposed refinements to the route within the Urban Sydney Sector: Sydney North;
- changes to the construction method and an amendment to Condition 2.19 of the Project Approval for the Botany Bay Sector.

On 13 June 2008 WDA received modification to the Project Approval for the Urban Sydney Sector refinements. Modification to the Project Approval for the Botany Bay Sector changes and amendment was received on 12 September 2008.

1.2 Purpose of this application for modification

Section 75W of the NSW EP&A Act relates to the modification of approved projects under Part 3A of the Act. Section 75W(2) allows a proponent to request that the Minister for Planning modify a project's approval. However,

section 75W(2) also states that "…*approval for a modification is not required if the project as modified will be consistent with the existing approval."*

This application for modification has been prepared to:

- seek amendment to Condition 2.18 which requires the installation of silt curtains around the cutter suction dredges, which will be impractical to install due to operational constraints
- seek amendment to Condition 2.19 which stipulates exact requirements that will be impractical to achieve, and studies have shown not necessarily reflective of associated impacts
- assess the environmental impacts of the proposed amendments to Conditions 2.18 and 2.19 compared with those described in the PPR and Minister's Conditions of Approval.

Section 75W(4) allows the Minister to modify an approval (with or without conditions) or disapprove of the modification.

1.3 Approach to this application for modification

As discussed above, this application for modification has been prepared to amend Conditions 2.18 and 2.19 of the Project Approval and assess the environmental impacts of the proposed amendments. This application for modification:

- Describes the proposed amendments to the conditions (refer Section 2)
- Assesses whether the amendments are permitted under the existing conditions of approval by considering:
    - whether the proposed amendments are generally in accordance with the documents listed in condition 1.1 of the Concept Approval "Terms of the Concept Approval" (refer Section 3)
    - whether the proposed amendments are generally in accordance with the documents listed in condition 1.1 of the Project Approval "Terms of the Project Approval" (refer Section 3)
- Assesses whether the amendments will make a material difference to anyone or the environment (refer Section 3)
- Assesses the potential environmental impacts of the amendments relative to those of the approved project (refer Section 4)
- Outlines issues relating to the amendments that were raised during consultation with affected stakeholders after receipt of the Project Approval, and during finalisation of the proposed amendments (refer Section 5)
- Identifies the next tasks following approval of the modification (refer Section 6).

Consideration is given to whether the proposed amendments are anticipated to result in any material changes to the impacts on the social or natural environment by considering the same key issues that were addressed in the EA and PPR.

2 Project descriptions and rationale for change

2.1 Description of the approved project – Water Distribution System

Chapter 10 of the PPR defined the project for which Sydney Water sought approval and states that:

"Sydney Water seeks Project Approval for construction, commissioning, operation and maintenance of a desalinated water delivery system linking the desalination plant on the Kurnell Peninsula with the existing distribution network.

Project Approval is sought for construction and operation of all components of the project, including those elements described in Chapter 5 of the Environmental Assessment of the Desalinated Water Delivery System, as amended by the refinements and changes outlined in Chapter 2 of this Preferred Project Report. In summary the indicative route is described in Table 10.1 and Figures 10-1, 10-2 and 10-3."

The delivery system will:

- *Be built to deliver an annual daily average of 500 ML of desalinated water per day;*
- *Link the desalination plant at Kurnell with Sydney's major water distribution system;*
- *Be generally located on the alignment indicated in Figure 10-1, Figure 10-2 and Figure 10-3;*
- *Be generally constructed using a combination of trenchless and trenched construction methods as indicated in Figure 10-1, Figure 10-2 and Figure 10-3;*
- *Require a range of construction related activities and facilities such as temporary laydown areas, temporary jetties, quays or work platforms, barges, site compounds, spoil stockpiles, connection to utility services and infrastructure, environmental controls etc;*
- *Include ancillary features to ensure safe operation and maintenance, including, but not limited to, air and scour valves, scour drain lines, isolation valves, pressure release valves, access chambers, cross connection pipework to the existing network, booster pump stations, surge protection equipment, and chlorine injection facilities;*
- *Require feasibility and pre-construction investigations, likely to include geotechnical, groundwater, soil, water and sediment studies along with other surveys and minor tasks or other activities likely to have minimal environmental impact; and*
- *Operate on a continuous (24 hours per day, 7 days per week) basis.*

The proposed amendments are considered to be generally consistent with this overall project description.

2.2 Description of the approved project – Botany Bay Sector

The Project Approval defines the Botany Bay Sector as *"the water-based component of the project between Silver Beach and Kyeemagh, including construction compounds at Silver Beach and Kyeemagh (approximately 8.0 kilometres)".* Table 10.1 of the PPR describes the project for which approval was granted. For the Botany Bay crossing the description of the route states *"Construction method using a lay barge…This section will be trenched."*

Section 2.6.5 of the PPR described the project in relation to construction of the trench as follows:

The trench will be excavated using two cutter suction dredgers. The first dredger will excavate the bulk of the trench and the second dredger will trim the trench to the required dimensions. The lay barge will follow the dredgers to install the pipelines within the trench. As the pipelines are installed, two dredge discharge barges will fill the trench. The vessels will work 24 hours a day and move progressively across the bay. Silt curtains will surround the discharge barges to manage potential turbidity impacts on water quality.

Two 500mm diameter pumping lines will transfer dredged material from the cutter suction dredges in the front to the dredge discharge barges at the rear. The pumping lines will be submerged on the seabed and will rise to two barge mounted booster pumps between the cutter suction dredges and discharge barges. The booster pumps are required to achieve the pumping distance and one will be required on each pumping line.

Figure 2.1 shows the relevant aspects of the project as presented in Figure 10.2 of the PPR, and modified 12/09/08.

2.3 Description of the proposed amendments to Conditions 2.18 and 2.19 – Botany Bay Sector

WDA propose to amend aspects of Conditions 2.18 and 2.19 of the Project Approval, which relate to water quality monitoring and management measures within the Botany Bay Sector of the desalinated water delivery system. Sections 2.31 and 2.32 below identify the proposed amendments, relative to the approved project.

2.3.1 Amendment 1 – Minister's Condition of Approval 2.18

Condition 2.18 of the Project Approval relates to the use of silt curtains and requires that:

Construction and maintenance activities associated with the Botany Bay Sector shall be carried out in a manner that minimises the potential for the re-suspension and dispersal of marine sediments and associated biota, including installation of silt curtains around the Silver Beach and Kyeemagh construction sites and dredge discharge barges within the Botany Bay Sector. Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.

Where silt curtains have been installed, they shall remain in place until the turbidity of the water within the silt curtains returns to background levels of turbidity in waters immediately outside the silt curtains.

The relevant aspect of Condition 2.18 WDA are seeking be amended, as well as the proposed amendments to the text are identified in the table below.

Relevant aspect of existing Condition 2.18 approval text	Proposed amendment to text
Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.	*All reasonable and feasible mitigation measures shall be employed during operation of the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L. These measures shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.*

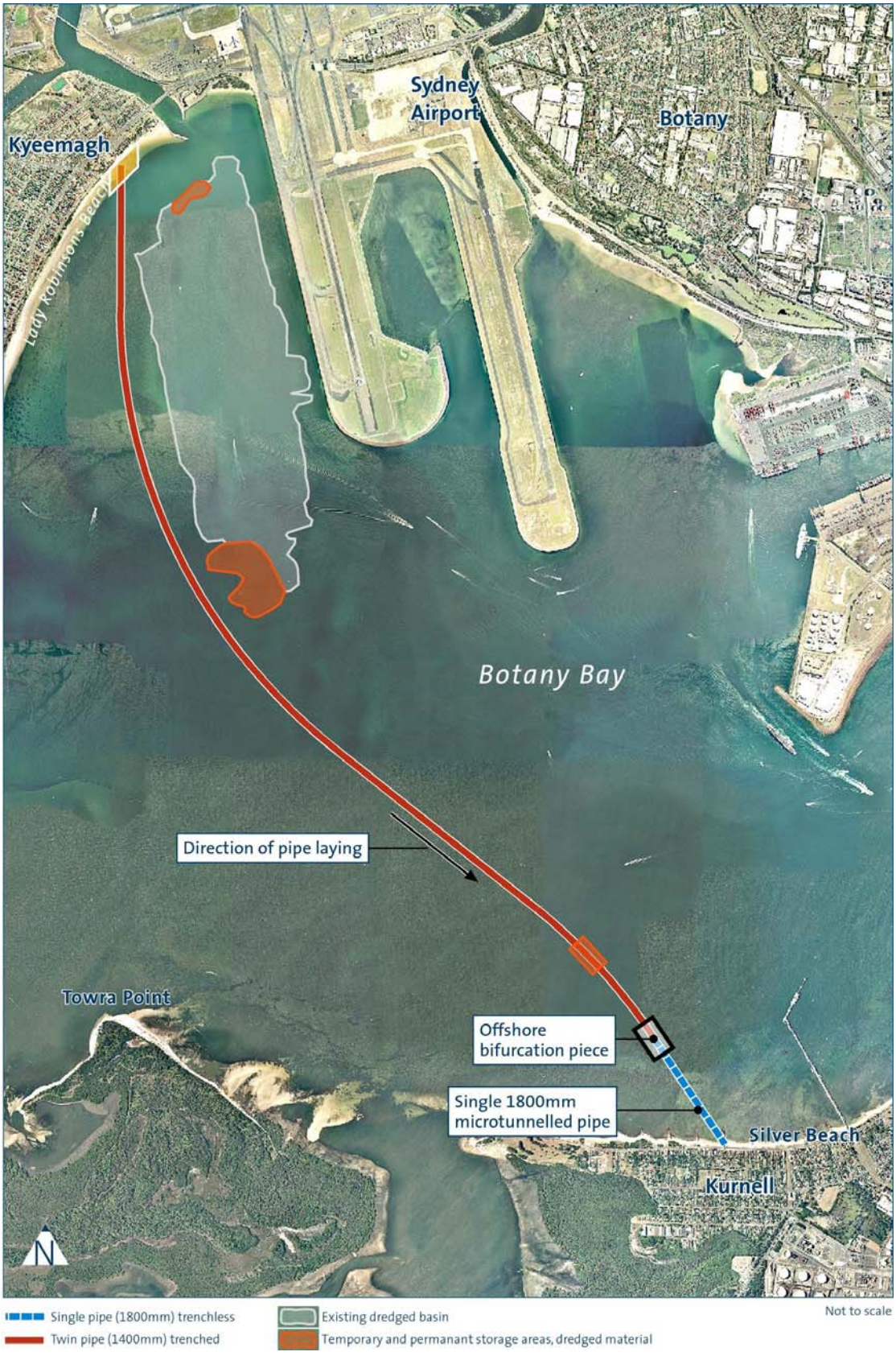

Figure 2.1: Project as described in the PPR and as modified 12/09/08 – relevant aspects only

In relation to the management of turbidity generated by dredging activities the PPR stated:

The use of cutter suction dredgers (or equivalent) will contain plume dispersion during dredging, as most of the finer sediments will be drawn into the suction head, leaving minimal suspended solids to cause a plume.

As such, the EA and PPR did not propose to install silt curtains around the cutter suction dredges. Consultation with the Department of Environment and Climate Change (DECC) and the Department of Primary Industries (DPI) regarding this issue has indicated that they are supportive of the proposed amendment, and the management measures proposed in the Botany Bay Sector Construction Water Management Plan.

It should be noted that the overall intent of the condition, to protect water quality and aquatic ecology within the Bay is not affected by the proposed amendments. Similarly, the extent of the proposed amendments is limited to installation of silt curtains around the cutter suction dredges only – silt curtains will be installed around the Silver Beach and Kyeemagh construction sites, as well as the dredge discharge barges.

2.3.2 Amendment 2 – Minister's Condition of Approval 2.19 (as modified 12/09/08)

Condition 2.19 of the Project Approval (as modified 12/09/08) relates to turbidity monitoring and visible surface plumes and requires that:

The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment and a distance of within ten metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.

The relevant aspect of Condition 2.19 WDA is seeking be amended, as well as the proposed amendments to the text are identified in the table below.

Existing approval text (Condition 2.19). Extracted from modified Project Approval 12/09/08	Proposed amendment to text
No visible surface plume outside the silt curtains is permitted.	*All reasonable and feasible mitigation measures shall be employed so as to minimise prolonged visible surface plumes (outside silt curtains) in the Bay, and shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.*

WDA propose that Condition 2.19 be amended in relation to the visible plume only. The EA and PPR briefly addressed the recreational/aesthetic impacts of visible plumes, however the PPR focussed on the relationship with turbidity as follows:

Both dredging and backfilling of the trench will cause increases in suspended solid concentrations in the water as a result of disturbance of seabed sediments. The majority of the sediments will settle onto the seabed in the immediate vicinity of the dredger. A proportion of the fine sediments (silt) will be transported away from the dredger by tidal currents, potentially forming a sediment plume. Potential turbidity impacts would be managed by disposing of dredged material within silt curtains

WDA considers that the proposed amendment to the condition would not affect the outcome or the intent of the condition, ie the response of the WDA in relation to a visible surface plume – the effect being an early warning device to minimise turbidity within the water column. The adopted construction approach utilises the cutter suction dredge to minimise disturbance to the seabed, and therefore visible surface plumes. The amendment has

been requested based on practical considerations and to ensure surface plumes (or more importantly, turbidity) are appropriately monitored and complied with. Consultation with DECC and DPI indicates that they are generally supportive of the proposed amendment. In addition, the proposed amendment is consistent with Condition 2.15 of Energy Australia's Project Approval for the Botany Bay Cable Project (19/12/07).

2.4 Rationale/justification for proposed amendments to Minister's Conditions of Approval

The intent of Conditions 2.18 and 2.19 are to minimise impacts to water quality and aquatic ecology, through appropriate monitoring, and management.

The proposed amendments to Conditions 2.18 and 2.19 are sought for a variety of practical and logistical reasons, whilst ensuring that environmental impacts are managed and minimised, as follows:

- Previous sand dredging projects within the Bay (excluding deep dredging associated with major port development) including the nourishment of Lady Robinson's Beach (Sydney Ports) and nourishment of Towra Point (Waterways Authority) did not employ turbidity barriers around the dredgers. No adverse impacts on water quality or aquatic ecology were reported as part of the environmental monitoring for these projects.
- Dredging personnel with experience in the industry have advised that silt curtains are rarely used in conjunction with dredging projects using the cutter suction method. An example where silt curtains were used, the silt curtains failed and additional turbidity was generated, such that the regulators requested the silt curtain be removed (pers comm. Ross Davidson, 27/10/08 - Marine Superintendent for a number of dredging projects including Northside Storage Tunnel, Sydney Water Alliance - dredging and removal of contaminated sediments, Long Bay, Cammeray, 1997-2000; Towra Beach Renourishment, DECC-NSW Maritime - dredging and beach renourishment, Botany Bay, 2006-07; Murray River Mouth Dredging, SA Water - dredging of Murray River mouth for flushing and tidal flows, 2008; Brooklyn Canal Dredging, NSW RailCorp - dredging and removal of sediments, Hawkesbury River).
- As discussed previously, the cutter suction dredge was selected because this method of dredging is designed to minimise turbidity generation, compared with other dredging methods. Use of a cutter suction dredge represents best management practice
- The pipeline route has been selected to avoid areas of fine sediments (eg clays), where practical. By selecting the route to dredge primarily through sands, the likelihood of exceeding the turbidity criteria is minimised Where dredging of the pipeline trench through known areas of clay is to occur (a short section off Kyeemagh), silt curtains will be deployed around the trench
- Operational constraints to using silt curtains around the cutter suction dredges include:
    - risk of the silt curtain or its associated anchors becoming entangled with the dredging operations, in particular in the event the dredger needs to reverse
    - restrictions to access/egress from the cutter suction dredges for the dredging crew affecting operating efficiency, and potentially affecting emergency situations
    - potential construction delays associated with installing/deploying the silt curtains, as well as the logistics including the number of boat movements to manoeuvre the curtain into place, impediments to the operation of the dredge and delay to its progress, as the silt curtain itself would need to be moved separately to stay in an appropriate position around the dredges

- The need to continually move the silt curtains, including the anchoring system, has the potential to create turbidity
- As the silt curtain is only required if the trigger levels are exceeded, there is the potential that the construction timeframe identified in the PPR for the Botany Bay Sector is compromised. Prolonged construction activity in the bay also has the potential to impact recreational users
- Visible surface plumes are not necessarily representative of impacts that might have the potential to affect water quality or aquatic ecology. For example the EA noted that a plume can be visible with an increase in turbidity of 5mg/L above background

In addition, the Botany Bay Sector Construction Water Management Plan includes contingency measures, such as varying the speed of the cutter, to be applied when turbidity exceeds the criteria identified in Conditions 2.18 and 2.19. For the reasons described above, these mitigation measures are more likely to be effective at minimising turbidity than the use of silt curtains. In addition, the environmental assessment in Section 4 concludes that the proposed amendments will result in no net change to environmental impacts.

3 Consistency Assessment

This application for modification is being prepared to amend Conditions 2.18 and 2.19 of the Project Approval. However, a consistency assessment was commenced for the proposed amendments to determine if the amendments would affect any conditions other than 2.18 and 2.19 and to confirm that the amendments were generally in accordance with the associated documentation. The results are summarised below.

3.1 Consistency with the Concept Approval

The proposed amendments do not relate to the Concept Approval. As such, the proposed amendments are considered to be consistent with the Concept Approval. Refer to Appendix A for further details.

3.2 Consistency with the Project Approval

The Project Approval includes a number of conditions with which the project must comply. These conditions relate to requirements such as environmental monitoring, auditing, etc, or to other parts of the project, for example impacts associated with the land pipeline. Appendix A includes details of consistency of the proposed amendments with the Project Approval. A copy of the Project Approval and Modified Approvals (13/06/08 and 12/09/08) are included as Appendix B.

Condition 1.1 - Terms of the Project Approval requires the project to be carried out in accordance with various documents including the conditions of project approval. Of these conditions, Conditions 2.18 and 2.19 are the only conditions that directly relate to this application for modification. The reasons and justification for seeking amendments to these conditions were discussed in Section 2.

Condition 5.2e is also relevant to this application for modification in that it will be used as the primary mechanism guiding environmental management. WDA do not propose to amend Condition 5.2e.

3.3 Are any new conditions required?

Section 4 assesses the potential environmental impacts associated with the proposed amendments and identifies the Minister's Conditions of Approval that will be implemented to manage impacts. As the impacts can be managed by implementing the existing Minister's Conditions of Approval (and Statements of Commitment), it is considered that new conditions are not required.

3.4 Assessing consistency with the approved project

When assessing consistency, it is generally accepted that the key tests must be drawn from the objectives of the project, description of the approved activity, and the described impacts of the project. The project objectives, description, and assessment of potential impacts are contained in a number of documents including:

- Major Project Application
- EA of the Concept Plan and PPR for Sydney's Desalination Project
- EA and PPR for the Desalinated Water Delivery System

3.4.1 Objectives

The proposed amendments are generally consistent with the objectives of the project (refer to Appendix A).

3.4.2 Project Description

The proposed amendments are generally consistent with the project description in that the amendments relate to changing the conditions of approval, rather than altering the construction methods or routes detailed in the EA and PPR. The project descriptions identified in the EA and PPR will not be changed by the proposed amendments.

3.4.3 Impacts

Section 4 assesses the potential impacts of the proposed amendments. When comparing whether the proposed and approved impacts are consistent, the following issues need to be addressed:

- Are there any significant impacts?
- Are the proposed impacts similar in scale to the approved impacts?
- Will someone be affected by an impact who was not previously impacted?
- Are there any new impacts and who/what will be affected?

These issues are discussed below.

Are there any significant impacts?

The proposed amendments apply to specific conditions and the practicalities of monitoring and managing turbidity and will not result in any significant environmental impacts. The proposed amendments will not affect the environmental and social impacts, compared to the approved project. Existing potential impacts will be managed by implementing the Minister's Conditions of Approval and Statements of Commitment (refer to Section 4).

Are the proposed impacts similar in scale to the approved impacts?

The proposed amendments will not affect the environmental or social impacts, compared to the approved project, and therefore the impacts are similar in scale to the approved impacts.

As described in Section 4, the proposed amendments will have no net effect on the overall environmental impacts. Potential impacts will be managed by implementing the Minister's Conditions of Approval and relevant Statements of Commitment (refer to Section 4).

Will someone be affected by an impact who was not previously impacted?

The proposed amendments will not affect anyone that was not previously impacted. WDA has consulted with affected stakeholders including DECC and DPI, and Silver Beach Aquaculture to identify potential issues (refer to Section 5). Potential issues discussed primarily related to whether the methods of monitoring and management proposed would be suitably effective. The measures have been identified in the Construction Water Management Plan.

Are there any new impacts and who/what will be affected?

The proposed amendments will not result in new impacts.

Based on the above considerations of consistency with objectives, project description and impacts, the proposed amendments are considered to be consistent with the approved project.

4 Environmental assessment

4.1 Gap Analysis / Summary of Change in Impact

This section compares the potential impacts from the proposed amendments against the approved project. The comparison uses the key potential environmental impacts assessed in the EA and PPR. Table 4.1 summarises the relative change in environmental impacts associated with the proposed amendments. Additional detail is provided in Sections 4.2 and 4.3.

The assessment has been limited to the most relevant key issues, namely aquatic ecology and water quality. Impacts affecting coastal processes and noise have not been addressed, as the proposed amendments to the Conditions are not expected to affect these matters.

Table 4.1: Change in environmental impact due to the proposed amendments

Aspect	Relative change in environmental impact	Additional management measures required
Aquatic ecology	No change in impacts associated with proposed amendments to Conditions 2.18 and 2.19.	N/A
Water quality	No change in impacts associated with proposed amendments to Conditions 2.18 and 2.19.	N/A

4.2 Summary of Approved Project

The PPR identified that both dredging and backfilling of the trench would cause increases in suspended solid concentrations (turbidity) in the water as a result of disturbance of seabed sediments. The majority of the sediments would settle onto the seabed in the immediate vicinity of the dredger. A proportion of the fine sediments (silt) would be transported away from the dredger by tidal currents, potentially forming a sediment plume. Potential turbidity impacts would be managed by disposing of dredged material within silt curtains. The assessment concluded that the water quality objective for the project should be an allowable increase in suspended solid concentrations of 50 mg/L above background levels.

The PPR also identified that the use of cutter suction dredges (or equivalent) would contain plume dispersion during dredging, as most of the finer sediments would be drawn up into the suction head, leaving minimal suspended solids to cause a plume. A submerged diffuser below a disposal barge was proposed to place the dredged material in the existing dredged basin for storage. The PPR committed to surrounding the discharge barge and diffuser with a silt curtain to manage water quality impacts, by limiting migration of fine sediments contained in the dredged material, as well as fine sediments located on the batter which could be disturbed during the placement process. The silt curtain would extend into the water column to a depth that would prevent a visible plume at the water surface beyond the perimeter of the silt curtain.

The PPR also noted that a decrease in water quality has the potential to impact on aquatic ecology, recreational fishing and aquaculture, etc.

In relation to visual surface plumes caused by turbidity, the assessments found that visual impacts are primarily a water quality issue relevant to recreation and aesthetics. The PPR noted that it is difficult to quantify trigger levels for visual impacts because of the subjective nature of determining what is considered acceptable. Similarly, modelling undertaken for the EA by Cardno Lawson and Trelor (2007) stated *"The plume is considered likely to be visible if it is 5 mg/L above background levels"*.

In regards to impacts on aquatic ecology, the EA and PPR documents identified that sustained high levels of turbidity can affect aquatic biota in several ways. Prolonged periods of high turbidity can reduce the amount of light reaching seagrass and algae, reducing growth rates and potentially causing death. High levels of suspended solids can damage fish gills and impair respiration. Sediment particles settling out of the water column can clog the respiratory and or feeding structures of invertebrates that feed by filtering particles from the water column. In extreme cases of turbidity, the rate of settling particles could overwhelm the ability of burrowing forms to move through sediment, restricting access to food and oxygenated water.

Importantly, the assessments noted that the sediment to be dredged was largely sand, and therefore, indirect impacts on filter feeding invertebrates was considered a low risk. The risk of potential indirect impacts could occur if patches of fine sediments are encountered.

4.3 Assessment of Modified Project

4.3.1 Water Quality

The proposed amendments effectively involve changing aspects of the construction water quality control measures identified in Conditions 2.18 and 2.19.

As discussed in Section 2, WDA is no longer proposing the use of silt curtains around the cutter suction dredges as a contingency measure, due to operational limitations and other reasons listed in Section 2.4. Cutter suction dredges were selected as they cause less disturbance to the seabed, and less turbidity, than other types of dredgers and also minimise the distance sediment may be transported in suspension before settling on the seabed. Thus, the cutter suction dredges themselves are a significant measure in minimising turbidity along the pipeline route.

The EA considered that backfilling would release greater quantities of fine sediment than dredging activities. Modelling carried out by Cardno Lawson Trelor (2007) indicates that plumes caused by the backfilling work are not expected to be visible at the sea surface. Silt curtains will be used around the dredge discharge barges, which are also fitted with purpose designed diffuser heads to limit the dispersion of fine sediments.

The proposed amendment to Condition 2.19 will remove the requirement that there be no visible surface plume outside the silt curtains. Experience has demonstrated that this condition is impractical to meet due to constraints associated with the pipe laying and dredging operations. Additionally, the presence of a visible surface plume is not an indication that turbidity measures have been exceeded and therefore it does not act as a useful indicator of high turbidity.

The proposed amendments to Conditions 2.18 and 2.19 retain the intent and the outcome of the condition, ie the ability of the WDA to respond appropriately to minimise impacts to water quality within Botany Bay.

The amended conditions include a commitment that all reasonable and feasible measures will be employed to minimise turbidity, and that these are to be detailed within the Botany Bay Sector Construction Water Management Plan as updated in November 2008. The Botany Bay Sector Construction Water Management Plan includes the following measures to minimise turbidity:

- selection of plant and equipment that minimise plume dispersion
- pipeline route selected to avoid, as far as possible, known areas of fine sediment
- use of turbidity curtains around active construction areas
- continuous monitoring of turbidity with optical turbidity sensors and an alarm system when turbidity thresholds are exceeded
- turbidity exceedance response protocol.

As such, while the management measures and response would be different compared to the existing conditions, the proposed amendments would not affect impacts to water quality, compared with the approved project, and provide practical application.

4.3.2 Aquatic Ecology

The impact assessment for the EA considered the potential for direct and indirect impacts to aquatic ecology associated with the project. Indirect impacts to aquatic ecology were identified as a result of impacts to water quality, which were discussed in Section 4.3.1 above. The proposed amendments to the conditions would not result in any direct impacts to aquatic ecology.

Cardno Ecology Lab Pty Ltd (2008) undertook a review and assessment of potential impacts relating to increases in turbidity and the susceptibility of aquatic flora and fauna to increased turbidity at the trigger point identified in the conditions (Appendix C). The review indicated that turbidity increases of 50 mg/L above background levels monitored over a period of 5 days (120 hours) is an acceptable trigger for management intervention. The effects of suspended sediment in the water column are dependant, among other things, on both concentration and duration of elevated turbidity. Thus, the appearance of suspended solids (turbidity) and/or a visible surface plume outside the silt curtains is likely to cause minimal impacts on seagrasses and aquatic fauna in the Bay over this period of time (5 days), provided that:

- turbidity is monitored according to the Botany Bay Sector Construction Water Management Plan; and
- all reasonable and feasible mitigation measures are employed to minimise the duration of the plume,

These findings indicate that the proposed amendments to Conditions 2.18 and 2.19 are not likely to result in adverse impacts to aquatic ecology in the Botany Bay Sector, and furthermore, that there is a 5 day time period in which management measures can be implemented to mitigate adverse impacts. While this study informed the preparation of the Botany Bay Sector Construction Water Management Plan, WDA adopted a significantly more conservative approach to identify management measures, using the monitoring data, including:

- adoption of a 12 hour moving average to assess potential water quality impacts
- setting an amber and red light warning system using the 15 minute interval data to trigger actions

As such, while the management measures and response would be different compared to the existing conditions, the proposed amendments would not affect impacts to aquatic ecology, compared with the approved project.

4.4 Management Measures / Conclusion

Overall, the proposed amendments will result in no change in impacts to either water quality or aquatic ecology, compared with the approved project.

Water quality monitoring will be undertaken in accordance with Conditions 2.18 and 2.19 (including the proposed amendments) and 5.2e of the Project Approval. Control of turbidity/suspended solids will be managed in accordance with the Botany Bay Sector Construction Water Management Plan (prepared in accordance with Conditions 2.18 and 2.19, 5.2e of the Project Approval and Statement of Commitments 3 and 6).

No additional Statements of Commitments are considered necessary for the proposed changes.

5 Consultation

WDA has consulted with potentially affected stakeholders in regards to the proposed amendments. This consultation has been undertaken in accordance with the project-wide Community and Stakeholder Relations Plan (CSRP) which outlines WDA's approach to community and stakeholder relations. The consultation specifically targeted relevant government agencies and potentially affected commercial bodies. Specifically, the consultation involved:

- Relevant Agencies – DECC and DPI (Fisheries)
- Potentially affected commercial groups – Silver Beach Aquaculture, Energy Australia and Sydney Ports Corporation

Detail on the consultation undertaken and any issues raised are provided below.

Additionally, based on the principles outlined in the CSRP, broader public consultation among local communities and recreational Bay users was not undertaken as the proposed amendments relate mainly to regulator issues. Some information regarding the proposed amendments was however provided in the monthly community updates and community information sessions. During these sessions, no issues relating to the proposed amendments were raised by the community present.

Consultation with relevant government agencies

WDA met with DECC and DPI on 16 October 2008. During the meeting the existing conditions and amendments to Conditions 2.18 and 2.19 were discussed. Both DECC and DPI were comfortable with the proposed approach for both conditions, and recognised both the practical difficulties associated with using silt curtains around the cutter suction dredges and the unnecessary limitations and constraints that the requirement for no visible surface plume outside the silt curtains might impose.

Subsequent to the meeting, DECC have contacted WDA and suggested that the term 'prolonged' be removed from the proposed amendment text. WDA considers that as our response to minimising a visible surface plume commences as soon as a visible surface plume is identified, leaving the term in would not affect the water quality of the Bay, and is preferable as the condition is consistent with Energy Australia's condition.

The potential for anchor handling activities to generate turbidity during lay operations was also discussed. Both DECC and DPI indicated that it was not the intent of the conditions to include anchor-handling activities, as anchoring is standard practice and the turbidity that it is generated is temporary and very localised. Given this understanding, WDA have not sought to amend the conditions to specifically exclude anchor-handling activities.

The history and background to the conditions were also discussed with DECC and DPI. It should also be noted that WDA is seeking to vary its existing Environmental Protection Licence to include the dredging activities associated with the Bay works.

While WDA has not specifically consulted NSW Maritime about the proposed amendments to Conditions 2.18 and 2.19, WDA undertakes regular consultation with NSW Maritime in relation to operations within the Bay and locations of equipment eg monitoring buoys.

Consultation with potentially affected commercial groups

WDA met with Silver Beach Aquaculture on 28 October 2008. During the meeting the proposed modification to the Project Approval was discussed, including:

- amendments to Conditions 2.18 and 2.19, in particular removal of the requirement for silt curtains around the cutter suction dredge, and removing the reference to “no visible surface plume”
- timeframe for submitting the application for modification.

Other issues discussed not specifically relating to this application for modification included the water quality monitoring that WDA are undertaking in accordance with the latest Construction Water Management Plan, and an explanation of the proposed “amber” and “red” light water quality monitoring triggers, the 12 hour averaging and the use of 15 minute data to trigger the “amber” system.

No issues were raised during the meeting.

Regular consultation with Sydney Ports Corporation and Energy Australia occurs in accordance with Condition 3.1 of the Project Approval which requires consultation be undertaken in order to provide a coordinated approach and, where possible minimise cumulative impacts. In relation to this application for modification, WDA, Sydney Ports Corporation and Energy Australia have discussed techniques for monitoring and managing turbidity, deployment of silt curtains and potential impacts to aquatic ecology and water quality. As a result of this consultation, WDA is seeking to amendment its condition to be in accordance with an Energy Australia condition.

WDA will continue to consult and inform stakeholders in accordance with Statements of Commitment 37 and 38, and Conditions 2.2b, 2.8, 2.10, 2.12, 2.14, 2.15, 2.16, 2.26, 4.3, 5.2b, 5.2f, 5.2g, 5.3, 5.4, 6.1 of the Project Approval.

6 Implementation

6.1 Environmental Safeguards

The environmental assessment (Section 4) undertaken for the proposed amendments indicates there would be no change in environmental and social impacts for the project overall.

The existing Statements of Commitment and Minister's Conditions of Approval are considered sufficient to manage potential impacts associated with the proposed amendments. No additional or new Statements of Commitment or Conditions of Approval are considered necessary.

Relevant Statements of Commitment from the PPR which have been identified in this document have been included as Appendix D.

6.2 Tasks following approval of modification

Once the Minister for Planning approves the modification, WDA will review the terms of approval to determine whether any actions are required to ensure compliance with any additional requirements. If required, WDA would then undertake such actions including review and update of relevant:

- Information provided to stakeholders such as NSW Maritime and other users of the Bay concerning the proposed amendments
- Management plans or procedures required by the Approvals or Statements of Commitment, including those approved by the Director-General of the DoP. This process will be undertaken in accordance with the WDA procedure for Altering an Activity Approved by the Minister.

7 Conclusion

This application for modification has been prepared to seek amendment of Conditions 2.18 and 2.19 of the Project Approval and to assess the environmental impacts of the proposed amendments within the Botany Bay Sector of the route.

This application for modification seeks to amend Conditions 2.18 and 2.19 as experience has demonstrated these conditions will be impractical to meet due to operational constraints, and effective management is achievable through the Construction Water Management Plan (Condition 5.2e). Overall, there would no net change in environmental and social impacts for the project due to the proposed amendments, compared to the approved project.

Section 75W of the EP&A Act provides for the Minister for Planning to modify a project approval, with or without conditions. WDA has assessed the environmental impacts associated with the proposed amendments and suggests modifying Conditions 2.18 and 2.19 as follows:

Condition	Suggested amendment	Proposed modified condition
Condition 2.18 of the Project Approval	*Replace:* *Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.*	*Construction and maintenance activities associated with the Botany Bay Sector shall be carried out in a manner that minimises the potential for the re-suspension and dispersal of marine sediments and associated biota, including installation of silt curtains around the Silver Beach and Kyeemagh construction sites and dredge discharge barges within the Botany Bay Sector.* *Where silt curtains have been installed, they shall remain in place until the turbidity of the water within the silt curtains returns to background levels of turbidity in waters immediately outside the silt curtains.* ***All reasonable and feasible mitigation measures shall be employed during operation of the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L. These measures shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.***
Condition 2.19 of the Project Approval (as modified, 12/09/08)	*Replace:* *No visible surface plume outside the silt curtains is permitted.*	*The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment and a distance of within ten metres from the silt curtain.* ***All reasonable and feasible mitigation measures shall be employed so as to minimise prolonged visible surface plumes (outside silt curtains) in the Bay, and shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.***

References

Cardno Ecology Lab (2008) *Water Deliver Alliance Advice on Methodology for Monitoring Turbidity in Relation to Pipeline Emplacement across Botany Bay.*

Cardno Lawson Treloar (2007) *Coastal Processes for the Pipeline Crossing of Botany Bay.*

Appendices

A Summary of Consistency Assessment
B Copy of Project Approval 07_0054 and Modifications of Approval (13/06/08 and 12/09/08)
C Advice on methodology for monitoring turbidity in relation to pipeline emplacement across Botany Bay (Cardno Ecology Lab, 2008)
D Relevant Statements of Commitment (PPR)

Appendix A – Summary of Consistency Assessment

Appendix A – Summary of Consistency Assessment

A.1 Consistency with the Concept Approval

The following sections assess consistency with the Concept Approval. The Concept Approval includes a number of conditions that relate to administrative conditions, compliance tracking, community information consultation and involvement, complaints management and environmental management. The following sections only address those conditions relevant to the proposed amendments in the context of the approved project.

A.1.1 Schedule 1

As stated in Schedule 1 of the Concept Approval, on 16 November 2006, the Minister for Planning approved the concept of:

'Construction and operation of a desalination plant on the Kurnell Peninsula and associated infrastructure for the supply of an annual daily average production of up to 500 megalitres of drinking water per day, including:

a) *Intake and outlet pipelines to draw raw seawater into the plant and return seawater concentrate to the ocean (including tunnelling under Botany Bay National Park);*

b) *Pipelines and/ or tunnels from the plant across Botany Bay to the Sydney Water Corporation water supply system for the distribution of drinking water;*

c) *Connection of the plant to the electricity grid; and*

d) *Temporary laydown areas for construction use.*

The amendments are consistent with the concept defined by the Concept Approval (Schedule 1) in that the delivery system will be able to supply up to an annual daily average of 500 ML of desalinated water per day. It is consistent with item (b) above as it involves a pipeline from the plant across Botany Bay to Sydney Water's water supply system. It also requires the use of temporary laydown areas for construction use, thereby evidencing consistency with item (d) above.

Items a) and c) above do not relate to the delivery system and so are not relevant to this consistency assessment.

A.1.2 Schedule 2 – Condition 1.1

Condition 1.1 requires that:

The Proponent shall carry out the concept plan and all related projects generally in accordance with the:

a) *Major Project Application 05_0082;*

b) *Environmental Assessment of the Concept Plan for Sydney's Desalination Project, dated November 2005, and prepared by Sydney Water Corporation;*

c) *Sydney's Desalination Project, Preferred Project Report, dated August 2006, and prepared by Sydney Water Corporation; and*

d) *The conditions of this approval.*

The following sections discuss whether the proposed amendments are generally in accordance with these documents.

Condition 1.1(a) - Major Project Application

The Major Project Application dated 10 November 2005 and its attachment (Sydney's Desalination Project; Major Projects Application Attachment; Project Description Report), contains the following three key references to the delivery system:

- On page 2 of 4 – '*pipelines and/or tunnels from the plant across Botany Bay to the Sydney Water Corporation water supply system for the distribution of drinking water*';

The amendments are consistent with this reference as the project involves a pipeline from the plant to the existing water supply system for the distribution of drinking water.

- On page 2 of the attachment – '*Infrastructure to deliver water to the existing distribution network, allowing any of the following:*
    - *50 ML/day delivered locally to Caringbah;*
    - *125 ML/day delivered to Kyeemagh and then to the existing distribution network; and*
    - *Up to 500 ML/day delivered to the major water distribution system consisting of the City and Pressure Tunnels via a pipeline or tunnel across Botany Bay*.'

The proposed amendments are consistent with this reference as the project involves delivery of up to an annual daily average of 500 ML/day of desalinated water to the City Tunnel via a pipeline via a pipeline or tunnel across Botany Bay.

- On page 3 of the attachment – '*to date, two water distribution methods (that is, distribution route and method of construction) are under consideration to connect the desalination plant to the water network. A pipeline and/or a tunnel could be used to distribute the water. Figures 1.2 and 1.3 show examples. Other distribution methods will be considered. Alternative distribution methods may arise during the detailed design process. Decisions on the route and method of construction will be made during detailed design*.'

Figures 1.2 and 1.3 of the Major Project Application were indicative of concepts under consideration at that stage of the project and are no longer reflective of the project. These concepts have been refined during the course of subsequent investigations as part of the:

- EA of the Concept Plan;

- Blueprint Design;
- EA for the Delivery System;
- PPR for the Desalinated Water Delivery System; and
- Detailed design following receipt of the Project Approval.

The proposed amendments do not alter the approved project described in the PPR, and subsequent modifications.

On the basis of the above, it is considered that the proposed amendments are generally in accordance with the Major Project Application.

Condition 1.1(b) - Environmental Assessment of the Concept Plan for Sydney's Desalination Project

Section 2.1 (page 2.2) of the EA of the Concept Plan identified one of the main components as being:

'Infrastructure to deliver water to the existing distribution network, allowing any of the following:

- *50 ML/day delivered locally to Caringbah;*
- *125 ML/day delivered to Kyeemagh and then to the existing distribution network; and*
- *Up to 500 ML/day delivered to the major water distribution system consisting of the City and Pressure Tunnels via a pipeline or tunnel across Botany Bay.'*

The proposed amendments are consistent with this reference as desalinated water will be delivered to the major water distribution system.

Section 2.1 of the EA for the Concept Plan also states that:

'To date, two water distribution methods (that is, distribution route and method of construction) are under consideration to connect the desalination plant to the water network. A pipeline and/or tunnel could be used to distribute the water. Figures 2.2 and 2.3 show examples of routes that have been investigated. Other distribution methods will be considered.

Alternative distribution methods may arise during the detailed design process. Decisions on the route and method of construction will be made during detailed design.

The precise details of the site layout, distribution routes and other infrastructure will not be available until further investigation and design are undertaken as part of the detailed design in the project procurement strategy. This will be subject to the applicable environmental approval process.'

The proposed amendments do not alter the overall concept of delivering desalinated water to the water supply system.

On the basis of the above, it is considered that the proposed amendments are generally in accordance with the EA of the Concept Plan.

Condition 1.1(c) - Preferred Project Report for Sydney's Desalination Project

Chapter 1.4 of the PPR for Sydney's Desalination Project (August 2006) outlined the following refinements to the delivery system proposed in the EA of the Concept Plan:

- A tunnel may not be required for a plant greater than 125 ML/day. Methods to deliver greater than 125 ML/day include one or more pipelines once across Botany Bay or a tunnel, both of which were described in the EA of the Concept Plan; and

- A pipeline to Miranda/Caringbah will not now form part of the project, as water can be supplied across Botany Bay more cost effectively.

Section 11.1.2 of the PPR for Sydney's Desalination Project stated that:

"Sydney Water will seek subsequent Project Approval/s for the remaining components of the desalination project, namely the desalinated water distribution methods (that is, distribution route and method of construction) from the desalination plant. This will be sought at a time that would allow construction to commence when storages are depleted to around 30 percent. Further studies, investigations and assessments will occur to better understand constraints and identify the preferred delivery route(s)."

The project, including the proposed amendments, is consistent with that presented in the PPR for Sydney's Desalination Project as:

- A tunnel is not required and a pipeline is able to cater for the ultimate design capacity of the desalination plant of 500 ML/day; and

- It does not involve a pipeline to Miranda/Caringbah.

Condition 1.1(d) – Conditions of the Approval

Condition 1.1d of Schedule 2 requires that the project be consistent with the requirements of the Concept Approval. There are a number of Conditions of Approval that do not relate to the design or assessment of the project. These are:

- Administrative conditions (Condition 1);

- Compliance monitoring and tracking (Condition 3);

- Community information, consultation and involvement (Condition 4); and

- Environmental management (Condition 5).

Where relevant, these conditions were incorporated into the Statement of Commitments in the PPR to ensure consistency with the Concept Approval.

Condition 2.1 (schedule 2) of the Concept Approval specifies assessment requirements for the project (refer to Table 3.1). These requirements were addressed by the EA and PPR for the desalinated water delivery system.

Table 3.1 Environmental assessment requirements

Requirement (as per condition 2.1 of the Concept Approval)	Consistency assessment
(a) details of the project, including route, capacity and proposed construction methods	Not relevant to the proposed amendments.
(b) a detailed project-specific Statement of Commitments, consistent with the Statement of Commitments prepared for the Kurnell Desalination Plant concept plan, with a clear indication of any new or amended commitments relating to the project	Chapter 11 of the PPR, Section 4 of the Application for Modification.
(c) a demonstration that the project is consistent with the requirements of this approval and generally consistent with the scope and intent of the concept outlined in the documents under condition 1.1 of this approval	This appendix.
(d) a demonstration that the project has been designed to take into account and, where relevant, mitigate against, the impacts of wave action and coastal processes both on project integrity and as a result of the project on surrounding areas	Not relevant to the proposed amendments.
(e) a demonstration that the project has been designed to minimise the loss of seagrasses during the construction and operation of the project	Not relevant to the proposed amendments – however Section 4 of the Application for Modification relates to aquatic ecology impacts.
(f) a framework Compensatory Seagrass Package, developed in consultation with the DPI, detailing a framework for how any loss of seagrass associated with the project will be offset. The Package shall include consideration of new and/or protected seagrass areas, or other compensatory measures agreed by the DPI, commensurate with the extent of seagrass impacts. The Package shall also consider how the compensatory measures will be implemented, timing for any proposed works, responsibilities for on-going maintenance and monitoring and funding arrangements	Not relevant to the proposed amendments.
(g) a demonstration that the project has been designed to minimise water quality impacts particularly turbidity in Botany Bay	Section 8.3 of the EA, and Section 4 of the Application for Modification.
(h) a comprehensive water quality impact assessment for the project, undertaken in consultation with the Department of Environment and Conservation (DEC) and DPI, considering how the project will be constructed and operated to meet the outcomes specified in Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000) and to contribute to the achievement of the objectives in Marine Water Quality Objectives for NSW Ocean Water (DEC, 2006). The assessment shall make specific references to the prevention of adverse impacts on the Towra Point Reserve and commercial and recreational fishing activities in and around Botany Bay	Section 8.3 of the EA, and Sections 4 and 5 of the Application for Modification.
(i) an assessment of potential noise and vibration impacts associated with construction of the project, and how these impacts will be mitigated, monitored and managed	Not relevant to the proposed amendments.

A.2 Consistency with the Project Approval

The following sections assess consistency with the Project Approval. The Project Approval includes a number of conditions, however not all are relevant to the proposed amendments to the construction methods. These conditions relate to matters such as, but not limited to:

- Botany Bay Cumulative Impacts and Coordination (Condition 3);
- Environmental Monitoring and Auditing (Condition 4);
- Environmental Management (Condition 5); and
- Environmental Reporting (Condition 6).

The following sections only address those conditions relevant to the proposed amendments in the context of the approved project. Condition 1 was considered relevant to this consistency assessment and are assessed below.

In addition, WDA will review the Project Approval to determine whether information such as procedures and management plans required by Conditions 3 - 6 need to be amended to meet compliance obligations.

A.2.1 Condition 1.1 – Terms of the Project Approval

The Project Approval does not define the project for which approval was sought and Condition 1.1 requires that:

The Proponent shall carry out the concept plan and all related projects generally in accordance with the:

a) Environmental Assessment of the Desalinated Water Delivery System, dated April 2007, and prepared by GHD on behalf of the Proponent;
b) Desalinated Water Delivery System: Preferred Project Report, dated August 2007, and prepared by Sydney Water Corporation;
c) Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban
d) Sydney Sector: Sydney North, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008;
e) Desalinated Water Delivery System: Application for Modification of Project Approval for the Botany
f) Bay Sector, prepared by the Water Delivery Alliance and dated 15 July 2008, and additional information dated 2 September 2008;
g) The concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and
h) The conditions of this approval.

Consistency with the documents (a), (b), and (f) is discussed below. The proposed amendments are not applicable to documents (c) and (d). Section A.1.2 above discussed consistency with document (e).

Condition 1.1(a) - Environmental Assessment of the Desalinated Water Delivery System

The delivery system was described in Chapter 5 of the EA for the delivery system. Section 5.4 and Section 8.2 of the EA described the construction and monitoring methods associated with the works in the Botany Bay Sector and stated that:

The trench will be excavated using a cutter suction dredge (or similar dredging equipment). Dredging and backfilling operations in Botany Bay will disturb sediments in the seabed, which could impact on the quality of the water in the bay.

The assessment is based on the construction method described in Section 5.4, which was developed to minimise the potential for the suspension and transport of fine sediments. The method incorporates the following features to minimise potential impacts:

- *Cutter suction dredgers (or similar equipment) will be used to dredge and backfill across Botany Bay, between the end of the seagrass area at Silver Beach and the shore approach at Kyeemagh. These dredgers cause less disturbance of the seabed than other types of dredgers. They also minimise the distance sediment may be transported in suspension before settling onto the seabed.*

The use of cutter suction dredgers (or equivalent) will contain plume dispersion during dredging, as most of the finer sediments will be drawn into the suction head, leaving minimal suspended solids to cause a plume. During backfilling of the trench, greater quantities of fine sediment will be released than during dredging. This is considered by the assessment as the worst case.

A monitoring program consisting of turbidity and suspended solids measurements is outlined to test whether the objective is being achieved. Management measures will be triggered if monitoring indicates that the objective is not being met.

Sections 5.4 and 8.2 of the EA reflect that the construction and monitoring methods described in the EA for the delivery system were designed to minimise potential impacts of dredging. The proposed amendments are consistent with this intention.

Condition 1.2 states that in the event of any inconsistency between the documents identified in condition 1.1a) and 1.1b), the most recent document prevails to the extent of the inconsistency. Chapter 2 of the PPR changed the construction methods in the Botany Bay Sector from that presented in the EA for the delivery system. As such, the PPR prevails over the EA to the extent of any inconsistency. The following section assesses the consistency of the proposed refinements with the PPR.

Condition 1.1 (b) – Desalinated Water Delivery System Preferred Project Report

Chapter 10 of the PPR defined the project for which Sydney Water sought approval. This was based on the project described in Chapter 5 of the EA as refined and changed by Chapter 2 of the PPR. In relation to construction of the trench and the methods of monitoring and managing turbidity and visible plumes, the PPR stated:

The trench will be excavated using two cutter suction dredgers. The first dredger will excavate the bulk of the trench and the second dredger will trim the trench to the required dimensions. The lay barge will follow the dredgers to install the pipelines within the trench. As the pipelines are installed, two dredge discharge barges will fill the trench. The vessels will work 24 hours a day and move progressively across the bay. Silt curtains will surround the discharge barges to manage potential turbidity impacts on water quality.

The barge and diffuser will be surrounded by a silt curtain to manage water quality impacts by limiting migration of fine sediments contained in the dredged material and fine sediments located on the batter which could be disturbed during the placement process. The silt curtain would extend into the water column to a depth that would prevent a visible plume at the water surface beyond the perimeter of the silt curtain.

Both dredging and backfilling of the trench will cause increases in suspended solid concentrations in the water as a result of disturbance of seabed sediments. The majority of the sediments will settle onto the seabed in the immediate vicinity of the dredger. A proportion of the fine sediments (silt) will be transported away from the dredger by tidal currents, potentially forming a sediment plume. Potential turbidity impacts would be managed by disposing of dredged material within silt curtains.

The use of cutter suction dredgers (or equivalent) will contain plume dispersion during dredging, as most of the finer sediments will be drawn into the suction head, leaving minimal suspended solids to cause a plume.

Chapter 10 of the PPR included refinements to the route and changes to the construction methods within the Bay. The overriding requirement to be considered when selecting the preferred option continues to be *"…that the method employed results in an environmental impact no greater than indicated by this environmental assessment".*

The proposed amendments are generally consistent with the PPR as:

- cutter suction dredges will still be used. This method of dredging is designed to minimise turbidity generation, compared with other dredging methods, and use of a cutter suction dredge represents best management practice
- silt curtains will still be installed around the Silver Beach and Kyeemagh construction sites, as well as the dredge discharge barges
- there will be no greater potential impacts to water quality and aquatic ecology compared to the EA and PPR

Section 4 of the Application for Modification assesses the potential environmental impacts of the proposed amendments and concludes that overall, the amendments will result in no net changes of potential environmental or social impacts relative to those described in the PPR. Potential impacts are able to be managed by implementing the Statement of Commitments.

Condition 1.1(c) – Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008

Condition 1.1(c) is not relevant to the Application for Modification.

Condition 1.1(d) – Desalinated Water Delivery System: Application for Modification of Project Approval for the Botany Bay Sector, prepared by the Water Delivery Alliance and dated 15 July 2008, and additional information dated 2 September 2008

Condition 1.1(d) is not relevant to the Application for Modification.

Condition 1.1(e) – Concept Plan granted approval with respect to the Kurnell Desalination Plant concept plan (05_0082)

Condition 1.1(e) is addressed in Section A.1.2 of this Appendix.

Condition 1.1(f) – Conditions of the Project Approval

The Project Approval includes a number of conditions with which the project must comply. These conditions relate to requirements such as environmental monitoring and auditing etc, or to other parts of the project, for example land pipeline impacts and coordination. Of these conditions, conditions 2.18 and 2.19 relate to the Application for Modification.

A.2.2 Condition 2.18

WDA is seeking amendment to part of Condition 2.18 as a result of practical and logistical reasons. Condition 2.18 of the Project Approval relates to the use of silt curtains and, in relation to the Application for Modification requires:

Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.

WDA considers the requirement for silt curtains around the cutter suction dredge impractical to meet due to operational limitations. Section 2.4 of the Application for Modification details the rationale and justification for changing this condition, including that the use of cutter suction dredges have been designed to minimise turbidity, and represent best management practice. It should be noted that the overall intent of the condition, to protect water quality and aquatic ecology within the Bay is not affected by the proposed amendments. An Application for Modification has been prepared to obtain approval for the amendments proposed in the table below:

Existing approval text (Condition 2.18). Extracted from original Project Approval 22/10/07	Proposed amendment to text
Construction and maintenance activities associated with the Botany Bay Sector shall be carried out in a manner that minimises the potential for the re-suspension and dispersal of marine sediments and associated biota, including installation of silt curtains around the Silver Beach and Kyeemagh construction sites and dredge discharge barges within the Botany Bay Sector. Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L. *Where silt curtains have been installed, they shall remain in place until the turbidity of the water within the silt curtains returns to background levels of turbidity in waters immediately outside the silt curtains.*	*Construction and maintenance activities associated with the Botany Bay Sector shall be carried out in a manner that minimises the potential for the re-suspension and dispersal of marine sediments and associated biota, including installation of silt curtains around the Silver Beach and Kyeemagh construction sites and dredge discharge barges within the Botany Bay Sector.* *Where silt curtains have been installed, they shall remain in place until the turbidity of the water within the silt curtains returns to background levels of turbidity in waters immediately outside the silt curtains.* ***All reasonable and feasible mitigation measures shall be employed during operation of the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.*** *These measures shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.*

A.2.3 Condition 2.19

WDA is seeking amendment to Condition 2.19 as a result of constraints encountered in practically implementing the condition. Condition 2.19 of the Project Approval outlines the requirements for monitoring turbidity outside the silt curtains and, in relation to the Application for Modification states:

No visible surface plume outside the silt curtains is permitted."

WDA considers the requirement for *'no visible surface plume…'* as too specific to meet given the constraints of the technology available, and that visible plumes are not necessarily representative of impacts that might have the potential to affect water quality or aquatic ecology. As noted in the EA, a plume can be visible with an increase in turbidity of 5mg/L above background levels. An Application for Modification has been prepared to obtain approval for the variation proposed in the table below:

Existing approval text (Condition 2.19). Extracted from Modification of Approval 12/09/08	Proposed amendment to text
The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment and a distance of within ten metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.	*The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 m depth for Silver Beach and between 1 and 1.5 m depth in the water column for all other sites and equipment and a distance of within ten metres from the silt curtain.* ***All reasonable and feasible mitigation measures shall be employed so as to minimise prolonged visible surface plumes (outside silt curtains) in the Bay, and shall be detailed within the Botany Bay Sector Construction Water Management Plan as described under condition 5.2e.***

Appendix B – Copy of Project Approval 07_0054 and Modifications of Approval (13/06/08 and 12/09/08)

Project Approval

Section 75J of the *Environmental Planning and Assessment Act 1979*

I, the Minister for Planning, approve the project referred to in Schedule 1, subject to the conditions in Schedule 2.

These conditions are required to:

- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the ongoing environmental management of the project.

Frank Sartor MP
Minister for Planning

Sydney 22nd Oct 2007 File No: 9039739

SCHEDULE 1

Application No:	07_0054
Proponent:	Sydney Water Corporation
Approval Authority:	Minister for Planning
Project:	"the desalinated water delivery system" project
Concept Plan:	the project is a component of the approved concept plan for the Kurnell Desalination Plant (05_0082)
Part 3A Project:	On 25 October 2005, the Minister for Planning formed the opinion pursuant to clause 6 of *State Environmental Planning Policy (Major Projects) 2005* that the proposal is for the purpose of development described in clause 25(2) of Schedule 1 to that Policy. The proposal is thus declared to be a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* applies.
Concept Plan Authorisation:	On 16 November 2005, the Minister for Planning authorised the submission of a concept plan for the proposal.
Critical Infrastructure:	On 16 November 2005, the Minister for Planning formed the opinion pursuant to clause 6A of the *State Environmental Planning Policy (Major Projects) 2005* that the proposal is for the purpose of development described in Schedule 5 to that Policy (clause 1 – Kurnell desalination project). The proposal is thus declared to be a critical infrastructure project within the meaning of section 75C of the Act.

KEY TO CONDITIONS

SCHEDULE 2

Act, the	*Environmental Planning and Assessment Act 1979*
Conditions of Approval	The Minister's conditions of approval for the project
DECC	Department of Environment and Climate Change
Department, the	Department of Planning
Director-General, the	Director-General of the Department of Planning, or delegate.
DPI	Department of Primary Industries
EA	*Environmental Assessment of the Desalinated Water Delivery System*, dated April 2007, and prepared by GHD on behalf of Sydney Water Corporation
Minister, the	Minister for Planning.
Proponent	Sydney Water Corporation, or any party acting under authorisation from and on behalf of the Sydney Water Corporation
Publicly Available	Available for inspection by a member of the general public (for example available on an internet site or at a display centre).
RTA	NSW Roads and Traffic Authority
Site	The land to which this approval applies

1. ADMINISTRATIVE CONDITIONS

Terms of Project Approval

1.1 The Proponent shall carry out the project generally in accordance with the:

a) *Environmental Assessment of the Desalinated Water Delivery System*, dated April 2007, and prepared by GHD on behalf of the Proponent;

b) *Desalinated Water Delivery System: Preferred Project Report*, dated August 2007, and prepared by Sydney Water Corporation;

c) the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and

d) the conditions of this approval.

1.2 In the event of an inconsistency between:

a) the conditions of this approval and any document listed from condition 1.1a) to 1.1b) inclusive, the conditions of this approval shall prevail to the extent of the inconsistency; and

b) any document listed from condition 1.1a) to 1.1b) inclusive, and any other document listed from condition 1.1a) to 1.1b) inclusive, the most recent document shall prevail to the extent of the inconsistency.

1.3 Notwithstanding condition 1.2, if there is any inconsistency between this project approval and the concept plan approval for the Kurnell Desalination Plant concept plan, the concept approval shall prevail to the extent of the inconsistency.

1.4 The Proponent shall comply with any reasonable requirement(s) of the Director-General arising from the Department's assessment of:

a) any reports, plans or correspondence that are submitted in accordance with this approval; and

b) the implementation of any actions or measures contained in these reports, plans or correspondence.

Limits of Approval

1.5 This project approval shall lapse on 31 December 2015, unless works the subject of this project approval or any other project approval granted with respect to the Kurnell Desalination Plant concept approval are physically commenced on or before that date. The Director-General may extend this lapse date if the Proponent demonstrates to the satisfaction of the Director-General that the desalination plant technology remains current, appropriate and reflective of best practice at the date the approval would otherwise lapse.

Project Sectors

1.6 For the purpose of this approval, the project shall be considered in three sectors:

a) the **Kurnell Sector**, being the dry-land component of the project between the desalination plant site and Silver Beach (approximately 2.0 kilometres);

b) the **Botany Bay Sector**, being the water-based component of the project between Silver Beach and Kyeemagh, including construction compounds at Silver Beach and Kyeemagh (approximately 8.0 kilometres); and

c) the **Urban Sydney Sector**, being the dry-land component of the project between Kyeemagh and Erskineville (approximately 8.3 kilometres).

2. SPECIFIC ENVIRONMENTAL CONDITIONS

Construction Methods

2.1 Without limiting or restricting the selection of a construction method for other parts of the project, the Proponent shall ensure that the project parts identified in Table 1 are only constructed using a trenchless technology.

Table 1 - Trenchless Technology Project Segments

Sector	Description	Location
Kurnell Sector	Under residential streets	From under Captain Cook Drive (near the Kurnell subtransmission substation) to the corner of Tasman Street and Dampier Street, and along Dampier Street to Silver Beach (Figure 10-1 of the document referred to under condition 1.1b))
Botany Bay Sector	Under seagrass beds	From Silver Beach to a point around 800 metres from the mean high water mark into Botany Bay along the pipeline alignment (Figure 10-2 of the document referred to under condition 1.1b))
Urban Sydney Sector	Under residential streets and watercourses	From Cook Park along Tancred Avenue and under Muddy Creek to Riverine Park (Figure 10-3 of the document referred to under condition 1.1b))
	Under watercourses	Under Cooks River (near Marsh Street) to Tempe Recreation Reserve (Figure 10-3 of the document referred to under condition 1.1b))
	Under major rail infrastructure	Under Botany Freight Line (Figure 10-3 of the document referred to under condition 1.1b))
	Under major road infrastructure	Under Canal Road (Figure 10-3 of the document referred to under condition 1.1b))
	Under residential streets	From Sydney Park, near Mitchell Road, along Mitchell Road and Ashmore Street to the junction of Ashmore and Bridge Streets (Figure 10-3 of the document referred to under condition 1.1b))

Noise and Vibration Impacts

Construction Hours

2.2 Construction activities associated with the Botany Bay Sector (excluding trenching activities within one kilometre of the nearest residences) (refer to condition 1.6) and those parts of the Kurnell Sector and Urban Sydney Sector employing a trenchless construction technology (refer to condition 2.1), but not including establishment of launch and receival pits, may be undertaken 24-hours per day, seven days per week, subject to:

a) compliance with the relevant Construction Noise Management Plan (refer to condition 5.2b)); and

b) in the case of works associated with the Kurnell Sector or the Urban Sydney Sector, notification of the local council and potentially-affected residential landowners and occupiers at least 48 hours prior to any works being undertaken outside of the hours specified in condition 2.3.

2.3 The Proponent shall only undertake construction activities associated with the project, other than those referred to under condition 2.2, that would generate an audible noise at any residential premises during the following hours:

a) 7:00 am to 6:00 pm, Mondays to Fridays, inclusive;

b) 8:00 am to 1:00 pm on Saturdays; and
c) at no time on Sundays or public holidays.

This condition does not apply in the event of a direction from police or other relevant authority for safety reasons or where required in an emergency to avoid the loss of lives, property and/ or to prevent environmental harm.

2.4 The hours of construction activities specified under condition 2.3 of this approval may be varied with the prior written approval of the Director-General. Any request to alter these hours of construction shall be:
a) considered on a case by case basis or activity-specific basis;
b) accompanied by details of the nature and need for activities to be undertaken during the varied construction hours;
c) accompanied by written evidence to the Director-General that activities undertaken during the varied construction hours are justified; appropriate consultation with potentially affected receivers and notification of the relevant local council has occurred; and all practicable and reasonable mitigation measures will be put in place; and
d) accompanied by any information necessary for the Director-General to reasonably determine that the noise impact of activities undertaken during the varied construction hours will not unreasonably impact on the acoustic amenity of receptors in the vicinity of the works.

Noise and Vibration Goals and Limits

2.5 The following construction noise goals shall apply to the project:
a) with respect to airborne noise, a construction noise goal:
i) developed in accordance with the DECC's *Noise Control Guideline Construction Site Noise* during the hours of construction specified under condition 2.3 of this approval;
ii) established on the basis of what can reasonably and feasibly be achieved using best practice noise mitigation outside of the hours specified under condition 2.3 of this approval. Where applying such mitigation measures results in a noise level exceeding more than 5dB(A) ($L_{A10(15\text{-minute})}$) above rating background noise levels at sensitive receiver locations, the requirements of condition 5.2b) i) 3 apply; and
b) with respect to ground-borne noise, a construction noise goal of:
i) 45dB(A) ($L_{Aeq(15\text{-minute})}$) between the hours of 7:00 am and 6:00 pm;
ii) 40dB(A) ($L_{Aeq(15\text{-minute})}$) between the hours of 6:00pm and 7:00am; except where ground-borne noise is predicted to occur for more than seven consecutive days in which case, 35dB(A) ($L_{Aeq(15\text{-minute})}$) between the hours of 10:00pm and 7:00am applies.

Ground-borne noise is to be assessed within any habitable room.

2.6 The Proponent shall ensure that the vibration resulting from construction and operation of the trenchless technology does not exceed the evaluation criteria presented in *Environmental Noise Management – Assessing Vibration: A Technical Guideline* (DEC, 2006).

Impacts on Buildings and Structures

2.7 Subject to the agreement of the landowner, building condition surveys shall be completed on the following buildings/ structures prior to proximate tunnelling or excavation associated with the project:
a) all buildings/ structures above the excavation/ tunnel and other buildings/ structures likely to be affected by tunnel/ excavation works or other major vibration-inducing construction activities in the vicinity of the buildings and structures in the Kurnell Sector and the Urban Sydney Sector. A suitably qualified person is required to certify that the survey area (and the buildings surveyed within) encompasses the maximum area that

could reasonably be expected to be affected by tunnelling/ excavation or other major vibration-inducing construction works associated with the project; and

b) all buildings/ structures of heritage significance listed in Table 9.18 of the document referred to under condition 1.1a) of this approval, unless otherwise determined following geotechnical and vibration analysis endorsed by a suitably qualified person that the building/ structure(s) is not likely to be adversely affected by tunnel/ excavation works or other major vibration-inducing construction works associated with the project.

2.8 All property owners of buildings/ structures to be surveyed, as required under condition 2.7, shall be advised at least 48 hours prior to the commencement of the survey of their property of the scope and methodology of the surveys and the process for making a claim in relation to any property damage attributable to the construction of the project. A copy of the final survey shall be provided to each affected landowner upon request. A register of all properties surveyed shall be maintained by the Proponent and provided to the Director-General upon request.

2.9 Any damage to buildings/ structures, attributable to the construction of the project, either directly and indirectly (that is, including as a result of vibration or changes in groundwater) shall be rectified by the Proponent within a reasonable period, at no cost to the owner(s).

Traffic Impacts

2.10 Prior to the commencement of construction of the Kurnell Sector and the Urban Sydney Sector, the Proponent shall provide to the relevant road authority, the following information:

a) where directional drilling/boring is proposed under roads, detailed plans (including vertical and horizontal alignment) of the pipeline route and mitigation measures proposed to reduce impacts to traffic and pedestrian safety during construction works on either side of the road. An indication of timing of works, hours of construction and maintenance arrangements during operation should also be outlined;

b) where trenching is proposed to cross roads or where trenching is proposed to occur within the road reserve, detailed design plans for the road works (including vertical and horizontal alignment) is to be provided as well as information regarding plant and equipment proposed to be used, construction compound locations, construction schedule and hours of construction, localised traffic diversions, need for short-term closure of roads or traffic lanes and restricted or modified access to adjacent properties.

c) details of all works that impact upon classified roads, including proposed mitigation measures to be implemented to reduce construction impacts such as traffic control measures for peak traffic periods (i.e. detours/diversions) and measures to ensure traffic and pedestrian safety during construction activities are required to be outlined. Ongoing maintenance arrangements for the operational phase should also be provided.

2.11 The Proponent shall ensure that any measures to restore roads to pre-existing conditions are undertaken in a timely manner, in accordance with the requirements of and to the satisfaction of the relevant road authority, at the full expense of the Proponent.

2.12 The Proponent shall ensure that all road crossings of classified roads, as defined in the *Roads Act 1993*, are constructed using underboring/directional drilling construction techniques unless otherwise agreed with the RTA. The construction method and depth of cover shall be determined in consultation with the RTA.

2.13 At all locations at which the project crosses:

a) an existing road corridor (or future road corridors) between the Cooks River and Campbell Road (inclusive), Alexandria,

b) at Marsh Street, along the Alexandra Canal north of the bridge crossing near the Tempe Recreation Reserve, and

c) at General Holmes Drive,

the project shall be concrete encased, or equivalent, in order to protect the project from future road transport infrastructure, in consultation with the RTA.

2.14 Prior to the commencement of construction of the Urban Sydney Sector the Proponent shall consult with the RTA with respect to construction methods, project alignment, methods for protecting the pipeline infrastructure and future on-going maintenance of the project in that area. The consultation shall specifically address and resolve the potential for the project to adversely affect the RTA's future plans for road enhancement and development in order to minimise the potential for conflicts between the project and existing and any future major road transport infrastructure.

2.15 The Proponent shall ensure that the project is designed and constructed to be maintenance free within any RTA road reservations identified in environmental planning instruments and any future corridors identified by the RTA, or as otherwise agreed with the RTA. The Proponent shall ensure that pits, valves, hydrants, access structures or other related fittings are only located within areas of the project which are not within an existing or future road corridor, or as otherwise agreed with the RTA.

2.16 The Proponent shall provide the RTA with "as built" plans of the project where it is located within classified roads, as defined under the *Roads Act 1993,* and RTA road corridors (existing and future), showing the horizontal and vertical alignment and provisions for the protection of the project including locations of concrete encasement, or equivalent, if applicable, within six months of completion of construction of the project within those locations.

Soil and Water Quality Impacts

2.17 The Proponent shall employ soil and water management controls to minimise soil erosion and the discharge of sediment and other pollutants to lands and/or waters during construction of the Kurnell Sector and the Urban Sydney Sector, in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

2.18 Construction and maintenance activities associated with the Botany Bay Sector shall be carried out in a manner that minimises the potential for the re-suspension and dispersal of marine sediments and associated biota, including installation of silt curtains around the Silver Beach and Kyeemagh construction sites and dredge discharge barges within the Botany Bay Sector. Silt curtains, or equivalent, shall be installed around the cutter suction dredges where monitoring demonstrates that turbidity levels at a point two metres from the cutter suction dredges, due to dredging activities, exceeds the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L.

Where silt curtains have been installed, they shall remain in place until the turbidity of the water within the silt curtains returns to background levels of turbidity in waters immediately outside the silt curtains.

2.19 The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point mid-depth in the water column and a distance of two metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.

2.20 All equipment associated with the construction and operation of the project shall be operated and maintained in a manner that minimises the potential for oil and grease spills/ leaks.

2.21 During construction of the Botany Bay Sector, the Proponent shall ensure that equipment capable of responding to a worst case oil spill is available at all times.

2.22 Prior to the commencement of construction of the Botany Bay Sector seaward of the mean high water mark, the Proponent shall develop work practices and procedures to be applied during construction to mitigate potential impacts on water quality and aquatic ecology. The work practices and procedures shall be consistent with the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC, 2000) and shall include, but not be limited to management of sediment-bound contaminants and acid sulfate soils located along the pipeline route. The Proponent shall consult DECC and DPI in development of these work practices and procedures. The Proponent shall submit a copy of the final work practices and procedures to the Director-General, prior to their implementation.

Impacts on Ecology

2.23 The Proponent shall ensure that construction of the Botany Bay Sector is carried out in a manner that minimises the potential for disturbance and/ or the spread of *Caulerpa taxifolia*.

2.24 The Proponent shall ensure that construction and maintenance of the Botany Bay Sector, particularly dredging and land reclamation works, is carried out in a manner that minimises the potential for impacts on seagrass beds, water quality, aquatic ecology and estuarine wetland systems.

2.25 Where practicable, noisy or other potentially disturbing activities associated with the construction of the project within Botany Bay shall cease or be scaled back when cetaceans and other marine mammals are approaching or in the area of construction activities.

2.26 The Proponent shall ensure that all revegetation and rehabilitation works are undertaken, in consultation with the relevant local council, using locally native species. The Proponent shall ensure that the regeneration of revegetated/rehabilitated areas is managed for a period of six months, or as agreed by the Director-General, until the newly planted vegetation has fully established.

Air Quality Impacts

2.27 The Proponent shall construct the project in a manner that minimises dust emissions from construction areas, including wind-blown and traffic-generated dust. All construction shall be undertaken with the objective of preventing visible emissions of dust from the site.

Waste Management

2.28 All wastes generated by the project shall be beneficially reused, recycled or directed to a waste facility lawfully permitted to accept the materials.

3. BOTANY BAY CUMULATIVE IMPACTS AND COORDINATION

3.1 Prior to the commencement of construction of the project, the Proponent shall consult with Sydney Ports Corporation (with respect to the timing of construction works associated with the expansion of Port Botany) and with EnergyAustralia (with respect to the timing of construction works associated with the Botany Bay electricity cable) to identify any potential coincident construction works between the project and those developments. Should construction works coincide, the Proponent shall consult with Sydney Ports Corporation and EnergyAustralia, as relevant, for the purposes of the development of a **Coordinated Environmental Monitoring and Management Protocol**. The Protocol shall provide a framework for identification of reasonable and feasible opportunities for the coordinated and cooperative monitoring and management of environmental impacts from the developments. The Protocol shall include, but not necessarily be limited to:

a) procedures for access to, and provision of, monitoring data from each development, particularly in relation to water quality and ecological health;

b) identify and implement reasonable and feasible opportunities for coordinated and cooperative approach to the management of cumulative environmental impacts from the developments, with particular reference to water quality, noise impacts, construction traffic, dust impacts, aquatic ecology and reuse of spoil;

c) arrangements for communication between the parties, including designated contact persons and contact details;
d) notification procedures in the event of an incident at either development that may impact on the other development(s), or generate a significant common or cumulative impact;
e) mechanism for review of the Protocol from time to time; and
f) such other matters as parties may agree.

The Proponent shall provide a copy of the Protocol to the Director-General as soon as practicable after agreement on the terms of the Protocol.

4. ENVIRONMENTAL MONITORING AND AUDITING

Ecosystem Monitoring

4.1 Prior to the commencement of construction of the Botany Bay Sector seaward of the mean high water mark, the Proponent shall prepare an **Ecosystem Monitoring Program** to monitor the impacts of the project on ecosystems of Botany Bay. The Program shall be developed in consultation with the DECC and the DPI, and shall include, but not necessarily be limited to:

a) a sampling, data collection and assessment regime to establish baseline ecological health, with particular reference to seagrasses, sygnathid species and benthic biota and for ongoing monitoring of ecological health during construction of the Botany Bay Sector. The monitoring program should include specific provisions for monitoring in and around construction works, including Towra Point Aquatic Reserve and its mangrove habitat, and should also take into account spatial variability in species types and distribution;
b) criteria against which the impact of the project on the ecological health of Botany Bay will be assessed;
c) water quality monitoring in the context of potential ecological impacts, particularly in relation to turbidity;
d) mitigation measures to be implemented in the event that reduced ecological health is identified with reference to established assessment criteria, including a timetable for implementation; and
e) monitoring for ecological health and biodiversity outcomes following completion of construction works, and for the recovery of biodiversity within the areas directly and indirectly affected by the Botany Bay Sector for a period of at least twelve months, unless otherwise agreed or directed by the Director-General.

Beach and Foreshore Monitoring

4.2 Prior to the commencement of construction of the Botany Bay Sector, the Proponent shall prepare a **Beach and Foreshore Monitoring Program** to monitor the impacts of the project on beach and foreshore erosion and quality where it is likely to be materially affected by the project. The Program shall be developed in consultation with the DECC and DPI and shall include, but not necessarily be limited to:

a) surveys of beaches and foreshore areas around Botany Bay, including those areas likely to be materially affected by the construction of the project and at least one reference site to establish baseline profiles for those areas;
b) monitoring of those beaches and foreshore areas around Botany Bay referred to under part a) during construction of the project and following completion of construction to identify any changes in beach and foreshore profiles;
c) provisions to determine "source" and "sink" areas and to ameliorate any damage to habitat determined as a "sink" area for erosion sourced sediment;
d) contingency measures to be implemented in the event that beach and foreshore profile changes attributable to the project are identified, and a timetable for implementation; and
e) provision for amelioration of any damage to beach and foreshore areas as a result of the construction of the project.

Noise and Vibration Monitoring

4.3 Prior to the commencement of construction of the project, the Proponent shall prepare a **Construction Noise and Vibration Monitoring Program** for the purpose of assessing compliance with the goals and limits referred to under conditions 2.5 and 2.6. The Program shall be developed in consultation with the DECC.

5. ENVIRONMENTAL MANAGEMENT

Construction Environmental Management

5.1 The Proponent shall apply the **Construction Environmental Management System** required to be developed under the concept approval for the Kurnell Desalination Project during construction of the project.

5.2 In addition to the general requirements of the Construction Environmental Management System, the Proponent shall prepare and implement the following project-specific Construction Environmental Management Plans and Protocols during the construction of the project:

a) where soil testing prior to the commencement of construction identifies the presence of acid sulfate soils, an **Acid Sulfate Soil Management Plan** prepared in accordance with guidance provided in *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee, 1998);

b) a **Construction Noise and Vibration Management Plan**, in consultation with DECC, to detail how construction noise and vibration impacts would be minimised and managed, including, but not necessarily limited to:

i) as primary objectives:

1. attainment of the construction noise goals and vibration limits specified under this approval at all times;
2. where construction noise goals cannot be met, to achieve best practice noise control (including, for example, acoustic enclosures over micro tunnelling launch and receival pits), in terms of noise level and duration of noise emissions at affected receivers at all times;
3. where the use of best practice noise control cannot substantially achieve the construction noise goals, alternative measures to resolve noise impacts on affected receivers (including, for example, temporary relocation of receivers);

ii) details of construction activities and a schedule for construction works;

iii) identification of construction activities that have the potential to generate noise and/ or vibration impacts on surrounding land uses, particularly residential areas;

iv) a program for the periodic monitoring of noise emissions and vibration during construction, as required under condition 4.3;

v) procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity;

vi) development of reactive and pro-active strategies for dealing promptly with any noise complaints, including documentation of a fast response, the completed action on a complaint and feedback from the complainant;

vii) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be undertaken, how the results of this monitoring would be recorded; and, if any non-compliance is detected with the goals and limits specified under this approval; and

viii) mechanisms to consider and address cumulative noise impacts, particularly from other construction work potentially occurring in the area;

c) a **Construction Traffic Management Protocol** to detail how heavy vehicle movements associated with the project (other than in relation to spoil management) will be managed during construction. The Protocol shall specifically address the movement of oversize loads to and from the site, the management of construction

traffic, restrictions to the hours of heavy vehicle movements to avoid road use conflicts, and the transport of construction waste materials;

d) a **Spoil Management Plan**, consistent with the Spoil Management and Disposal Strategy required under the concept plan approval for the Kurnell Desalination Project. The Plan shall include procedures for undertaking further sediment samples at various depths along the trenched portion of the Botany Bay Sector to provide detail on particle size and quality of sediments to be disturbed;

e) a **Construction Water Management Plan** (for the Botany Bay Sector), in consultation with DECC, to detail how water quality will be managed during construction of the Botany Bay Sector, with specific reference to the minimisation and control of turbidity/ suspended solids. In particular, a turbidity criterion is to be established to enable instantaneous measurements to be obtained and used operationally.

f) an **Erosion and Sedimentation Management Protocol** (for the Kurnell Sector and Urban Sydney Sector), in consultation with DECC, to detail how surface water and stormwater will be managed during construction. The Protocol shall include use of appropriately-sized stormwater controls, in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).

g) a **Groundwater Management Protocol** (for the Kurnell Sector and Urban Sydney Sector), in consultation with DECC, to detail how groundwater will be managed during construction, with specific reference to identification and management of any contaminated groundwater along the pipeline route.

5.3 The Plans and Protocols referred to under condition 5.2 shall be submitted for the approval of the Director-General prior to the commencement of construction, or within such period otherwise agreed by the Director-General.

5.4 Nothing in this approval precludes the Proponent from developing the Plans and Protocols referred to under condition 5.2 as separate plans/ protocols, or as a single plan/ protocol, nor does it preclude the staging of submission of any of these plans/ protocols consistent with the staging of any construction works. Construction of the relevant component of the project must not commence until written approval of all Plans and Protocols relevant to that component of the project has been received from the Director-General.

Operation Environmental Management

5.5 The Proponent shall apply the **Operational Environmental Management System** required to be developed under the concept approval for the Kurnell Desalination Project during operation of the project.

6. ENVIRONMENTAL REPORTING

Incident Reporting

6.1 The Proponent shall notify the Director-General of any incident with actual or potential significant off-site impacts on people or the biophysical environment as soon as practicable and within 24 hours after the occurrence of the incident. The Proponent shall provide full written details of the incident to the Director-General within seven days of the date on which the incident occurred.

6.2 The Proponent shall meet the requirements of the Director-General to address the cause or impact of any incident, as it relates to this approval, reported in accordance with condition 6.1 of this approval, within such period as the Director-General may require.

Modification of Approval

Section 75W of the *Environmental Planning and Assessment Act 1979*

I, the Executive Director, Major Project Assessments Division of the Department of Planning, in accordance with the Instrument of Delegation issued by the Minister for Planning, on 7 June 2007, pursuant to section 75W of the *Environmental Planning and Assessment Act 1979* determine the modification to the approval referred to in Schedule 1 in the manner set out in Schedule 2.

Executive Director
Major Project Assessments
As delegate for the Minister for Planning

Sydney 13 June 2008 File No: 9039739

SCHEDULE 1

Project Approval:	granted by the Minister for Planning on 22 October 2007 (MP 07_0054).
For the following:	"the desalinated water delivery system" project as part of the approved concept plan for the Kurnell Desalination Plant (05_0082)
Modification:	Amendments to the alignment of the Urban Sydney Sector of the project, generally in Alexandria and Erskinville.

SCHEDULE 2

The approval is modified as follows:

1. Replacing existing condition 1.1 with new condition 1.1 as follows:

1.1 The Proponent shall carry out the project generally in accordance with the:
- a) *Environmental Assessment of the Desalinated Water Delivery System*, dated April 2007, and prepared by GHD on behalf of the Proponent;
- b) *Desalinated Water Delivery System: Preferred Project Report*, dated August 2007, and prepared by Sydney Water Corporation;
- c) *Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North*, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008;
- d) the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and
- e) the conditions of this approval.

2. Replacing existing condition 1.2 with new condition 1.2 as follows:

1.2 In the event of an inconsistency between:
- a) the conditions of this approval and any document listed from condition 1.1a) to 1.1c) inclusive, the conditions of this approval shall prevail to the extent of the inconsistency; and
- b) any document listed from condition 1.1a) to 1.1c) inclusive, and any other document listed from condition 1.1a) to 1.1c) inclusive, the most recent document shall prevail to the extent of the inconsistency.

3. Replacing existing condition 2.1 with new 2.1 as follows:

2.1 Without limiting or restricting the selection of a construction method for other parts of the project, the Proponent shall ensure that the project parts identified in Table 1 are only constructed using a trenchless technology.

Table 1 - Trenchless Technology Project Segments

Sector	Description	Location
Kurnell Sector	Under residential streets	From under Captain Cook Drive (near the Kurnell subtransmission substation) to the corner of Tasman Street and Dampier Street, and along Dampier Street to Silver Beach (Figure 10-1 of the document referred to under condition 1.1b))
Botany Bay Sector	Under seagrass beds	From Silver Beach to a point around 800 metres from the mean high water mark into Botany Bay along the pipeline alignment (Figure 10-2 of the document referred to under condition 1.1b))
Urban Sydney Sector	Under residential streets and watercourses	From Cook Park along Tancred Avenue and under Muddy Creek to Riverine Park (Figure 10-3 of the document referred to under condition 1.1b))
	Under watercourses	Under Cooks River (near Marsh Street) to Tempe Recreation Reserve (Figure 10-3 of the document referred to under condition 1.1b))
	Under major rail infrastructure	Under Botany Freight Line (Figure 10-3 of the document referred to under condition 1.1b))
	Under major road infrastructure	Under Canal Road (Figure 10-3 of the document referred to under condition 1.1b))
	Under residential streets	From Sydney Park, near the intersectiom of Euston Road and Campbell Road, along Euston Lane to Maddox Street and through Ashmore and Mitchell Industrial Estates (Figure 2.2 of the document referred to under condition 1.1c))

Modification of Approval

Section 75W of the *Environmental Planning and Assessment Act 1979*

I, the Executive Director, Major Project Assessments Division of the Department of Planning, in accordance with the Instrument of Delegation issued by the Minister for Planning, on 7 June 2007, pursuant to section 75W of the *Environmental Planning and Assessment Act 1979* determine the modification to the approval referred to in Schedule 1 in the manner set out in Schedule 2.

Executive Director
Major Project Assessments
As delegate for the Minister for Planning

Sydney 12 SEPTEMBER 2008 File No: 9039739

SCHEDULE 1

Project Approval:	granted by the Minister for Planning on 22 October 2007 (MP 07_0054).
For the following:	"the desalinated water delivery system" project as part of the approved concept plan for the Kurnell Desalination Plant (05_0082)
Modification:	Amendments to the construction methods and dredged material storage arrangements.

SCHEDULE 2

The approval is modified as follows:

1. Replacing existing condition 1.1 with new condition 1.1 as follows:

1.1 The Proponent shall carry out the project generally in accordance with the:

a) *Environmental Assessment of the Desalinated Water Delivery System*, dated April 2007, and prepared by GHD on behalf of the Proponent;

b) *Desalinated Water Delivery System: Preferred Project Report*, dated August 2007, and prepared by Sydney Water Corporation;

c) *Desalinated Water Delivery System: Application for Modification of Project Approval for the Urban Sydney Sector: Sydney North*, prepared by the Water Delivery Alliance for Sydney's Desalination Project and dated 5 May 2008;

d) *Desalinated Water Delivery System: Application for Modification of Project Approval for the Botany Bay Sector*, prepared by the Water Delivery Alliance and dated 15 July 2008, and additional information dated 2 September 2008;

e) the concept plan approval granted with respect to the Kurnell Desalination Plant concept plan (05_0082); and

f) the conditions of this approval.

2. Replacing existing condition 1.2 with new condition 1.2 as follows:

1.2 In the event of an inconsistency between:

a) the conditions of this approval and any document listed from condition 1.1a) to 1.1d) inclusive, the conditions of this approval shall prevail to the extent of the inconsistency; and

b) any document listed from condition 1.1a) to 1.1d) inclusive, and any other document listed from condition 1.1a) to 1.1d) inclusive, the most recent document shall prevail to the extent of the inconsistency.

3. Replacing existing condition 2.19 with new 2.19 as follows:

2.19 The Proponent shall ensure that construction of the Botany Bay Sector, including all dredging, subsurface storage and reclamation works, is carried out in a manner such that turbidity outside the silt curtains (as required under condition 2.18) does not exceed the background turbidity by more than an equivalent suspended sediment concentration of 50mg/L at a point of approximately 0.2 metre depth for Silver Beach and between 1 and 1.5 metre depth in the water column for all other sites and equipment and a distance of less than 10 metres from the silt curtain. No visible surface plume outside the silt curtains is permitted.

Appendix C – Advice on methodology for monitoring turbidity in relation to pipeline emplacement across Botany Bay (Cardno Ecology Lab, 2008)

Report to:

Worley Parsons

Water Deliver Alliance

Advice on Methodology for Monitoring Turbidity in Relation to Pipeline Emplacement across Botany Bay

November 2008

Water Deliver Alliance

Advice on Methodology for Monitoring Turbidity in Relation to Pipeline Emplacement across Botany Bay

November 2008

Report Prepared for:

Worley Parsons

Level 11, 141 Walker Street

North Sydney, NSW 2059

Report Number – 50/0708C

Report Status – Issue 3 of 3, 20 November 2008

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1.0 INTRODUCTION

Worley Parsons is developing a monitoring programme to assist in managing the emplacement of a pipeline to deliver water from the desalination plant being built at Kurnell to the people of Sydney. One issue being considered is the creation of turbid water within parts of Botany Bay as a result of the emplacement operation. A range of measures has been identified, including silt curtains to contain turbid water, offsite disposal of some of the spoil and development of trigger values which, if exceeded, would lead to a specified management response. It is acknowledged by the Water Delivery Alliance (WDA – the group responsible on behalf of Sydney Water for this part of the desalination project) and in the scientific literature that increases in the turbidity of water can affect aquatic flora and fauna.

Cardno Ecology Lab Pty Ltd (formerly The Ecology Lab Pty Ltd) has been asked by Worley Parsons (part of the WDA) to provide advice on the proposed monitoring programme for turbidity. This advice applies to the suspension of sediment during the pipeline emplacement procedure, which involves dredging/tunnelling, laying of the pipe within trench/tunnel and backfilling.

As advised by Worley Parsons (email: 2 October 2008) the environmental assessment for the project identified the following as potentially being affected by turbidity from the dredging works:

- seagrass beds
- oyster farms at Towra Point
- a fin-fish aquaculture facility off Silver Beach
- recreational fishing generally and
- Towra Point Aquatic Reserve generally.

Currently, turbidity is being measured at 15 minute intervals immediately outside silt curtains around the works and at a number of background sites around the bay. The water quality criterion that has been adopted for turbidity is background + 50 mg/L of suspended solids (50 mg/L ~ 43 NTU). Monitoring so far has indicated background can reach at least 30 NTU (measured at Kyeemagh on ebb tide after heavy rain in the Cooks River catchment), yielding maximal values that could occur immediately outside the silt curtains of ~ 73 NTU or in the order of 80 mg/L suspended solids.

Measures of turbidity taken at 15 minute intervals would yield a vast amount of data and it is considered desirable that consecutive measures be averaged over some ecologically meaningful time period. As a working value for assessment, it would be possible to compute moving averages of the data over, say, 12 hourly intervals, yielding continuous averages that can be assessed though time and against data calculated in the same way for the background sites. Two questions arise:

1. Ecologically, would turbidity levels of 80 mg/L (background of ~30 mg/L plus 50 mg/L) persisting over a 12 hourly period cause significant damage to the environmental components of concern (see dot points above) and hence be too long a period to occur before implementing a management response?
2. If not, what would be an ecologically meaningful period of exceedance at 80 mg/L that could occur before management intervention is warranted?

2.0 METHODS

The questions were addressed in two ways. First, scientific literature was reviewed to gain an understanding of the effects of turbidity/suspended solids on aquatic ecosystems. Given the tight time-frame available for the review, references were generally limited to those held within the library of Cardno Ecology Lab. This library contains over 30,000 books, articles and reports, all accessible via electronic database. References held on the effects of turbidity on aquatic ecosystems span the period 1977 to the present and provide a comprehensive, if not complete, overview of the subject.

Second, the severity of effects was related to the conditions within Botany Bay by considering the concentration of suspended solids and potential durations of exposure. Newcombe (1994) developed a formula for assessing Severity Effect (SE) in terms of the dose of increased suspended solids, where dose is the product of concentration and duration of exposure. He defined the natural logarithm (ln) of dose as the "Stress Index". The formula for Severity Effect applied to cold water species of fish was:

$$SE = 0.738 \ln (mg.hr.L^{-1}) + 2.179. \quad (1)$$

This relationship was statistically significant ($r^2 = 0.638$, $p < 0.01$, $n = 120$).

This approach was applied to the desalination project with the following caveats:

1. The formula was derived essentially from studies on fishes in the northern hemisphere, although some of the species occur in families that are represented in Botany Bay.

2. Whilst the formula applies to cold water species, Newcombe (1994) considered that warm water species are more resilient. This may indicate that species in Botany Bay are slightly more tolerant than would be implied by the formula.

3. Newcombe (1994) considered that estuarine species are more tolerant than pelagic or "clean" water species. Again, this could suggest a greater resilience to turbidity in Botany Bay than implied by the formula.

The determination of a meaningful period over which to average measures taken every 15 minutes should include consideration of the precision associated with the averages. Precision provides a measure of the variability of the data. It is also important in statistical testing of potential spatial (i.e. between impact and background sites) and temporal differences (i.e. among periods of construction activity, tides or significant natural events such as flooding, storms, etc).

For this review, averages and precision were calculated progressively from two to 150 simulated measures of turbidity. The simulated measures were created from a table of random numbers and ranged from 1 to 80, reflecting the possible natural and construction-induced turbidity. Three separate runs were undertaken and presented graphically. Precision, P was determined as recommended by Andrew and Mapstone (1987):

$$P = (StdE/mean) * 100 \qquad (2)$$

Where StdE = standard error = (Standard deviation/$\sqrt{}$ (number of measures, n)).

P is scaled from 0% (all measures equal) to 100% (one measure > 0, all other measures = 0). Typically, values of P < 10% represent high precision, although this is dependent on the magnitude of any differences considered to be ecologically meaningful. Moreover, the use of random numbers probably does not truly reflect natural conditions, especially based on a moving average, where consecutive measures will often be more similar in magnitude than those further apart in time. Nevertheless, the approach used here provides a guide to precision and more accurate measures of precision will be available once more monitoring is undertaken.

3.0 RESULTS

3.1 Review of Literature

3.1.1 General Considerations

The review of available literature provides valuable guidance on the potential effects of the pipeline emplacement on key ecological indicators. Direct comparisons, however, are difficult for a number of reasons:

- Impacts of turbidity on seagrasses are generally related to reduction in photosynthetic capacity (e.g. Abal and Dennison 1996, Vermaat *et al.* 1997, Dekker *et al.* 2006, Zimmerman 2006). This can be affected by a number of optical properties, including suspended solids, but also chlorophyll concentration, water colour and other factors (e.g. growth of epiphytes on seagrass leaves). Typically, compensation depth (the depth at which photosynthesis balances respiration) is considered as a function of light attenuation (Vermaat *et al.* 1997), which can be simply considered as a percentage of solar irradiation at the water surface. Thus, it is difficult to relate the literature on seagrasses to simple measures of turbidity or suspended solids.
- Most studies report susceptibilities to turbidity using aquatic flora and fauna not present in Botany Bay. Some taxonomic families or genera are common to Botany Bay and the studies reported below, but generally inferences need to be made about the applicability of studies to the bay.
- Many studies report sediment concentrations or turbidity levels affecting aquatic biota without identifying the duration of exposure (e.g. Zimmerman 2006, p 316). As discussed by Newcombe (1994) and Wilber and Clarke (2001) concentration AND exposure ("dose") are both critical in assessing the effects of turbidity. This is discussed further below.

3.1.2 Impacts of Turbidity in Relation to Key Indicators

3.1.2.1 Seagrasses

The major seagrasses occurring in Botany Bay include strapweed (*Posidonia australis*), eelgrass (*Zostera capricorni*) and paddleweed (*Halophila ovalis*), with *Z. muelleri* and *H. decipiens* also being reported. Posidonia, Zostera and Halophila occur off Silver Beach and

within the Towra Point Aquatic Reserve; Zostera and Halophila also occur off Kyeemagh, on the western side of the bay.

Vermaat *et al.* (1997) provide an excellent review of the capacity of seagrasses to survive increased turbidity and siltation. Koch *et al.* (2006) note that seagrasses can enhance deposition of suspended sediments, although plants with longer leaves (e.g. Posidonia) are likely to have a greater effect on deposition. As noted above, the major effect of turbidity on seagrasses is the reduction of photosynthetic capacity due to reduction of light. This can be highly complex depending not only on the optical properties of the water column and water depth, but it is also influenced by the growth of epiphytes on seagrass leaves. If a significant component of turbidity includes nutrients, there may be a reduction in light through the water column and impacts due to enhanced epiphyte growth.

Ralph *et al.* (2006) state that reduced light over prolonged periods can lead to depletion of seagrass carbon reserves or, in cases of extreme light deprivation, a lack of photosynthetically-produced oxygen can lead to sediment anoxia and more rapid mortality. Examples provided include a cyclone and severe flooding with prolonged turbidity in Hervey Bay, Qld; large volumes of terrestrial runoff and regular dredging of shipping channels. They cite Dennison *et al.* (1993) as concluding that minimum light requirements for seagrasses vary from 5% to 20% of solar irradiance. In their review, Ralph *et al.* (2006) cite the following examples:

- *Halophila ovalis* survived for one month under low light conditions (Longstaff and Dennison 1999).
- Species with larger rhizomes and hence greater carbon storage, have managed to survive more than five months at minimum light requirements (Gordon *et al.* 1994, Lee and Dunton 1997).
- *Zostera marina* (a northern hemisphere species) declined after 20 days of reduced light availability (Moore *et al.* 1997).
- Experimental shading of *Z. marina* lead to reduced sugar concentrations by 40 - 51% following 21 days of shading (Burke *et al.* (1996).

These examples suggest that seagrasses can survive for at least several weeks under low light conditions, or following sedimentation but that larger species (e.g. Posidonia) could survive much longer due to greater storage of reserves (see also Vermaat *et al.* 1997).

3.1.2.2 Invertebrates and Fish

Impacts of increased turbidity/suspended sediments on aquatic fauna range from behavioural effects to physiological changes to mortality as a result of gill clogging, reduced ability to locate food or hypoxia due to depletion of oxygen in the water column (Moore 1977, Cyrus and Blaber 1987, 1988, Newcombe 1994, Wilber and Clarke 2001). It is noteworthy that some species prefer highly turbid water, apparently in terms or avoiding of locating prey (Ruello 1973, Moore 1977, Cyrus and Blaber 1987).

As noted above, it is important to understand not only the magnitude of turbidity or concentration of suspended solids, but also the duration of exposure to be able to assess impacts to aquatic biota. Newcombe (1994) combined these terms to calculate "dose" and then "Severity Effect" (SE). The SE was then linked to 14 classes of ill effects in fishes caused by suspended sediments:

- Classes 1 – 4 indicated behavioural effects, ranging from alarm reactions, increased coughing rates to reduction in feeding rates.
- Classes 5 – 9 indicated behavioural and physiological effects, ranging from minor physiological stress to reduced rates of growth or development.
- Classes 10 – 14 indicated lethal effects, ranging from > 0% to 20% mortality, mortality rates increased by predation, to mortalities of > 80% to 100%.

Moore (1977) provides examples of concentrations of suspended sediments affecting a range of invertebrates and fish. He quotes Morton and Miller (1968) as concluding that New Zealand rock oysters (*Crassostrea glomerata* [= *Saccostrea glomerata*?]) are untroubled by turbid water, requiring only to be raised on racks above the level of settling silt. Mussels (*Mytilus edulis*) survived 440 mg/L of suspended sediment but died after 13 days when the experimental concentration of mud was increased to 1,220 mg/L. Ruello (1973) found that adult school prawns (*Metapenaeus macleayi*) were most abundant in turbid coastal waters resulting from estuarine discharge in which the waters were rich in both organic detritus and silt. Similar results have also been found for penaeid prawns in other parts of the world (Moore 1977).

Moore (1977) cites numerous studies in which fish mortalities were not detected until concentrations of suspended solids exceeded several hundred mg/L (i.e. well above what is predicted for the pipeline for the Desalination Plant). In one study, four species of estuarine

fishes from Chesapeake Bay were placed in cages near the outlet nozzle of a suction dredge for up to two months (Richie 1970 in Moore 1977). Survival rates were relatively high for several species, although control also reported substantial levels of mortality, which casts some doubt on the findings.

Wilber and Clarke (2001) provide a relatively recent review of the mortality (and behaviour) of fishes related to concentrations of suspended solids and exposure, and related this to what might be expected from dredging operations. In estuarine fishes, eggs and larvae were the most sensitive life forms, with mortality occurring typically at concentrations exceeding 100 mg/L with exposures of less that one day. Older stages of fishes generally required concentrations of 600 mg/L in excess of one day, but generally occurring over several days. No impacts were reported for concentrations < 100 mg/L, irrespective of exposure time. Adult bivalves were even more resistant, with mortalities occurring at concentrations greater than 1000 mg/L for periods exceeding five days.

3.2 Assessment of Turbidity Monitoring Proposed for the Pipeline Emplacement

Figure 1 shows the Severity Effect (Newcombe 1994, plus see above) with varying exposure times for a maximal concentration of 80 mg/L. Even after 300 hours of exposure (12.5 days) the severity effect is still within the sublethal range. For periods of between 100 and 120 hours, severity ranges between 8 and 9. As discussed above, this relationship is likely to be conservative given that Botany Bay is likely to be more "warm water" than as applied by Newcombe and estuarine biota are likely to be more resistant than species occurring in clearer waters. On this basis, it is considered that an exposure time of around 120 hours (5 days) would be an appropriate trigger for management intervention, in terms of aquatic fauna. In terms of seagrasses, the data suggest that the species in Botany Bay would be able to resist low light levels for periods of several weeks, thus a 5 day trigger period at 80 mg/L would also appear to be appropriate.

Figure 2 shows the outcome of simulated precision based on concentrations of suspended sediment ranging from 1 – 80 mg/L. Levels of precision of < 10% are achieved after combining about 48 samples, or 12 hours, as posited above. It is also likely that the field data would achieve greater precision because consecutive samples are likely to yield similar concentrations. If there were a "spike" in concentrations, this would be identified by a reduction in precision.

4.0 CONCLUSIONS

Effects of suspended sediment are dependent, among other things, on both the concentration and duration of elevated turbidity. The literature indicates that the trigger value being proposed for the pipeline emplacement is not particularly high for relatively short durations, especially for estuarine ecosystems.

It is suggested that the duration of turbidity exceedance at the trigger value should be 120 hours (i.e. 5 days). This is likely to cause minimal damage to seagrasses and acceptable behavioural or sublethal effects to most estuarine fauna in the bay. The aquaculture facility at Silver Beach is currently growing mostly mulloway (*Argyrosomus japonicus*) and yellowfin bream (*Acanthopagrus australis*) (pers. comm. D. Barker). Both these species occur naturally in extremely turbid waters and are not considered to be vulnerable to the trigger value. Similarly, oysters are relatively remote from the works, are resistant to moderate to high levels of turbidity, and are cultured on racks or trays above the seabed. It is unclear how levels of turbidity, especially over small space and time scales, would affect recreational fishing, other than spearfishing, which is not particularly common within the bay. If plumes mover to the entrance to the bay, some divers may encounter a loss of water visibility and short term inconvenience.

The Towra Point Aquatic Reserve contains the three main species of seagrasses (as well as mangroves, saltmarshes and bare substrata). Seagrasses would be the group most susceptible to increased turbidity, but given the review above and relative remoteness of the reserve compared to the pipeline route, the trigger value proposed is considered ample to facilitate protection of this protected area.

It is further suggested that calculating the moving average comprising the most recent 15 minute measure and all 15 minute measures up to the immediate past 12 hourly period (i.e. 48 measures for each average) would be a good initial approach, by providing an opportunity to respond quickly to any major changes in turbidity (and well before the 5 day exposure period). A key consideration here is to ensure that data are compared to the background measures so that differences in turbidly measured just outside the silt curtains and at the background sites can be determined. Notwithstanding this, it would also be prudent to calculate the precision associated with the moving averages to see if the optimal duration can be assessed more objectively on the basis of maximising precision.

5.0 ACKNOWLEDGEMENTS

This report was written by Dr Marcus Lincoln Smith with assistance from Daniel Pygas.

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7.0 FIGURES

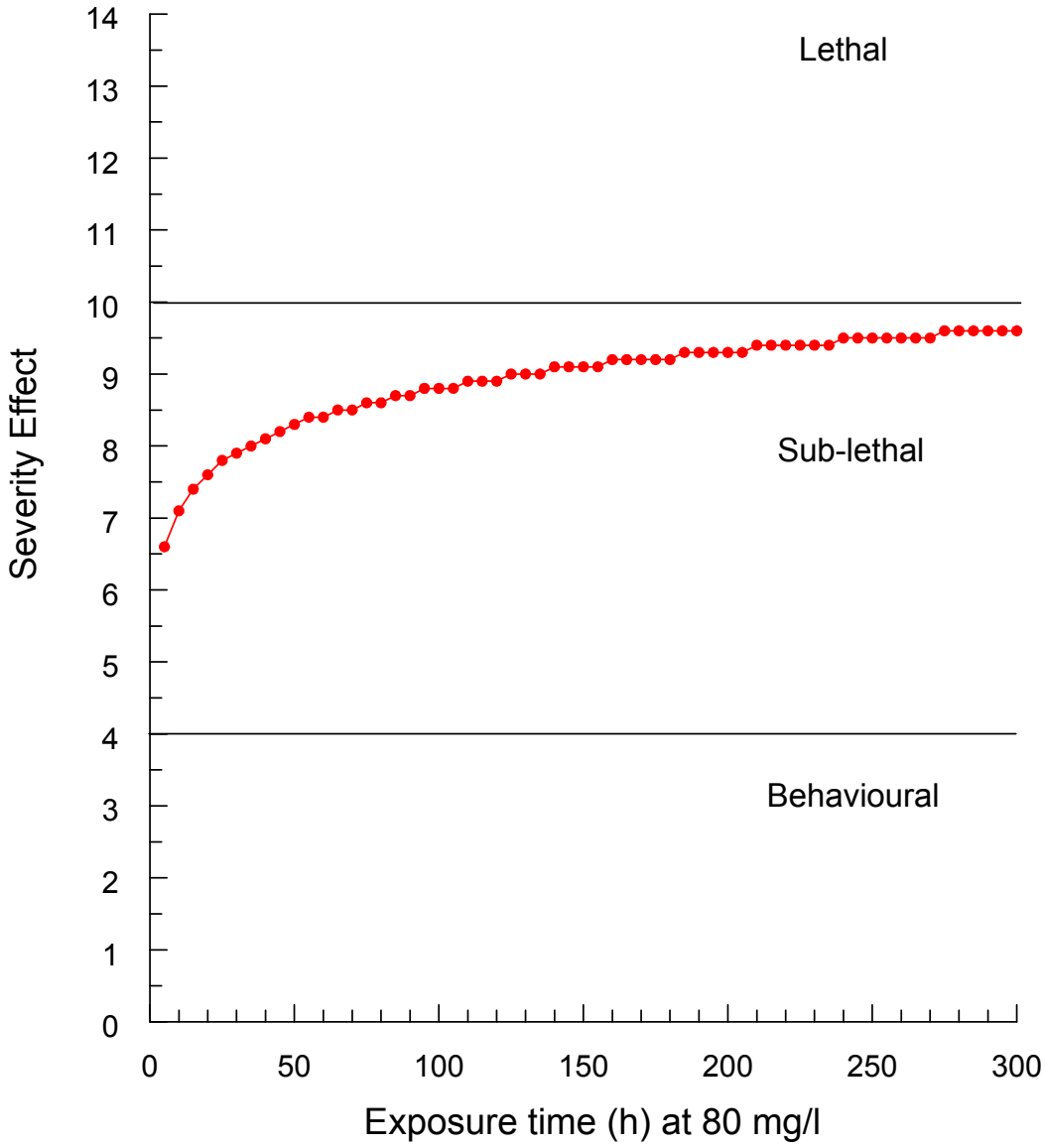

Figure 1. Severity Effect over time at 80 mg/L suspended solids (see text).

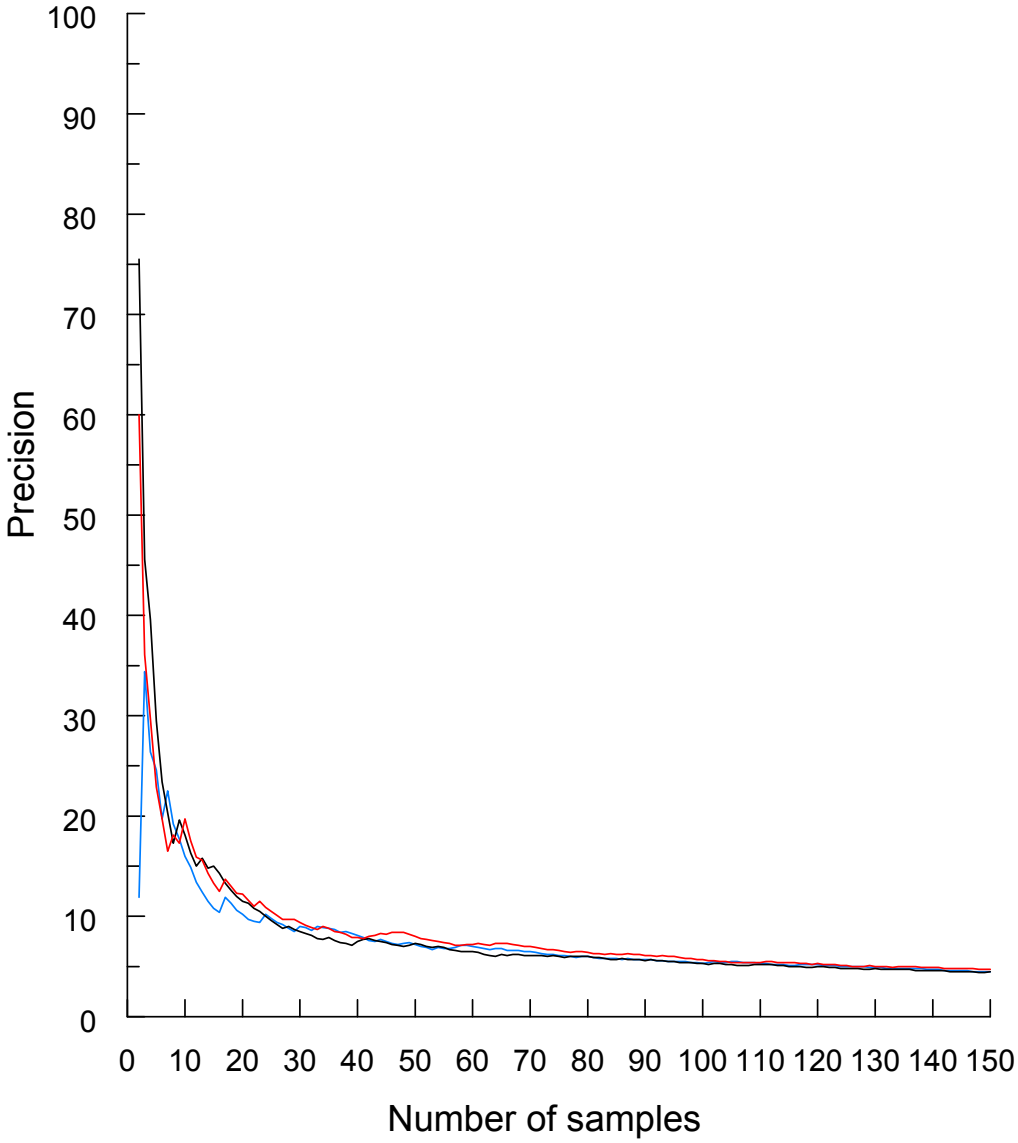

Figure 2. Sampling precision associated with increasing sample sizes. Data based on simulations over three runs.

Appendix D – Relevant Statements of Commitment (PPR)

Appendix D - Relevant Statements of Commitment

Desired Outcome	Action	Timing
Water Quality and Aquatic Ecology		
Control potential dispersion of existing contaminated sediments during construction of Botany Bay pipeline.	3. Work practices will be developed to manage sediment-bound contaminants and acid sulphate soils located along the pipeline route (as detected by geotechnical testing) for implementation during construction. This may include where possible, the adoption of least impact construction dredging and the use of controls such as silt curtains.	During design (before construction commences).
No significant or irreversible impacts from dredging on sensitive natural ecosystems, oyster leases or aquaculture activities during construction of the Botany Bay pipeline.	6. Dredging activities will be carried out to minimise turbidity in Botany Bay immediately adjacent to the dredging area and to minimise potential impacts on sensitive natural ecosystems, oyster leases or aquaculture activities.	During design (before construction commences).
Communications Processes		
The community and stakeholders have a high level of awareness of all processes and activities associated with the delivery system; Provision of accurate and accessible information; and A high level of responsiveness to issues and concerns raised by the community.	37. Communities directly impacted by construction will be provided with detailed information on the nature and timing of the proposed works including: a. Sydney Water will work with local Councils, stakeholder groups and the community to identify local issues and concerns prior to the commencement of construction to ensure that appropriate measures are put in place to mitigate local impacts; b. Measures will address issues such as access, local amenity, safety and traffic management; and c. Local communities will be consulted should site restoration works be required following construction.	During design (before construction commences).
	38. Communications processes will be developed and implemented at appropriate times with impacted communities throughout delivery of the delivery system. These will include: a. Opportunities to input to mitigation measures for construction or operations; a. Methods to inform the community of the progress and performance of the project and issues of interest to the community; b. Notification of construction activities to potentially affected local residents and businesses; c. Processes to receive and manage complaints in accordance with Sydney Water's customer contract; d. Consultation with affected property owners including property inspections, where appropriate; e. Induction and training of construction personnel in communications requirements; and f. Protocols to notify stakeholders of relevant activities and any incidents should they occur.	During design (before construction commences).