MAJOR PROJECT ASSESSMENT: Hexham Swamp Rehabilitation Project

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

November 2006

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EXECUTIVE SUMMARY

The Minister for Natural Resources (the Proponent) is seeking the Minister for Planning's approval for the staged and controlled opening of existing floodgates located at the mouth of Ironbark Creek in order to restore tidal flow to the Hexham Swamp, which is located on the northern outskirts of Newcastle (refer to Figure 1), and thereby restore some of its previous estuarine values.

Note that the Hunter-Central Rivers Catchment Management Authority (CMA) is acting on behalf of the Minister for Natural Resources on this proposal.

The proposed development would involve the following key components:

- staged and controlled opening of up to 8 floodgates (see Figure 2) at the mouth of Ironbark Creek (a tributary of the Hunter River), with monitoring between stages to demonstrate whether actual impacts are consistent with predictions;
- minor filling of some private lands, raising of access roads and tracks and bunding to minimise the impact of increased tidal flow on private property and public assets;
- installation of one-way tidal gates on a number of informal drainage lines; and
- possible removal of an informal causeway across Muckeye Creek.

Figure 3 identifies the location of the swamp's main features.

Potential benefits include, in particular, improved water quality, improved fish and prawn stocks, and greater habitat diversity resulting in greater bird life. These changes are anticipated to result in greater economic activity from increased fishing and tourism (the Shortland Wetlands Centre adjoins the Hexham Swamp).

Key issues relating to the proposed Project include: flooding, tidal inundation, impacts on flora and terrestrial and aquatic fauna and mosquito control.

There will be some loss of revenue from reduced grazing activity, and some loss of freshwater habitat. However, the revenue losses should be more than offset by the economic benefits of increased fishing and tourism activity. The freshwater habitat losses will also be more than offset by the greater overall ecological values of the restored estuarine environment.

Other potential impacts are avoidable or can be managed to acceptable levels. It should be noted that the staged method of gate opening will enable an adaptive management approach to be taken to impacts – and will allow an early response should problems be identified. In order to mitigate/ manage the residual issues, the Department has recommended a number of conditions, which address matters such as compliance, monitoring, reporting, remedial works, overall environmental management plans, management of specific issues (including flooding, tidal inundation, groundwater, soils, protection of the green and golden bell frog, weed control, mosquito management, noise management), and community consultation and complaint management.

The Project is about environmental restoration and enhancement. The Department has assessed the merits of the Project and is satisfied that it could bring important environmental benefits and the potential impacts of the proposed development can be suitability mitigated and/or managed to ensure a satisfactory level of environmental performance. On these grounds, the Department considers the site to be suitable for the proposed development and that the Project will provide important environmental, social and economic benefits to the region. Consequently, the Department concludes that the Project is in the public interest and recommends that the Project be approved, subject to conditions of approval.

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1 BACKGROUND

Hexham Swamp is a wetland currently dominated by freshwater vegetation. 30 years ago, it contained a much more diverse suite of habitats. The installation and operation of floodgates in the early 1970s reduced tidal inundation, resulting in saltmarsh and mangrove communities being replaced by freshwater communities. The loss of estuarine habitats has resulted in a loss of visits by migratory waders and waterbirds, and the abundance of local fish, prawns and other marine organisms has also been affected by the loss of nursery areas.

The Hexham Swamp Rehabilitation Project aims to restore some of the estuarine values, by opening the existing floodgates (there are eight gates) at the mouth of Ironbark Creek. This will re-instate tidal flows to the area, and will result in saline inundation of some existing freshwater habitats. Ancillary works, such as bunds, are proposed to protect land not part of the Project from saline intrusion.

The estimated total value of the Project is $ 7million (including land acquisition costs).

The Project was subject to both Parts 4 and 5 of the Environmental Planning and Assessment (EP&A) Act. A development application (DA) was lodged with Newcastle Council on 20th April 2005, however, at the time of the commencement of Part 3A of the EP&A Act (1st August, 2005), the DA had not been determined.

Consequently, the Proponent withdrew its DA with Council in favour of seeking the Minister's approval for the entire Project under Part 3A of the Act. A Project Application was subsequently lodged with the Director-General, dated 14th December, 2005.

The application of Part 3A of the EP&A Act is discussed further in section 3 below.

2 PROPOSED DEVELOPMENT

2.1 Approval Originally Sought

There are two key components to the proposal:

- The staged opening of floodgates at the mouth of Ironbark Creek; and
- Various ancillary works to limit saline intrusion on private lands and public assets.

The aim is to restore the estuarine values of the swamp, leading to improved water quality, improved fish and prawn stocks, and greater habitat diversity with greater birdlife. The specific objectives of the Project, as defined in the Environmental Assessment (EA), are shown at Appendix C.

There will be some loss of freshwater habitat and loss of grazing opportunities (and associated revenue losses). The overall improved environment will offset any losses of freshwater habitat values. The Proponent anticipates that any economic losses will be more than offset by increased revenues from fishing activities and tourism activities (the Shortland Wetlands Centre is adjacent to the site).

Gate Opening

Water movement at the mouth of Ironbark Creek is controlled by eight floodgates, located within a single structure. The gates are shown in Figure 2, and their location is shown in Figure 3.

One gate is slightly open at the moment. It is proposed that this gate be fully opened as the first stage of the Project. This will increase tidal exchange between the swamp and the Hunter River. Monitoring of the effects of the opening will be undertaken, and further gates will be opened if monitoring shows that the effects of tidal inundation are consistent with predictions. After the first gate opening, it is proposed two gates be opened, then

four, and then all eight. Note that each stage will be followed by monitoring, and the following stages will only proceed if the monitoring shows satisfactory outcomes.

The gate openings will increase water levels in the swamp, increase salinity levels in the swamp, and increase the amount of tidal flushing between the swamp and the Hunter River.

Further details of the proposed staging are set out in section 2.4 of the Environmental Assessment (EA)[1].

The Project area comprises approximately 2000 hectares, a considerable portion of which is owned by private individuals/ organisations. As part of the rehabilitation Project, the CMA will or has already acquired around 800 hectares of private and public land with a view in the longer term to transferring it to the management of the Department of Environment and Conservation (DEC). Other land within the Project area will be subject to "easements to inundate" or other agreements with the landowners.

In general, easements have been purchased to a level of 1.5m AHD (which has been adopted as the Project Boundary), or to a level of RL 3.5m AHD (which is equivalent to the 1 in 100 year ARI flood level in the Hunter River). The variability depends on the nature of the properties involved, or on land owner requirements.

Ancillary Works

Some minor engineering works are proposed to minimise the impacts of saline intrusion on private lands and some public assets. These works are detailed in section 2.5 of the EA.

In summary, they include: bunding some properties to prevent saline incursion beyond the bunds; minor filling, to raise land/access tracks above saline water levels, or prevent impacts from rising groundwater levels; one way gates on some drainage lines to prevent upstream saline incursion; and possible removal of an informal causeway across Muckeye Creek to improve tidal flushing.

The EA outlined an indicative timetable for the implementation of the ancillary works. With the exception of the removal of the Muckeye Creek causeway, many of the works would be carried out prior to the first gate opening, with the remaining works being undertaken prior to the second gate opening. The Muckeye Creek works would be carried out if necessary. The EA did foreshadow, however, that some of the works may be carried out on an as necessary basis, once the full extent of inundation is realised.

[1] The EA comprises of two documents: (i) Environmental Assessment Supplement Hexham Swamp Rehabilitation Project, prepared by WBM Oceanics Australia and dated April 2006; and (ii) Environmental Impact Statement Hexham Swamp Rehabilitation Project: Volumes 1 and 2, prepared by WBM Oceanics Australia and dated August 2005. References to sections in the EA refer to sections in the 'Environmental Impact Statement'.

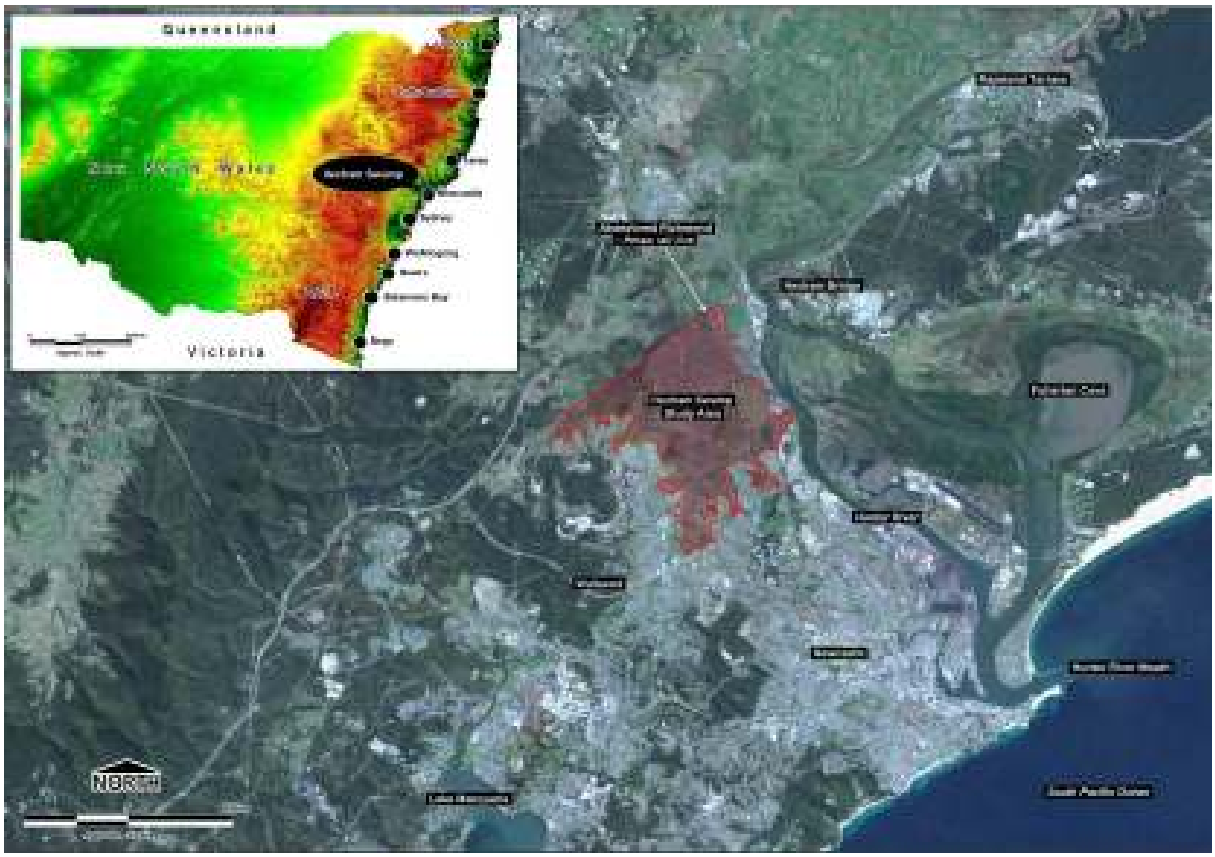

Figure 1. Location of Hexham Swamp in the context of the broader area

Figure 2 Existing Eight Floodgates at the mouth of Ironbark Creek

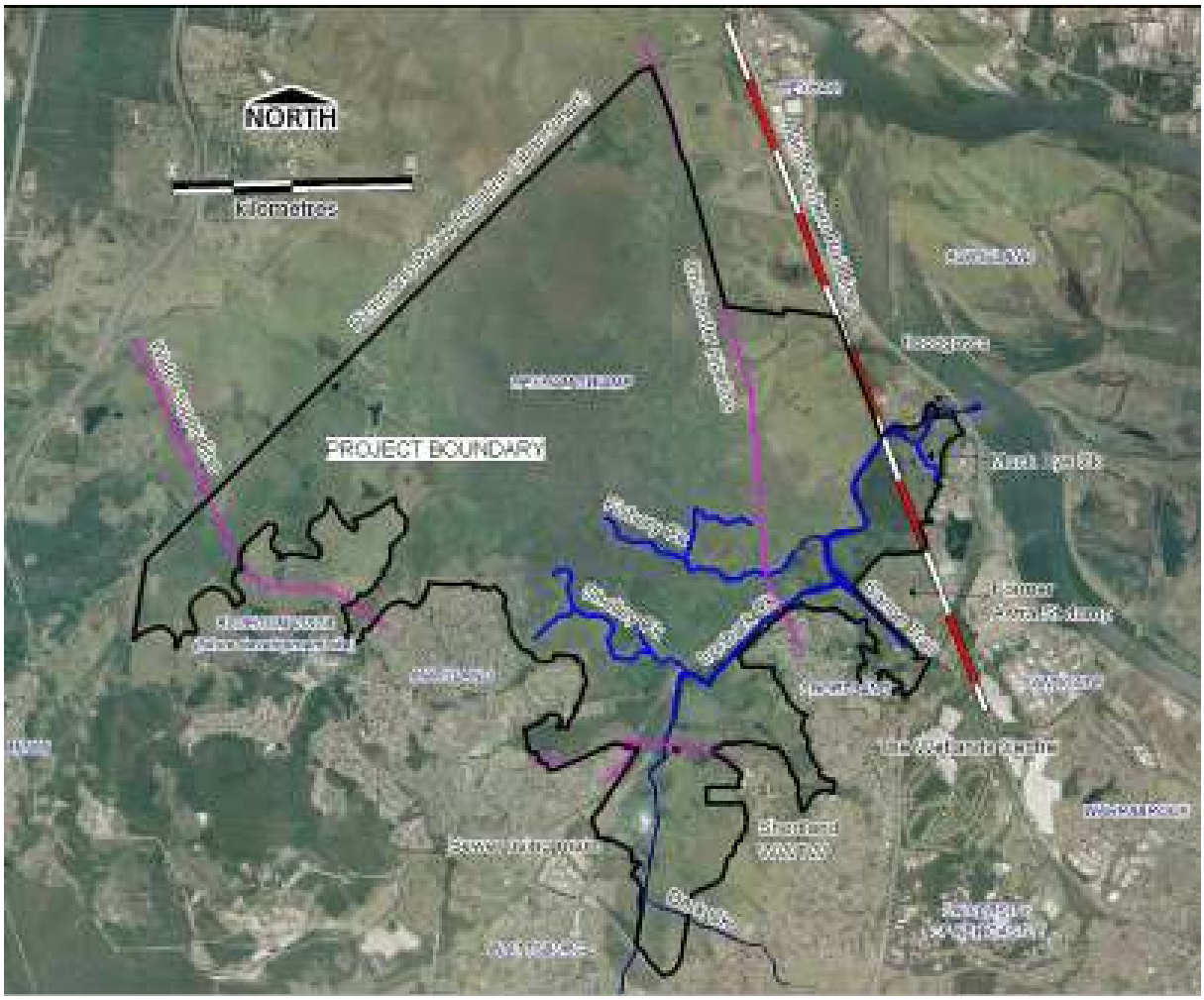

Figure 3- Location of Hexham Swamp Features

2.2 Amendments to the Proposal

Further modelling and refinement of tidal inundation took place after the EA was prepared. It is understood that funding constraints have required the CMA to further consider whether all mitigation works are required and, if so, whether they are required as early as identified in the EA. This modelling suggests that certain works may only be required at later stages of gate opening, or possibly not at all. The Proponent is now seeking to defer certain elements of the proposal and only undertake these works where monitoring and/ or further modelling suggests that the Project is impacting on these properties through saline intrusion either via surface waters or groundwater. The revised construction timetable is outlined in Table 1 below:

Table 1 –Proposed Construction Timetable

Timing	Mitigative Work
Prior to the opening of the first floodgate	• construction of a 700 metre bund at Marsden Street bund as described in section 2.5.1 of the EA
	• installation of one-way tidal flapgates at Ironbark Creek, Dark Creek and The Wetlands Centre as described in section 2.5.10 of the EA
	• construction of the BAL bund as described in section 2.5.2 of the EA
	• minor filling of Lot 20 DP 16703 and Lots A & B DP 350274 as described in section 2.5.8 of the EA
Following the opening of the	• minor filling of the following access tracks in order to maintain access:

first floodgate and on an as-needs basis	○ the TransGrid and tracks within The Wetlands Centre (located on Lot 5 DP 233520, Lot 2 DP 1043133 and Lot 1 DP 1069498); ○ the existing maintenance track for the Chichester Water Main Pipeline; ○ the existing access track servicing the Main Northern Rail Line; and ○ the existing access track servicing TransGrid powerlines adjacent to Ironbark Creek
	• construction of bunds in front of the culverts under the abandoned Richmond-Pelaw rail line to prevent the intrusion of saline tidal waters onto private land located on the western side of the rail line
	• minor filling on Lot 28 DP 864756
	• installation of one-way tidal flapgates downstream of the 2HD ponds (located on Lot 3 DP 553556) where tidal intrusion presents a credible risk to the hydrology and water quality of the 2HD ponds
	• minor filling of the Wallsair airport to raise the height of the surface to prevent impacts from rising groundwater
	• removal of informal causeway along Muckeye Creek

The proposed amendment was requested subsequent to the Submissions Report. A copy of the request is at Appendix B. The mitigation measures are considered further in section 5 of this report.

3 STATUTORY CONTEXT

3.1 Permissibility

The proposed rehabilitation Project site is located on land variously zoned under the *Newcastle Local Environmental Plan 2003* (Newcastle LEP) as 4(b) Port and Industry, 5(a) Special Uses, 6(a) Open Space and Recreation, 7(a) Conservation, 7(b) Environmental Protection, 7(c) Environmental Investigation and 8(a) National Parks.

The proposal is defined as "Environmental Protection Works" under the Newcastle LEP. Under clause 13(e) of the Newcastle LEP, environmental protection works do not require development consent except as otherwise identified in the LEP. For this Project, development consent would nominally not be required in zones 4(b), 5(a), 6(a), 7(a), 7(b) and 7(c), however, clause 24 of the LEP applies to the Project and as such, development consent would be required for parts of the Project where it would either be carried out on land which is below the mean high water mark, or where it forms part of the bed of a river or other natural watercourse, or where it has been reclaimed.

State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14) overrides the Newcastle LEP and states that where the Project is located on land which is mapped as being a SEPP 14 wetland, development consent is required as the Project involves work that involves filling of land within a SEPP 14 wetland. Part of the Project site is located on land to which SEPP 14 applies.

With respect to development on land zoned 8(a), of which approximately 50% of the Project site lies, only development which has been "authorised by or under the *National Parks and Wildlife Act 1974* (NPW Act) and any development incidental or ancillary to such development" may be carried out without development consent. All other development is prohibited. That part of the Project site located on land zoned 8(a) is known as the Hexham Swamp Nature Reserve which was dedicated in 1990 under the NPW Act. Under section 72 of the NPW Act, a plan of management is required to be prepared for nature reserves dedicated under the Act. This plan guides the management of the reserve. In 1998, the Minister for the Environment formally adopted the Kooragang Nature Reserve and Hexham Swamp Nature Reserve Plan of Management. One of the key objectives of the Plan is to rehabilitate Hexham Swamp. It is considered that this Project is consistent with the aims and objectives of the Plan of Management. The Department of Environment and Conservation has been

consulted in relation to the Project and made a submission indicating its support for the concept of the Project. Accordingly, the Department is satisfied that the Project could be authorised by or under the NPW Act.

3.2 Major Project Status

As discussed in section 3.1 above, prior to the commencement of Part 3A of the *Environmental Planning and Assessment Act 1979* (the Act), the proposed Hexham Swamp Rehabilitation Project required both development consent under Part 4 of the Act for part of the Project and assessment under Part 5 of the Act for the remaining portion of the Project. In particular, development consent was required to undertake work within a SEPP 14 wetland and on land subject to clause 24 of the Newcastle LEP, whilst outside these areas, the work was permissible without development consent, with only a flood works approval under section 90 of the *Water Management Act 2000* required to be obtained by the Proponent.

As the proponent for the Project is the Minister for Natural Resources (and a flood works approval would be required to be obtained from the Minister for Natural Resources), the proponent is also considered to be a determining authority (within the meaning of Part 5 of the Act) for the Project. The Minister for Natural Resources has also advised that the Project is likely to significantly affect the environment and would (but for Part 3A of the Act), require an Environmental Impact Statement to be prepared in accordance with section 112 of the Act.

On 29th July 2005, a Ministerial Order under section 75B(1) of the Act declared activities (within the meaning of Part 5) for which the proponent is also a determining authority, and that in the opinion of the proponent, would have required an EIS to be obtained under Part 5, as a Project to which Part 3A of the Act applies. As a result, that part of the Project that would ordinarily have been assessed under Part 5 of the Act, is now subject to Part 3A of the Act and, by operation of section 75B(3), the remaining part of the Project which would have otherwise required development consent, may also be taken to be part of the Project to which Part 3A of the Act applies.

3.3 Minister's power to approve

Under section 75J of the *Environmental Planning and Assessment Act 1979* (the Act), the Minister may approve (or disapprove) of the carrying out of the Project.

3.4 Public Exhibition of Environmental Assessment

The Environmental Assessment for the proposed Project was placed on public exhibition from 5th June 2006 until 7th July 2006 at the Department's head office and Newcastle office as well as the offices of Newcastle City Council, Hunter-Central Rivers Catchment Management Authority and the Nature Conservation Council of NSW. The Environmental Assessment was also published on the Department's website.

The Proponent's response to the submissions is contained in its Submissions Report which was submitted to the Department on 24th August 2006 and published on the Department's website.

4 CONSULTATION AND ISSUES RAISED

4.1 Submissions Received

In response to the public exhibition of the EA for the Project, the Department received twenty one (21) submissions. Of these, 15 were received from members of the public or public interest groups in which 13 supported the Project and 2 raised concern or objected to the Project.

Six (6) submissions were received from public authorities including the Department of Environment and Conservation, Department of Natural Resources, Hunter Water Corporation, TransGrid, Australian Rail Track Corporation (ARTC) and Newcastle City Council. All agencies supported the Project with the exception of ARTC and TransGrid who expressed general concern with the possible impact of saline intrusion on their assets.

Following subsequent correspondence between the Proponent and these agencies it is understood that all issues have now been satisfactorily addressed by the Proponent.

Key issues raised in submissions include:

- Positive benefits for prawn and fish stocks through providing habitat for juveniles;
- Improved habitat for birds, particularly migratory birds;
- Public health impacts through increased mosquito population;
- Potential impacts on assets and restriction of access to assets through inundation;
- Flooding impacts; and
- Loss of freshwater habitat.

Key issues raised in submissions are addressed in the following section of this report.

5 ASSESSMENT

5.1 Flora Impacts

Issue
Since the floodgates were installed in Ironbark Creek in 1970-71, the composition of vegetation has changed from one dominated by saltmarsh species and mangroves to a predominantly freshwater habitat, comprising primarily *Phragmites* (common reed). The aim of the proposal is to restore a more estuarine vegetation community to Hexham Swamp, particularly saltmarsh species. It is noted that this will be at the expense of some freshwater habitat, however, the Proponent considers that the broader environmental benefits of the proposal outweigh this loss.

Most submissions received in relation to the Project expressed support for the Project and noted the benefit of an estuarine vegetation community for both terrestrial and aquatic fauna habitat.

Swamp Characteristics
The Proponent notes that the vegetation of Hexham Swamp has been described in a number of studies and has involved the use of both historical aerial photography and field surveys. One of the more comprehensive studies looking at the change in vegetation structure was undertaken in 2000 using aerial photography and GIS analysis. This and more recent field surveys have been used by the Proponent in predicting the change to the vegetation community as a result of the staged re-opening of the floodgates.

The results of the GIS analysis show that the vegetation of Hexham Swamp has been subject to considerable change over the last century. The Proponent considers that while freshwater swamp forests were cleared early on, most likely for agricultural pursuits, much of the recent change has been brought about by the construction of the levee in the Hunter River and floodgates at the mouth of Ironbark Creek which has greatly changed the hydrology of the Swamp. In general, the study shows that between 1938 and 2000, there has been a 75% loss of mangroves, 99% loss of saltmarsh, 63% decline in open water habitat and a substantial increase in *Phragmites* swamp (2861%) and 900% increase in Casuarina woodland. There has also been a 34% decline in freshwater swamp habitat (refer figures 3.15 to 3.21 in the EA).

It is evident that there has been a dramatic increase of *Phragmites* swamp habitat largely at the expense of saltmarsh habitat. The Proponent predicts that as a result of tidal inundation of the swamp, over time, the *Phragmites* swamp will die-off and be replaced by a more estuarine vegetation community comprising saltmarsh and mangrove habitat.

Three ecological communities and one plant species found within Hexham Swamp are listed under the *Threatened Species Conservation Act 1995* (TSC Act) and include the *Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*, *Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions*, *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions* and *Zannichellia palustris*.

Consideration - saltmarsh
The aim of the proposal is to restore a more estuarine vegetation community, by allowing more saline water to enter the swamp area. This should lead to the expansion of saltmarsh within the swamp, and thereby assist in the protection of this community.

Consideration – swamp oak floodplain forest
It is predicted that the Swamp Oak Floodplain Forest will experience some die-back as a result of the Project. However, the Proponent notes that the determination for this endangered community recognises that there may be competing interests between protecting different communities within the floodplain as a result of programmes to restore more natural hydrological regimes within the floodplain and that only through careful management, can these interests be balanced. Up to 27 of 47 hectares within the Swamp are predicted to be inundated by tides, however, given the dramatic decline in saltmarsh community within the Hunter and the potential for this Project to have a positive benefit for that community, on balance, the Proponent considers that the priority in this instance is for the restoration of coastal saltmarsh and that it is more important than the preservation of existing swamp-oak communities within the Swamp. In stating this, the Proponent has argued that the saltmarsh community has been in decline for over 30 years in the Hunter region. Its restoration would be of at least regional, and possibly state, significance. The presence of saltmarsh is considered important to the sustainability of migratory bird populations in the area. The Proponent also noted that most of the freshwater losses would be of *Phragmites* (see below).

The Department concurs with the Proponent and considers that in this instance, the importance of restoring saltmarsh habitat to the Lower Hunter catchment outweighs the potential disadvantages from a loss of swamp sheoak, particularly as the restoration of saltmarsh will increase habitat diversity within the swamp and is likely to provide habitat for other fauna such as migratory birds (see section 5.4 for further details).

Consideration – freshwater wetlands
With respect to Coastal Floodplain wetlands, which include *Phragmites australis*, the Proponent notes that since the closure of the floodgates, this community has expanded at an increasing rate at the expense of other habitat such as mangroves, saltmarsh and saline ponds. As with the sheoak forest, the determination of this community recognises there is a need to consider the importance of restoring a natural hydrological regime within the floodplain. As a result of opening all eight floodgates, the Proponent predicts that up to 536 of the 918 hectares mapped as *Phragmites* would potentially be inundated, thereby protecting at least 392 hectares within the swamp. Given the importance of restoring coastal saltmarsh and that a significant proportion of *Phragmites* swamp will remain, the Proponent is satisfied that the priority to preserve saltmarsh outweighs any disadvantages of losing some *Phragmites* habitat.

The Department concurs with this position and notes that the rapid advance of *Phragmites* within the Swamp has come at the expense of other habitat, thereby reducing habitat diversity and consequently a loss or reduction in utilisation by fauna (refer section 5.4 for further discussion of this issue). The Department notes that the loss of *Phragmites* habitat is a consequence of the proposal, however, it is satisfied that this loss will be more than offset by the potential gains of saltmarsh habitat which has been all but lost from the site.

If the gates remain closed, the Proponent predicts that *Phragmites* will continue to further expand within the Swamp area as sedimentation increases and deeper pools become shallower. The Proponent also predicts an increase in swamp sheoak as the swamp dries out due to sedimentation and reduced salinity. These changes would likely be at the further expense of mangrove and saltmarsh communities.

Consideration - Zannichellia palustris
Zannichellia palustris has been found to occur with the Swamp, however, the Proponent notes that as an annual species, it is not persistent in any one area, its occurrence instead being dependent on a mix of factors including rainfall, competition with other plants and seed presence. As a result of opening the floodgates, the Proponent predicts that any area subject to tidal inundation is likely to become unsuitable for supporting *Z. palustris*, however, the Proponent notes that other areas will still remain available to this species with tidal inundation potentially providing greater dispersal of seeds enabling it to develop elsewhere within the catchment. The Proponent also notes that a "do nothing" approach may also prove detrimental to the viability of the species given

the likely spread of *Phragmites* and other perennial species. Overall, the Proponent considers that the proposal is unlikely to significantly affect the local population. The Department has considered the Proponent's assessment and is satisfied that whilst there may be a decline in available habitat within the swamp as a result of the proposal, the other benefits of the proposal outweigh this potential impact and notes that the proposal may have a positive benefit for this species by increasing its dispersal potential within the catchment.

Consideration – decaying vegetation
Another potential negative effect of tidal inundation is the potential odour generation from decaying vegetation. This issue was highlighted in Newcastle City Council's submission. The Proponent addressed this issue noting that a staged approach to the opening of the gates would limit the potential for mass die-off and consequently, reduce the potential for odour generation. Furthermore, by timing the opening of floodgates to occur during winter when vegetation is generally at a minimum and by undertaking selective stock grazing prior to opening the gates, the volume of vegetation potentially exposed to inundation would be reduced and hence, odour generation would be reduced. The Department is satisfied that any potential odour impacts would be relatively short-term in nature and will be minimised through the Proponent's management of floodgates.

Conclusion
The aim of the Project is to change the vegetation community within the Swamp area, so as to achieve an overall ecological improvement. To ensure that changes to the community occur as predicted by the Proponent and in an appropriate manner, the Department recommends the Proponent undertake a detailed survey of vegetation before the commencement of opening the first gate and at times thereafter. A staged approach to the opening of the floodgates is supported to ensure that any unforseen impacts can be addressed prior to permitting the next stage of the Project to proceed. This position is reflected in the Department's recommended conditions of approval.

Overall, the Department is satisfied that the staged reopening of the floodgates at Ironbark Creek will have a largely beneficial outcome for the vegetation community within Hexham Swamp and will lead to a more diverse community structure.

5.2 Health Impacts

Issue
As part of its Environmental Assessment, the Proponent recognises that there is likely to be a change to the local mosquito population as a result of re-opening the floodgates. The Proponent predicts that whilst the species mix will most likely change from predominantly freshwater to predominantly estuarine species, the population density of mosquitoes is unlikely to significantly change from that already experienced in the area. In addition, the population of mosquitoes at Hexham Swamp contributes only a minor amount to the total mosquito population of the region, given the large population at the nearby Kooragang Island.

The Department received a small number of submissions that expressed concern about the likely increase in mosquito numbers as a result of restoring tidal flow to Hexham Swamp. These submissions cited their experience prior to the gates being installed when mosquito numbers were so great in number that it was almost impossible to be outdoors after five o'clock. Submissions also expressed particular concern about the threat of mosquitoes and their ability to transmit disease, noting that both Ross River Fever and Dengue Fever were now found in the Hunter region.

Consideration
The Proponent notes that prior to the installation of the gates, the swamp was subject to semi-diurnal fluctuations of tides resulting in a mosquito species composition that was dominated by saltwater-species, although freshwater species were also known to occur, and include: the saltmarsh mosquito (*Ochlerotatus vigilax*), Hexham grey mosquito (*O. alternans*), the common banded mosquito (*Culex annulirostris*), saltwater culex (*C. sitiens*) and the common Australian anopheline (*Anopheles annulipes*). These species were most prevalent between December and March when Hexham Swamp was inundated with salt water. During periods of drought, however, the Proponent notes that the breeding of mosquitoes in the Swamp was greatly reduced.

Of these species, the Proponent notes that it is the saltmarsh mosquito which is the most prevalent pest species in Newcastle and is known to be a vicious biter and vector of pathogens (including Ross River virus and Barmah

Forest virus). It is also known to have a long migration path of up to 20 kilometres from its breeding source. The common banded mosquito (a primarily freshwater species) is also a known vector of arboviruses that cause encephalitis and epidemic polyarthritis.

Mosquito populations have continued to flourish since the floodgates were first installed, particularly as fish that would otherwise predate on mosquito larvae have been restricted. However, the Proponent notes that the species composition has shifted towards a more freshwater-dominated species mix with the common banded mosquito being the most predominant pest species breeding in Iron Bark Creek. Importantly, the Proponent notes that even when the common banded mosquito population is at its peak following summer rainfall, it is often overshadowed by the population of the saltmarsh mosquito which breeds in nearby estuarine wetlands such as those found on Kooragang Island.

The Proponent notes that it is difficult to predict the change that will occur to mosquito habitat in Hexham Swamp following the reestablishment of tidal flows. This is largely because there is uncertainty as to how the vegetation will respond to the tidal change and what the water retaining capacity of the land will be. Notwithstanding, the Proponent makes some general assumptions about the likely changes and predicts that due to the saltwater intrusion, there will be a decrease in suitable habitat for freshwater species and an increase in potential habitat for saltwater species. Regardless of the species mix, the Proponent contends that Hexham Swamp would continue to be a minor contributor towards the total mosquito population of the Lower Hunter River given the large mosquito habitats on Kooragang Island and within the Tomago wetlands and hence, is unlikely to make a substantial contribution to the overall public health risks in the region.

Mitigation

Whilst the Proponent contends that it is difficult to predict what the mosquito population will be following the reopening of the floodgates, it notes that it will be able to readily respond to unexpected or unusually large mosquito abundances through controlling the timing, frequency and quantity of tidal movement through the gates. This is because mosquito populations are largely influenced by the presence of pools of water, that is, if water is allowed to stagnate for a period of time without being flushed, mosquito larvae are able to develop into adult mosquitoes.

To minimise the extent of mosquitoes breeding in Hexham Swamp, the Proponent identifies a number of mitigation strategies that could be implemented, including:

- opening of floodgates during the non-mosquito season, from May to October, to enable the Proponent to assess the actual extent of tidal inundation and therefore, derive a more accurate picture of likely mosquito population changes;
- restricting the intrusion of king tides and potentially spring tides to limit the potential for stagnant pools of water to develop in the upper reaches of the Swamp;
- using chemical controls which target the juvenile stages of mosquitoes; and
- using biological controls such as predatory fish to feed on the mosquito larvae.

The Proponent states that it will initially limit its mosquito management to first opening the gates outside the mosquito breeding season and limiting the extent of king tides during the summer solstice period, however, if it is found that these measures are not effective at managing mosquitoes (that is, there is a significant increase in mosquito numbers over that currently experienced) then the Proponent would implement further actions such as restricting large spring tides and if necessary, chemical controls. The Department supports a stepwise approach to the management of mosquito populations and considers that chemical control should only be used as a last resort and only where it can be demonstrated to not detrimentally affect other species.

It should be noted that the Proponent has received expert advice from the Western Sydney Area Health Service on mosquito management, and that it has advised its mitigation strategies are consistent with this advice.

In addition, the Proponent notes that a cross-agency committee has been established by the Premier's Department to address long-term mosquito management in the broader Hunter region. As such, the Proponent highlights that future management of mosquitoes in Hexham Swamp would be guided by any plans prepared by the Committee. The Department recognises the importance of establishing a broader management plan for dealing with mosquitoes in the Hunter area, however, the Department is concerned about the timing of this

Project and the preparation of this broader plan and wants to ensure that mosquitoes are managed from the time the first floodgate is opened. To this end, the Department recommends that in the absence of any established framework setup by the Committee, the Proponent should be required to implement its own site-specific management plan to address mosquito control prior to the first gate being opened. Additionally, the Department recognises that the physical control of floodgates is a useful tool in minimising the potential for stagnating pools to occur and hence, mosquito breeding habitat and supports the timing of floodgates being opened outside of the mosquito season to enable a more accurate picture of the inundation regime to be identified. These recommendations are incorporated into the Department's recommended conditions of approval.

Furthermore, the Department understands that a programme for monitoring the mosquito populations in the area is currently being undertaken and now includes the Hexham Swamp. The Department notes the importance of obtaining this data to enable the Proponent to effectively manage the mosquito population of Hexham Swamp following the staged reopening of floodgates and recommends that should the Minister approve the Project, a condition be included which requires the ongoing monitoring of mosquitoes at Hexham Swamp.

Conclusion

The Department recognises that it is difficult to quantify the nature of change that will occur to the mosquito population following the staged opening of the floodgates at Ironbark Creek, however, it is satisfied that the management measures proposed by the Proponent, including continuous monitoring and research; adaptive management of floodgates during king tides and the overall staged approach to the opening of the gates will provide suitable measures to protect against any adverse impacts.

Should the Minister determine to approve the Project, the Department recommends a number of conditions be included in any Project approval including a requirement that the Project be operated in a manner which minimises the impact on human health and comfort levels resulting from changes to the mosquito population at the Swamp as well as a requirement to implement a mosquito management plan and associated monitoring.

5.3 Impacts on Private Property through Tidal Inundation

Issue

The key objective of this Project is to restore tidal flows to the Hexham Swamp by progressively opening the floodgates at the mouth of Ironbark Creek. As previously noted, the eight gates were installed during 1970/1971 and have remained effectively closed to this day. As a result, Hexham Swamp has changed from a primarily estuarine system to a more freshwater system. Opening the floodgates should result in a return to a tidally influenced estuarine-community for the majority of the swamp.

A key issue resulting from the staged opening of the floodgates will be the inundation of land that for at least 30 years has not been affected by saline water. Where modelling has predicted tidal inundation over private property, the Proponent has sought and obtained easements to inundate or has purchased the property. In addition, the Proponent has also sought approval to construct bunds or fill the land to exclude the tidal waters from certain property. Newcastle Council, whilst supportive of the overall objectives of the Project remain concerned about permitting minor filling on some private property that is within a SEPP 14 area.

As with all modelling, there exists a level of uncertainty with the predictions made. In this case, the Proponent notes that the extent to which tidal inundation may occur cannot be fully known before the floodgates are opened. However, the Proponent notes that by undertaking a staged approach to the opening of floodgates and undertaking monitoring, predictions regarding the extent of tidal inundation can be refined and measures can be implemented to refine the proposed floodgate management strategy.

Impacts from tidal inundation other than on private property, such as flora and fauna and water quality, are discussed elsewhere within this report.

Consideration

The extent of tidal inundation within Hexham Swamp has been predicted using the two-dimensional TUFLOW model. Figure 4 shows the predicted extent of tidal inundation with 1 and 8 gates open without mitigation measures, such as bund construction, in place. Figures 4.4 to 4.8 within the EA show the extent of inundation under spring and king tide conditions under each stage of opening the floodgates with mitigative works in place.

Where possible, the Proponent states that it has sought easements over private property to inundate their land as a preferred outcome. However, where the Proponent was unable to satisfy private landowners through purchasing easements, the Proponent has sought approval to undertake mitigation works.

These works have previously been outlined in section 2 of this report. In relation to the construction of the 700 metre Marsden Street bund, the Proponent states that the construction of a bund was the preferred solution as these landowners wished to maintain their existing use of the land without potentially being affected by saltwater intrusion. The Proponent notes that in the event of tidal inundation behind the bunds, easements to inundate have also been purchased or are in the process of being purchased. For two other locations, the Proponent states that it was unable to negotiate an easement and considered that the only other option agreeable to the landholders was to raise land levels, through filling. The Proponent considered that this was not an ideal situation but notes that in the overall scheme of the Project and of the land that will be affected by the Project, it is a minor concession.
At Marsden Street (see Figure 4), it is proposed that fill be placed on three properties. The total area is less than 4000m^2 ha. About 1000m^3 of material would be required, to raise the ground level from the current 0.25m-1m AHD to 0.8m -1m AHD.

At Hardes Avenue (see Figure 4), about 1500m^2 would be filled. About 450m^3 of material would be required, to raise the ground level from the current 0.3m – 0.8m AHD to 0.8m AHD.

Newcastle Council has stated that whilst it understands the Proponent's position, the filling is considerable when considered in isolation, particularly as some of it will occur on SEPP 14 land. Since the public exhibition of the proposal, the Proponent has sought to modify the timing of mitigation works and states that it will only fill the property at Hardes Avenue where monitoring identifies that saline intrusion is occurring. Further refined prediction modelling suggests that this may never occur. The Department considers this an appropriate outcome and reduces the need for otherwise conservative filling of private property. The Proponent does, however, propose to fill land along Marsden Street prior to the opening of the first gate. The Department recognises Council's concern in relation to the matter, but is generally satisfied that this is the only viable solution at present.

The Department understands that the Proponent will undertake mitigation works for other private property on an as-needs basis to ensure that saline intrusion resulting from the opening of the floodgates does not impede access to property or negatively impact upon these properties (see section 2 of this report). The EA had originally indicated that such works would occur prior to the opening of the first or second floodgate. Subsequently, it advised it will undertake these works only if they are necessary. The Department is satisfied that this approach will ensure protection of properties, while minimising any costs and potential adverse consequences of such works. A number of conditions have been recommended that will ensure tidal inundation is adequately controlled. The Department is also satisfied that the proposed amendment to the timing of works (as set out in the EA) is consistent with the objectives of the exhibited proposal.

Concern has been raised by the adjacent Wetlands Centre in relation to the proposal, particularly that it may jeopardise the Centre's ability to fulfil its responsibilities in relation to its listing as a RAMSAR wetland. The Proponent responded to this concern and noted that it will be undertaking mitigative works such as raising parts of the access tracks within the Centre and installing one-way tidal flap gates to prevent tidal inundation of the Centre's site. The Department is generally satisfied with this approach and notes that the proposed on-going monitoring of tidal inundation will enable the Proponent to identify any unforseen impacts and appropriately ameliorate these.

Conclusion
Given the uncertainty in prediction modelling of tidal inundation, the Department notes that the staged opening of the floodgates will provide a key management tool to enable the predictions to be verified and where necessary, adjustments made to the operation of the gates to ensure no adverse or unforseen impacts occur. The Department supports this approach and is reflected in the Department's recommended conditions of approval.

Overall, the Department is satisfied that the inundation of land as a result of opening the gates could be appropriately managed through the commitments made in the EA and the Department's recommended conditions of approval.

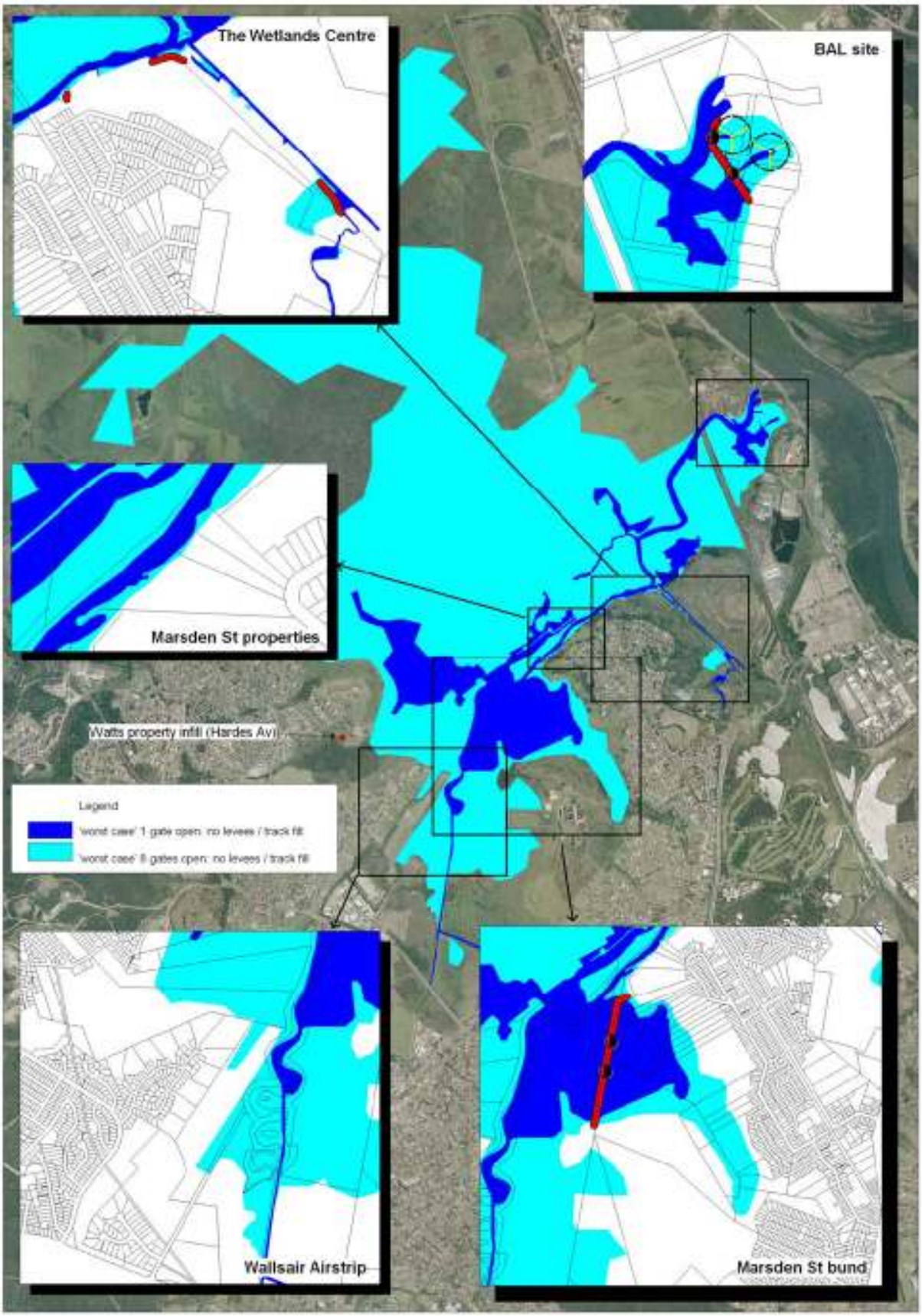

Figure 4 Predicted inundation extents (1 gate open and 8 gates open), without mitigative works

5.4 Terrestrial Fauna Impacts

Issue

Changes to the species composition and abundance of terrestrial fauna, particularly avifauna, are predicted to occur as a result of changes to the composition of vegetation, which is predicted to occur as a result of opening the floodgates and allowing tidal inundation of the swamp. In general, the Proponent predicts that the species diversity and abundance of birds will increase. With respect to amphibian populations, the Proponent notes that potential habitat is likely to decline as a result of restoring tidal inundation to the Swamp, however, considers that the broader environmental benefits outweighs this minor impact.

A submission from a local bird observers club supports the proposal and considers that the rehabilitation of the swamp will increase the capacity of the area to support wading birds and waterfowl.

Consideration

The Proponent notes that the installation of the floodgates has severely modified the flow regime of Ironbark Creek and consequently the diversity of habitat available for fauna has been substantially reduced. Currently, there exist two broad types of habitat within the Ironbark catchment, the channel habitat and wetland habitat.

The channel habitat includes Ironbark Creek and its tributaries. Whilst the individual creeks show considerable variation both along their length and between each other, this habitat may be broadly described as having a permanent body of water with an average depth of around 1.5 metres and relatively steep bank structure with minimal intertidal fringes.

The wetland habitat makes up the balance of the Project site. The wetland area has numerous small (<1m wide) and shallow (<1m deep) drainage channels which drain into Ironbark Creek but are not currently subject to tidal inundation. The maximum depth of this area does not generally exceed 1 metre for most of the year and is covered almost entirely by freshwater vegetation.

Birds and Bats

Over 200 species of birds have been recorded in the Ironbark Creek catchment. Of these species, one (Black-necked Stork) is listed as endangered under the *Threatened Species Conservation Act 1995* (TSC Act). A further seven are listed as vulnerable under the TSC Act. Sixteen bird species listed under JAMBA and CAMBA are also either known and/ or likely to occur within the Hexham Swamp area.

The Proponent states that no systematic surveys of avifauna of Hexham Swamp appear to have been undertaken prior to the construction of the floodgates in 1970/1971, however, historical evidence suggests that the swamp would have supported a diversity of birds within the estuarine and freshwater habitat. Since the construction of the floodgates, studies suggest that there has been a decline in the diversity and abundance of the avifauna community of Hexham Swamp, most likely as a result of changes to the diversity, extent and quality of these habitats.

If no change was made to the current regime of excluding tidal waters in Hexham Swamp, the Proponent predicts that in the short term, there will be no effect on the avifauna communities which utilise the swamp. Over the longer term, however, the Proponent predicts that the species richness and abundance of birds will decline. This prediction is based on the assumption that both the swamp she-oak and common reed areas will continue to expand at the expense of other habitat such as saltmarsh, as has been occurring over recent years. In particular, the common reed areas are expected to support a relatively lower diversity of birds compared to the diversity which could be supported by the equivalent area of healthy saltmarsh, although direct evidence was not provided in the EA. However, a study[2] was cited which suggests declines and absences of various wading species that had been previously present in the lower Hunter estuary. It attributed these changes to the loss of estuarine islands, and to the loss of saltmarsh and freshwater wetlands within the lower Hunter Valley. The loss of wetlands has particularly contributed to a decline in smaller wader species. Many of these species exhibit a preference for shallow wetlands and saltmarsh habitat which were formerly extensive within Hexham Swamp.

[2] Kingsford RT and Levy RF (1996) *Changes to the Hunter River Estuary, 1801-1996, and their implications for migratory wading birds and other waterbirds*. Report for the Kooragang Wetland Rehabilitation Project, Wallsend.

Should the Project be granted approval, the Proponent states that the opening of all eight floodgates is likely to result in the inundation of up to 750 hectares of vegetated habitat. The common reed community in particular, is predicted to be substantially impacted by this change with approximately 25% subject to inundation under mean spring conditions and 57% under king tide conditions.

As a result, the Proponent predicts that the *Phragmites* will die back, although this is expected to take some time given the partial salt tolerance of this species, providing opportunities for saltmarsh species to re-establish. The positive effect of this is to provide habitat that is favoured by many species listed under JAMBA and CAMBA (migratory waders) and other threatened species.

The Proponent undertook an eight part test of significance for those threatened species known or likely to occur in the area. The assessment suggests that in general, habitat may increase for some species whilst for others, no change is predicted as areas utilised by those species are unlikely to be affected by tidal inundation.

The Proponent considers that no suitable foraging or roosting habitat exists within Hexham Swamp and as a result, increased tidal inundation from the opening of floodgates would not impact upon any threatened bats. The Department supports this finding.

Frogs

Using the National Parks and Wildlife Atlas, together with records from previous studies, the Proponent states that fourteen species of amphibians have been recorded in and around Hexham Swamp. Of these, one species, the Green and Golden Bell Frog, is listed as endangered under the TSC Act, however, it has not been recorded recently within Hexham Swamp apart from the known population in the 2HD ponds (now considered hydrologically distinct from the Swamp).

The Proponent notes that the installation of the floodgates in Ironbark Creek in the 1970s may have produced conditions favourable for the expansion of frog distribution in the south-east of the swamp as the water became fresher over time and consequently, the vegetation communities became dominated by more freshwater species.

The Proponent predicts that if the floodgates were to remain as they are today, the frog species diversity and/ or abundance would be unlikely to change in the future based on their current utilisation of habitat within the Hexham Swamp. Opening of all eight gates, however, would markedly reduce frog populations as large areas of freshwater habitat would be inundated (at least periodically) by saline water.

An eight-part test for the endangered Green and Golden Bell Frog was undertaken and the assessment suggests that the opening of the gates will reduce the area available for breeding/ foraging by the frog. However, if the gate openings were not to proceed, the long term viability of the population would also be uncertain due to the predicted continual gradual decline in the water quality of the swamp, the simplification of habitat in the swamp and the infestation of the predator fish *Gambusia holbrooki*, which is a known predator of native fish and frogs. Overall, whilst opportunities for the Green and Golden Bell Frog in the swamp may be restricted, the Proponent highlights that the locations in which the Green and Golden Bell Frog have more recently been recorded (such as the 2HD pond), will not be affected by the Project. The Proponent states that it will continue to undertake surveys in and around Hexham Swamp for the frog and will also implement a monitoring programme to measure salinity levels within the 2HD ponds. Should the salinity levels change in a manner that could affect the frog population, the Proponent states that it will install one way flapgates to prevent any intrusion of water from the Swamp into these ponds. This is consistent with the requirement of the Commonwealth Department of the Environment and Heritage and, in particular, that the Project would not be a controlled action provided certain actions such as installing flapgates were undertaken in the event that monitoring suggested that the Project was having a deleterious effect on the Green and Golden Bell frog or its habitat within the 2HD pond.

Conclusion

The Department notes the re-opening of the floodgates has the potential to improve habitat for birds within the Swamp and is satisfied that there would not be any significant impact on other bird or bat species that prefer freshwater habitat. To ensure changes to the swamp are occurring as predicted, the Department recommends

the implementation of a comprehensive monitoring programme for terrestrial fauna which is reflected in the Department's recommended conditions of approval.

The Department is satisfied that the potential impacts on the Green and Golden Bell Frog will be limited, given the risks posed now by the deteriorating environment, and that known frog locations can be protected. The Department recommends a condition be imposed to ensure that the proposal does not adversely affect Green and Golden Bell Frog populations or habitats within and in areas adjacent to the Hexham Swamp, notably the 2HD ponds. The Proponent must also undertake water quality monitoring within the 2HD ponds to ensure that salinity levels do not increase or water quality generally does not decline as a result of re-opening the floodgates. Flapgates or equivalent would need to be installed to mitigate this. These recommendations are reflected in the Department's recommended conditions of approval.

5.5 Aquatic Fauna Impacts

Issue

One of the key drivers of this Project is the potential for re-establishing habitat for prawn and fish species. Anecdotal evidence from local fisherman suggest that prior to the installation of the floodgates, Hexham Swamp was an important habitat for commercially important juvenile prawn and fish species. The Proponent predicts that as a result of re-opening the gates, local prawn and fish stocks will increase.

A large percentage of submissions received by the Department identified the recovery of prawn and fish stocks as a key reason for supporting this Project.

Consideration

The Department received a submission which challenged the likelihood of the Hexham Swamp restoration Project as being able to contribute to the recovery of fish stocks and considered that the only way they would improve in the Hunter was by banning fishing. Whilst the issue of fishing within the Hunter and its impact on fish stocks is outside the scope of the Department's assessment, with respect to providing habitat, there is considerable evidence within the literature to suggest that areas like Hexham Swamp provide habitat for juveniles and as such can contribute to improving adult fish stocks within an area. The Proponent notes that most species of direct fisheries importance rely upon estuaries during at least part of their life-cycle either for breeding, feeding or shelter.

By doing nothing, fisheries values would most likely continue to diminish as a result of on-going water quality degradation, habitat degradation and lack of access.

Conclusion

The Department recognises the potential for Hexham Swamp to provide habitat for prawn and fish species following the staged re-opening of the floodgates and the positive benefits this is likely to have on the abundance and diversity of fish in the area. In order to test predictions regarding the success of the Project in relation to this, the Department recommends the Proponent prepare and implement a monitoring programme which measures species abundance and diversity of aquatic species. This is reflected in the Department's recommended conditions of approval.

5.6 Flooding Impacts

Issue

Hexham Swamp is a major flood storage area on the south bank of the Hunter River with the majority of the Swamp being drained by Ironbark Creek. Urban development in the local area has modified the quantity and quality of stormwater runoff from the catchment and has resulted in a shorter response time (due to increased impervious areas) when compared with natural (vegetated) conditions.

Concern has been raised in two submissions regarding the impact of the reopening of floodgates at Ironbark Creek on local flooding. In particular, concern has been raised regarding the construction of the bunds and whether this would have the effect of moving the floodwaters elsewhere. Additionally, concern was expressed that owing to the development of Waratah, Shortland and Wallsend and subsequent increase in stormwater

runoff, the raising of the floodgates could result in both the flooding of additional homes and properties which were not previously subject to flooding.

Consideration

As discussed previously, floodgates were installed at the mouth of Ironbark Creek in 1970-1971 to reduce nuisance flooding of the local area from the Hunter River and to restrict saline intrusion of low-lying farmland around the swamp margins. The floodgates only provide flood protection for events up to about a 1 in 10 year ARI (average recurrence interval). Overtopping of the floodgates and associated levee system will occur at approximately 1.8 metres AHD.

In terms of locally generated floods, modelling by the Proponent and others has indicated that the level of the tide within Hexham Swamp will have little influence on the peak flood level for major flood events (greater than 1 in 20 year ARI) as the total volume of floodwater stored in the swamp far outweighs the volume associated with tidal inundation. The effects for smaller flood events (less than 1 in 20 year ARI), however, are more noticeable because the volume of floodwaters is comparable to that of the volume associated with tidal inundation. Nevertheless, modelling undertaken by the Proponent indicates that the difference in flood levels between the existing situation and all 8 gates open would be a maximum of 50 mm just downstream of the floodgates and that this difference would attenuate with distance (refer Figure 4.9 in the EA). Importantly, the Proponent highlights that the minor impact of opening the floodgates on local flooding is restricted to the area downstream of Minmi Road only (which is not built-up) and will have no impact on the Wallsend commercial district.

In response to concerns raised in submissions, the Proponent notes that areas that have been developed in recent years such as Maryland are well above the flood level of the swamp and as such, the Project will not have any impact on these properties. Furthermore, areas affected by the minor increase are located fully within the Project site with all land either owned by the Hunter-Central Rivers Catchment Management Authority or where there is an agreement in place to inundate the land (an easement). In its submission, Newcastle City Council notes the findings of the EA and did not express concern with these.

The Proponent notes that the installation of bunds at Marsden Street and near the BAL site are low enough such that they would be overtopped by the 1 in 1 year ARI flood event, however, it is predicted that these bunds will result in a small change in the duration of inundation. In particular, the Proponent notes that drainage of the land behind the bunds following a flood event will be slightly impaired as water will only be able to drain through the one-way culverts within the bund resulting in an increase in flood duration for the 1 in 1 year event from 15 to 19 days. The Proponent considers, however, that this will not have any long-tern impacts on groundwater conditions or vegetation in the affected areas.

The Department recognises that the installation of bunds will result in a minor change in flood behaviour, however it is satisfied that the change is minimal and the benefits of installing the bunds to protect private property outweigh this minor effect. Furthermore, the Department is satisfied that the bunds will not result in other property being inundated as the bunds are not designed for flood protection, but tidal inundation.

To limit the influence of the Hunter River on flooding in the swamp catchment, the Proponent states that the floodgates will continue to be managed as they are today. That is, following the issue of a flood warning, the gates will be closed in accordance with the Lower Hunter River Flood Procedures Manual. As currently occurs, flood waters will be held within Hexham Swamp until flood levels within the Hunter River subside to below the swamp flood level. The Department is satisfied with this approach and recommends that should the Minister approve the Project, a condition to this effect should be included in any conditions of approval (see APPENDIX A).

Conclusion

The Department is satisfied that the staged reopening of the floodgates at Ironbark Creek will have limited effect on flood behaviour in the local area. Conditions of approval are recommended. These will require the floodgates to be managed in accordance with the Flood Procedures Manual, and require that the Project does not result in a significant change to flood behaviour over that which existed immediately prior to the opening of the first floodgate. This should be sufficient to ensure that the risk of flooding to urban areas is not increased as a result of the Project.

5.7 Water Quality

Issue

A number of studies looking at the quality of water within Hexham Swamp and Ironbark Creek have been undertaken since the installation of the floodgates in 1970/1971. These studies generally suggest that water quality within the swamp has deteriorated and been influenced in part by upstream activities (for example, the Shortland sewage treatment plant during the 1970s and runoff from nearby urbanised areas).

One of the predicted benefits of gate opening is improved water quality within Hexham Swamp and in particular, increased dissolved oxygen levels, and reduced nutrient levels, pollutants, suspended solids, biological oxygen demand (BOD) and faecal coliforms, compared to current baseline levels.

Consideration

The following table presents a summary of the general water quality within Hexham Swamp as determined via the numerous studies undertaken by the Proponent and others:

Table 2 – Existing Water Quality within Hexham Swamp

Pollutant/ Parameter	Existing Condition
Salinity	- generally lower than in the adjoining Hunter River with a notable gradient between the area adjacent to the floodgates and the freshwater tributary inputs. Salinity is primarily influenced by rainfall
pH	- variable throughout the swamp, although generally within the normal range for estuarine and brackish environments. Some remote areas of the swamp subject to low pH which may be as a result of acid sulphate soils
Turbidity/ Water Clarity	- generally shown to be lower than in the Hunter River
Dissolved Oxygen (DO)	- typically lower than found within the Hunter River (which exceed ANZECC guidelines) and more variable.
Nutrients and Algae	- generally higher than within the Hunter River and considered to be moderately to highly eutrophic. TN and TP has been recorded as exceeding ANZECC guidelines although have been lower in recent years which is attributed to the Shortland STP no longer discharging into the swamp. Chlorophyll-a concentrations typically exceed ANZECC guidelines
Bacteria	- limited information available, although it is predicted it would be high following rainfall due to inefficient sewerage systems, runoff from septic systems and the like
Metals and other Toxicants	- elevated concentrations have been detected within leachate from the former Astra Street landfill and within Canoe Channel and Ironbark Creek, including NH_3, NO_3^-, Cd, Cu, Ni, Pb, Zn, Fe, Al, Co, Mn, As, Hg, Ni, Cr(VI) and free cyanide. Some organics including phenanthrene, fluoranthene and benzo(a)pyrene have also been detected.

In general, the Proponent considers that the effects of the proposal with regard to surface water quality will primarily occur as a result of increased tidal exchange between waters within the swamp and the Hunter River and decomposition of vegetation that is generally intolerant to saltwater. In particular, the Proponent predicts that

in the short-term (less than 3-5 years), the water quality in the swamp following the opening of the gates will be variable, however, once estuarine vegetation has established within the swamp, water quality is predicted to improve over that which currently exists due to increased tidal exchange. Eutrophication within the swamp is predicted to be less likely following the opening of floodgates as nutrients will not be held within the Swamp and will disperse within the Hunter River.

The Hunter River may be expected to experience a localised decrease in water quality while the swamp is flushed and vegetation changes, however, this is expected to be minor in nature and not persistent.

Importantly, the Proponent considers that the staged approach to opening the floodgates will help to ameliorate any water quality impacts as vegetation will only be progressively inundated. Furthermore, by opening floodgates generally within the winter months, the density of vegetation and hence organic load within Hexham Swamp will most likely be low. The Proponent states it will continue monitoring the water quality within and adjacent to Hexham Swamp, including the 2HD pond which the Department supports.

There is a possibility that the increased groundwater levels resulting from tidal inundation could result in the mobilisation of leachate from the former Astra Street landfill site. The CMA considers this is unlikely, as it considers any contaminants most probably will have already leached out. However, as a precaution, and following consultation with the Department of Natural Resources, the Department recommends a condition that requires the floodgates to be operated so that they do not exacerbate any contaminant movement.

Conclusion
The Department recognises the potential for the opening of the floodgates to have a longer term positive benefit on water quality within the swamp. The Department supports an ongoing water quality monitoring programme for the site to quantify changes in water quality as a result of the Project and where necessary, undertake mitigative works to address any unforseen impacts. This is reflected in the Department's recommended conditions of approval.

5.8 Other Issues

Acid Sulphate Soils

The Proponent notes that the Hexham Swamp area is almost entirely located within an area that has previously been mapped as having a high probability of occurrence of acid-sulphate soil materials within the soil profile. Additional studies have also noted the potential buffering capacity by carbonate derived from shell fragments within the sediment.

The Proponent suggests that the tidal inundation of the Swamp will lead to a reduction in the potential for acid sulphate soils to generate acid as it is predicted that the re-opening of the floodgates will result in a rise in groundwater levels leading to a more static groundwater level. Furthermore, the buffering capacity of saline water is also noted and it is considered it will help to stabilise the pH levels within the Swamp. The Proponent considers that a do-nothing approach would carry a greater risk associated with potential discharge of acid water due to the continued depression of the groundwater table.

To limit the potential for acid generation, the Proponent states that in constructing the bunds and undertaking filling works, all soil will be imported from off-site with no soil within the Project site being used. The Department supports this approach and this is reflected in the recommended conditions of approval.

Additionally, the Department recommends the Proponent be required to prepare an Acid Sulphate Soils Management Plan in accordance with the ASSMAC manual where any potential or actual acid sulphate soils are disturbed.

Groundwater

As a result of increased tidal inundation, the Proponent states that there will be an associated increase in the groundwater table in the longer term. The extent of this influence has been generally predicted, and the Proponent notes that there may be effects on access tracks through a reduction in the structural integrity of the soil over time. The Proponent states that it will rectify any such impacts through undertaking minor filling. The Australian Rail Track Corporation (ARTC) raised some initial concern with the Project, particularly that it may

affect the integrity of its rail line. Further liaison with the Proponent has generally addressed ARTC's concerns. The Department is satisfied that conditions could be imposed to require the Proponent to ameliorate any structural impacts on ARTC's infrastructure arising from the operation of the Project.

Furthermore, the Proponent notes that management of groundwater impacts could be achieved through altering the opening of the floodgates. The Proponent notes that future decisions regarding the management of the floodgates will need to take into consideration both surface water and groundwater hydraulic processes.

An existing residential bore exists within the vicinity of the swamp. Whilst initial monitoring suggests that the Project will not impact upon this bore, the Department considers there should be a specific condition within any approval which highlights that the proposal must not result in the deterioration of water quality for that bore. Periodic monitoring will also be required to ensure compliance with this condition.

Erosion and Sedimentation

The Proponent notes the potential for an increase in the rate of erosion of the banks of Ironbark, Fishery and Shelley Creeks as a result of the increased tidal velocities from the reopening of the floodgates. The Proponent, however, considers this effect will be short-term in nature as the re-establishment of vegetation such as mangroves will improve the stability of the banks. Nevertheless, the Proponent states that it will continue to monitor the effect of the Project on bank stability and where necessary, implement formal bank stabilisation works or undertake active re-planting along un-vegetated banks. Following some initial concern, Newcastle City Council has indicated that it is generally satisfied with this approach. The Department also considers this approach to be satisfactory and recommends that a condition be included that requires the Proponent to implement an erosion and sediment monitoring programme.

To address potential erosion and sedimentation impacts arising from the construction of the bunds and minor filling work undertaken on private property, the Department recommends the Proponent prepare and implement an erosion and sediment control plan.

The Department is satisfied that measures proposed within the EA and the recommended conditions of approval will satisfactorily address any potential erosion and sedimentation issues arising from the Project.

Indigenous Heritage

The EA indicated that there was no archaeological material within the wetland area. However, there could be some on the margins of the Swamp. A stone artefact was found in the vicinity of the proposed Marsden Street bund. The bund would destroy the site. The potential for intact subsurface occupation evidence is low given past land uses and disturbance. The Awabakal LALC is supportive of the project, and supports the bund construction, subject to use of clean fill and receipt of approvals. The recommended conditions require the use of clean fill. Note that Part 3A approvals override the need to obtain approvals under the National Parks and Wildlife Act.

6 CONCLUSION

The Department considers that the proposed staged reopening of the floodgates at Ironbark Creek will have considerable environmental, economical and social benefits at a local and more regional level as the proposal has the potential to improve habitat diversity, water quality and increase species abundance and diversity within the swamp and local area.

Whilst the proposal has the potential to alter the mosquito population within the Lower Hunter region, the Department is satisfied that suitable management and mitigation measures could be imposed such that the impact on human health and comfort levels can be minimised.

Should the Minister determine to approve the Project, the Department considers that any conditions of approval should focus upon requiring the Proponent to undertake extensive monitoring of a range of parameters in order to determine the effect that tidal inundation is having on Hexham Swamp and whether or not this has been a success in terms of restoring Hexham Swamp, a key objective of this Project.

It is important, however, that any monitoring that is done as part of any approval for the Project, predictions about what is likely to happen are made *a priori*. This will ensure that the monitoring programmes are focused and are capable of actually testing hypotheses rather than just being a means by which to collect data. This position is reflected in the Department's recommended conditions of approval. From this, the Proponent will be able to implement any necessary mitigative works to address unforseen or adverse impacts.

The Department supports the staged approach to the opening of floodgates and recommends that prior to opening more than one floodgate, the Proponent be required to provide a report to the Director-General demonstrating that the Project is meeting its objectives and is consistent with broader management policies for the site. This is reflected in the recommended conditions of approval.

The Department considers that the recommended conditions of approval provide a rigorous and strict framework for the management, monitoring and reporting on the construction and operation of the site. This includes requirements for the management of traffic, flooding, stormwater, effluent, groundwater, acid sulphate soils, noise, disease and odour and for the undertaking of independent environmental auditing.

Based on this evaluation, it is considered that the merits of the proposal warrant the granting of approval, subject to the recommended conditions of approval.

7 RECOMMENDATION

It is recommended that the Minister approve the Project subject to the recommended conditions of approval provided in APPENDIX A.

APPENDIX A. CONDITIONS OF APPROVAL

SCHEDULE 1

Major Project No:	05_0193
Proponent:	Minister for Natural Resources
Approval Authority:	Minister for Planning
Land:	See Appendix 1
Project:	Hexham Swamp Rehabilitation Project
Major Project:	The proposal is classified as a Major Project under section 75B(2)(b) of the *Environmental Planning and Assessment Act 1979*

SCHEDULE 2

In this approval, except in so far as the context or subject-matter otherwise indicates or requires, the following terms have the meanings indicated:

Act	*Environmental Planning and Assessment Act 1979*
AEMR	Annual Environmental Management Report
Ancillary Facility	temporary construction facility, for example, an office and amenities compound, batch plant (concrete or bitumen), materials storage compound
construction	includes all work in respect of the Project **other than** survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing site compounds (in locations meeting the criteria of the conditions), or other activities determined by the Director-General to have minimal environmental impact (e.g. minor access roads, minor adjustments to services/utilities, etc.)
Council	Newcastle City Council
Committee	the Committee as described in condition 46
DEC	NSW Department of Environment and Conservation (incorporating the Environment Protection Authority and National Parks and Wildlife Service)
Department	NSW Department of Planning
Director-General	Director-General of the NSW Department of Planning, or delegate
dust	any solid material that may become suspended in air
EA	Environmental Assessment for the Hexham Swamp Rehabilitation Project prepared by WBM Oceanics Australia, as described in the documents listed under condition 1 (a) of this approval
Minister	NSW Minister for Planning, or delegate
operation	any activity that results in the manipulation, or intended manipulation, by opening or closing, of one or more floodgates at the mouth of Ironbark Creek.
Project	the Project to which this approval applies, the scope of which is described in the documents listed under condition 1 of this approval
Regulation	*Environmental Planning and Assessment Regulation 2000*
RTA	NSW Roads and Traffic Authority
Proponent	NSW Minister for Natural Resources
publicly available	available for public inspection by a member of the general public for example, by publishing on an internet site or at a display centre

site	the land to which this approval applies
utility	any infrastructure or service associated with water supply, sewerage, electricity supply, telecommunications or gas supply

GENERAL

Scope of Project

1. The Proponent must carry out the Project generally in accordance with:
   (a) the Environmental Assessment (EA) for the Project comprising:
      (i) *Environmental Assessment Supplement Hexham Swamp Rehabilitation Project*, prepared by WBM Oceanics Australia and dated April 2006;
      (ii) *Environmental Impact Statement Hexham Swamp Rehabilitation Project: Volumes 1 and 2*, prepared by WBM Oceanics Australia and dated August 2005;
   (b) the Submissions Report prepared by the Hunter-Central Rivers Catchment Management Authority and dated 24 August 2006;
   (c) the e-mail to the Department dated 18 October 2006 and letter to the Department dated 1 November 2006 from Hunter-Central Rivers Catchment Management Authority in relation to altering the timing of mitigative works; and
   (d) the conditions of this approval.

2. In the event of an inconsistency between:
   (a) the conditions of this approval and the documents listed under 1 (a) to 1 (c), the conditions of this approval shall prevail to the extent of the inconsistency; and
   (b) any document listed under condition 1 (a) to 1 (c), the most recent document shall prevail to the extent of the inconsistency.

Staging of Works

3. Prior to the commencement of operation of each stage of the Project (that is, the staged opening of the floodgates as generally described in section 2.4 of the document listed under condition 1 (a) (ii)), the Proponent must submit for the approval of the Director-General, a report concerning the performance and compliance of the previous stage(s) and in particular, whether the changes to the site and its surrounds are occurring as predicted in the EA and monitoring program (refer condition 40). Each report must address, but not necessarily be limited to:
   (a) an assessment of the Project's performance and compliance with the conditions of this approval, having regard to the reporting requirements of the Annual Environmental Management Report(s) (refer to condition 56 of this approval);
   (b) details of the Project's consistency with the objectives of the Kooragang Nature Reserve and Hexham Swamp Nature Reserve Plan of Management and any estuary management plan for the Hunter River;
   (c) an assessment of the implementation and compliance with the environmental management plans required under this approval;
   (d) an assessment of the Project's compliance with all other relevant licences, permits or approvals; and
   (e) results of consultation with the Committee established under condition 46 in relation to the matters listed under parts (a) to (d), inclusive.

   The Director-General may require the Proponent to address certain matters in relation to the environmental performance of the Project in response to the review of the report and any comments received from relevant government agencies. Any action required to be undertaken must be completed within such period as the Director-General may agree.

   The Proponent must not commence operation of the relevant stage of the Project until it has received the Director-General's written approval of the report and/ or any remedial action measures taken (or to be taken).

Provision of Documents

4. Where practicable, the Proponent must provide all documents and reports required to be submitted to the Director-General under this approval in an appropriate electronic format. Provision of documents and reports to other parties, as required under this approval, must be in a format acceptable to those parties and must aim to minimise resource consumption.

5. Nothing in this approval prevents the Proponent from combining reporting requirements under this approval with identical or similar reporting requirements for submission to another relevant party. Reporting requirements must only be combined with the prior agreement of the Director-General of the Department of Planning and the Director-General (or equivalent) of the other relevant party.

COMPLIANCE

6. The Proponent is responsible for the works the subject of this approval and the environmental impacts that result from those works.

7. The Proponent must put in place an environmental management system governing the conduct of all persons on the site, including contractors, subcontractors and visitors.

8. At least two weeks prior to the commencement of each of construction and operation of the Project, or within such period otherwise agreed by the Director-General, the Proponent must submit a report certifying, to the satisfaction of the Director-General, that it has complied with all applicable conditions of this approval prior to that event and must include the following:
   (a) details of how the conditions of approval required to be addressed before construction or operation were complied with;
   (b) the time when each relevant condition of approval was complied with, including dates of submission of any required reports and/or approval dates; and
   (c) details of any approvals or licences required to be issued by a government agency before construction or operation commences.

   Where either construction or operation is to be undertaken in stages, the Proponent may, subject to the agreement of the Director-General, stage the submission of certification consistent with the staging of activities relating to that event.

9. Notwithstanding condition 8 of this approval, the Director-General may require an update report on compliance with all, or any part, of the conditions of this approval. Any such update must meet the requirements of the Director-General and be submitted within such period as the Director-General may require.

10. The Proponent must meet the requirements of the Director-General in respect of the implementation of any measure necessary to ensure compliance with the conditions of this approval, and general consistency with the documents listed under condition 1 of this approval. The Director-General may direct that such a measure be implemented in response to the information contained within any report, plan, correspondence or other document submitted in accordance with the conditions of this approval, within such time as the Director-General may require.

ENVIRONMENTAL PERFORMANCE

Water Quality

Flood Impacts

11. Prior to the commencement of operation of the Project, the Proponent must establish and implement a programme outlining the care, control and maintenance procedures for the floodgates at Ironbark Creek and the roles and responsibilities of relevant parties in relation to this. The programme must be prepared having regard to the requirements of the Department of Natural Resources *Lower Hunter River Flood Procedures Manual* (2000), or its latest edition. A copy of the programme is to be provided to the Director-General and made publicly available.

12. The Project must not result in a significant change to the direction, velocity, volume or flow of floodwaters over that which existed immediately prior to the commencement of construction of the Project to ensure that the risk of flooding to urban areas is not increased.

Tidal Inundation Impacts

13. Prior to the commencement of operation of the Project, the Proponent must undertake the following works in order to mitigate the effects of saline intrusion on private property:
    (a) construction of the Marsden Street bund as described in section 2.5.1 of the document listed under condition 1 (a) (ii);
    (b) installation of one-way tidal flapgates at Ironbark Creek, Dark Creek and The Wetlands Centre as described in section 2.5.10 of the document listed under condition 1 (a) (ii); and
    (c) construction of the BAL bund as described in section 2.5.2 of the document listed under condition 1 (a) (ii)

14. The Proponent must design, construct, operate and maintain the Project to ensure that as a direct result of the Project, access is not restricted on
    (a) the existing access track within The Wetlands Centre which lies adjacent to Canoe Channel and includes part of a TransGrid access track (located on Lot 5 DP 233520, Lot 2 DP 1043133 and Lot 1 DP 1069498);
    (b) the existing maintenance track for the Chichester Water Main Pipeline;
    (c) the existing access track servicing the Main Northern Rail Line; and
    (d) the existing access track servicing TransGrid powerlines adjacent to Ironbark Creek.

15. The Proponent must design, construct, operate and maintain the Project to prevent the intrusion of saline tidal waters onto private lands located on the western side of the abandoned Richmond-Pelaw railway line embankment.

16. The Proponent must design, construct, operate and maintain the Project to ensure that it does not result in a reduction in water quality or increase in salinity within the 2HD pond (located on Lot 200 DP 867471) from that which exists immediately prior to the commencement of construction of the Project.

    In the event that modelling and monitoring required under this approval indicates a credible risk to the hydrology and/ or water quality of the 2HD pond such that the pond's habitat and breeding values for the Green and Golden Bell Frog may be adversely affected, the Proponent must install one-way flapgates within the channel which drains from the 2HD pond to Hexham Swamp, or another method as agreed by the Director-General, to ensure that saline intrusion does not occur.

17. The Proponent must design, construct, operate and maintain the Project to protect the Wallsair airstrip (Lot 102 DP 606506) from impacts from elevated groundwater levels, including degradation of the airstrip surface.

18. In order to mitigate the effects of saline intrusion on private property, the Proponent may also undertake minor filling of Lot 20 DP 16703, Lots A & B DP 350274 and Lot 28 DP 864756 as described in sections 2.5.8 and 2.5.9 of the document listed under condition 1 (a) (ii).

Groundwater

19. The Proponent must modify the operation of the floodgates if Newcastle City Council's groundwater monitoring programme indicates the movement of contaminants in groundwater from the former Astra Street landfill site as a result of inundation and associated increase in groundwater level. Floodgate

operation must be modified so that contaminant movement is not exacerbated and to allow Newcastle City Council to conduct appropriate remedial works.

20. Within two months after the installation of any bores required under this approval, the Proponent must submit a plan to the Newcastle office of the Department of Natural Resources identifying the location of the bores.

21. All drilling and bore construction required under this approval must be undertaken by a person(s) with a relevant New South Wales class licence.

22. The Proponent must design, construct, operate and maintain the Project to ensure that it does not result in a reduction in the water quality for licensed bore 20BL 135899 from that which exists immediately prior to the commencement of construction of the Project.

Soil Quality

23. All bund walls permitted under this approval must be constructed using Virgin Excavated Natural Material (VENM).

24. All bund walls constructed under this approval are to be suitably landscaped to avoid erosion for the life of the Project. Such landscaping must be in accordance with the approved erosion and sediment control plan, as required under condition 52 (a).

25. Bunds walls must be constructed such that where detailed design identifies that one side is required to be steeper than the other, that steeper side must be located on the guy-anchor block side (that is, not on the creek side).

Acid Sulphate Soils

26. Prior to the commencement of any works that will disturb the soils/ sediments on site, the Proponent must undertake acid sulphate soil (ASS) testing at those areas of the site. ASS testing shall be consistent with the NSW State Government's *Acid Sulfate Soils Manual* (ASSMAC 1998).

27. Should testing indicate that any acid sulphate soils (potential or actual) may be disturbed, the Proponent must prepare and implement an **Acid Sulphate Soils (ASS) Management Plan**. This Plan must detail measures to be implemented in relation to the management and handling of any acid sulphate soils identified as a result of the tests required as part of the above condition. The Plan must be prepared in accordance with the NSW State Government's *Acid Sulfate Soils Manual* (ASSMAC 1998).

Flora and Fauna

28. The Proponent must design, construct, operate and maintain the Project to ensure that it does not adversely affect any Green and Golden Bell Frog populations or habitats within and in areas adjacent to the Project site, notably the 2HD ponds.

29. The Proponent must undertake the Project in a manner that minimises or prevents the spread of noxious weeds, particularly alligator weed, water hyacinth and pampas grass.

Health

30. Any controlled grazing of the site must be consistent with the Hexham Swamp Rehabilitation Project Environmental Management System for the site, and must aim to minimise the potential for grazing to create mosquito breeding opportunities.

31. The Proponent must undertake the Project in a manner that minimises the impact on human health and comfort levels brought about by changes to the mosquito population arising from the operation of the Project.

32. The Proponent must prepare and implement a Mosquito Management Plan throughout the life of the Project, including a monitoring programme, having regard to the plan and monitoring programme described in the EA.

Air Quality

Odour

33. The Proponent must not cause or permit the emission of offensive odours beyond the boundary of the site. For the purposes of this condition, "offensive odour" has the same meaning as defined under section 129 of the *Protection of the Environment Operations Act 1997*.

Dust

34. The Proponent must undertake the Project in a manner that minimises or prevents the emission of dust from the site, including wind-blown and traffic-generated dust, including ensuring that all vehicles entering or leaving the site and carrying a load that may generate dust emissions, are covered at all times, except during loading and unloading.

Noise

35. Construction activities associated with the Project, including the arrival and departure of vehicles delivering or removing materials from the site, must only be carried out between the hours of:
    (a) 0700 and 1800, Monday to Friday;
    (b) 0800 and 1300 on Saturdays; and
    (c) at no time on a Sunday or public holiday,
    or as otherwise approved in writing by the Director-General.

36. All construction works undertaken on site must be undertaken in accordance with the EPA's *Environmental Noise Control Manual* and must not give rise to an 'offensive noise' as defined under the *Protection of the Environment Operations Act 1997* and accompanying Regulations.

37. The Proponent must minimise noise emissions from plant and equipment operated on the site in relation to the Project by installing and maintaining, wherever practicable, efficient silencers, low-noise mufflers (residential standard) and replacement of reversing alarms on vehicles with alternative silent measures, such as flashing lights.

Traffic and Transport

38. The Proponent must undertake all works affecting any public road, its associated road reserve and any public infrastructure in that road reserve, to meet any reasonable requirements that may be specified by Council.

Waste Generation and Management

39. All wastes generated on site as a result of the Project must be classified in accordance with the EPA's publication *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* and disposed of to a facility that may lawfully accept the waste.

ENVIRONMENTAL MONITORING

40. Prior to the commencement of operation of the Project, the Proponent must prepare and implement an **Environmental Monitoring Programme** to monitor and assess the impact of the Project on the surrounding environment, including but not limited to impacts on: wetland hydraulics; water quality; groundwater; aquatic fauna, including macrobenthos and fish; vegetation; birds and amphibians. The Programme must be prepared in consultation with the Committee (refer condition 46) and having regard to the monitoring programme identified in the document listed under condition 1 (a). The Programme must include, but not necessarily be limited to:

(a) identification of predictions relating to each issue about what changes will occur to the site and its surrounds as a result of the operation of each stage of the Project;
(b) details of a pilot study, where relevant, to enable the preparation of a focussed monitoring programme;
(c) locations at which monitoring will be undertaken, including a map showing locations. As a minimum, monitoring locations must include sites on either side of the floodgates and where relevant, control and reference sites;
(d) identification of the parameters/ pollutants to be monitored at each location;
(e) procedures and protocols for the sampling and analysis methodology to be undertaken for the monitoring, including sample design, statistical analyses and reporting. Procedures must be consistent with any relevant government publication and/ or Australian Standard;
(f) a programme for periodic monitoring of the parameters/ pollutants at each of the monitoring locations. As a minimum, monitoring must occur on at least one occasion prior to the commencement of operation of each stage of the Project; and
(g) identification of the parameters for each issue that would determine whether the restoration of Hexham Swamp has been a success and/ or has reached the required outcome.

The Monitoring Programme must be submitted for the approval of the Director-General at least two months prior to the commencement of operation of the Project, or as otherwise agreed by the Director-General.

Note: The Monitoring Programme must be capable of testing *a priori* predictions about what will occur at Hexham Swamp and its surrounds as a result of opening the floodgates at Ironbark Creek. The Programme must also be capable of determining whether the restoration of Hexham Swamp, as a result of opening the floodgates, has been a success and/ or has reached the required outcome, for example, the Swamp is similar to other reference sites.

UTILITIES AND PUBLIC WORKS

41. The Proponent must identify (including, but not limited to the position and level of service) all public utility services on the site and roadway, nature strip, footpath, public reserve or any public areas that are associated with, and/or adjacent to the site, and/or are likely to be affected by any activity associated with the Project.

42. The Proponent must consult with the relevant provider of the utilities identified in condition 41 and make arrangements to adjust and/or relocate their services as required. The cost of any such adjustment and/or relocation of services must be borne by the Proponent.

43. Any damage caused to public infrastructure as a result of the Project must be repaired to the satisfaction of Council or relevant utility provider and within such period as specified by the Council or relevant utility provider.

44. The sites for Ancillary Facilities must satisfy the following criteria unless otherwise approved through the Environmental Management Plan (EMP) required under condition 51:

(a) be located within the Project site;
(b) have ready access to the road network;
(c) be located to minimise the need for heavy vehicles to travel through residential areas;
(d) be sited on relatively level land;
(e) not require vegetation clearing beyond that already required for the Project; and
(f) not affect the land use of adjacent properties.

The location of the Ancillary Facilities must be identified in the EMP and must include an analysis against the above criteria. Where these criteria cannot be met the EMP must demonstrate there will be no adverse impacts from the Ancillary Facility's construction or operation.

COMMUNITY INFORMATION, CONSULTATION AND INVOLVEMENT

45. Subject to confidentiality, the Proponent must make all documents required under this approval publicly available on request.

Community Consultative Committee

46. The Proponent must continue operation of its Community Consultative Committee (currently referred to as the Hexham Swamp Project Committee) to oversee the environmental performance of the Project. The Committee must:
    (a) be comprised of at least those representatives currently sitting on the Committee, or as otherwise agreed with the Director-General;
    (b) be chaired by a chairperson, whose appointment has been approved by the Director-General;
    (c) meet at least twice a year;
    (d) review the Proponent's performance with respect to environmental management and community relations;
    (e) undertake regular inspections of the site; and
    (f) review community concerns or complaints about the Project with respect to environmental management and community relations.

Note: The Committee is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Proponent complies within this approval. At the date of this approval, the Committee is currently represented by members of the community, Department of Primary Industries (Fisheries), Department of Natural Resources, DEC, Commonwealth Department of the Environment and Heritage, Newcastle City Council, Hunter Water Corporation, Hunter Central Rivers Catchment Management Authority, Landcare, commercial fisherman, Kooragang Wetlands Rehabilitation Project and the Port Stephens and Wallsend Members of State Parliament.

47. The Proponent must, at its own expense:
    (a) ensure that at least one of its representatives attend the Committee meetings;
    (b) provide the Committee with regular information on the environmental performance and management of the Project;
    (c) provide meeting facilities for the Committee, if necessary;
    (d) arrange site inspections for the Committee, if necessary;
    (e) take minutes of the Committee meetings;
    (f) make these minutes publicly available;
    (g) respond to any advice or recommendations the Committee may have in relation to the environmental management or community relations; and
    (h) provide a copy of the minutes of each Committee meeting, including a response to any recommendations from the Committee, to the Director-General within one month of the meeting being held.

Complaints Procedure

48. Prior to the commencement of any physical works associated with the Project, the Proponent must ensure that the following are available for community complaints:
    (a) a 24-hour telephone number on which complaints about the Project may be registered;
    (b) a postal address to which written complaints may be sent; and

(c) an email address to which electronic complaints may be transmitted.

The telephone number, postal address and e-mail address must be advertised in a newspaper circulating in the locality on at least one occasion prior to the commencement of each stage of the Project. These details must also be provided on the Proponent's internet site. The telephone number, postal address and email address must be maintained throughout the life of the Project.

49. The Proponent must record details of all complaints received through the means listed under condition 48 of this approval in an up-to-date Complaints Register. The Register must record, but not necessarily be limited to:
    (a) the date and time, where relevant, of the complaint;
    (b) the means by which the complaint was made (eg. telephone, mail or email);
    (c) any personal details of the complainant that were provided, or if no details were provided, a note to that effect;
    (d) the nature of the complaint;
    (e) any action(s) taken by the Proponent in relation to the complaint, including any follow-up contact with the complainant;
    (f) the date and time any action was taken in response to the complaint; and
    (g) if no action was taken by the Proponent in relation to the complaint, the reason(s) why no action was taken.

    The Complaints Register must be made available for inspection by the Director-General upon request.

ENVIRONMENTAL MANAGEMENT

Environmental Representative

50. Prior to the commencement of construction of the Project, the Proponent must nominate a suitably qualified and experienced Environmental Representative(s) whose appointment is to receive prior approval of the Director-General. The Proponent must employ the Environmental Representative(s) throughout the life of the Project. The Environmental Representative must be:
    (a) the primary contact point in relation to the environmental performance of the Project;
    (b) responsible for preparing, implementing and updating all Management Plans and Monitoring Programmes required under this approval;
    (c) responsible for considering and advising on matters specified in the conditions of this approval, and all other licences and approvals related to the environmental performance and impacts of the Project;
    (d) responsible for receiving and responding to complaints in accordance with condition 48 of this approval; and
    (e) given the authority and independence to require reasonable steps to be taken to avoid or minimise unintended or adverse environmental impacts, and failing the effectiveness of such steps, to recommend to the Director-General that relevant actions be ceased should an adverse impact on the environment be likely to occur.

    The Proponent must notify and seek the approval of the Director-General of any changes to that appointment that may occur from time to time.

Environmental Management Plan (EMP)

51. The Proponent must prepare and implement an **Environmental Management Plan** to outline environmental management practices and procedures to be followed throughout the life of the Project. The Plan must be prepared in accordance with the Department's publication *Guideline for the Preparation of Environmental Management Plans 2004*, or its latest revision and having regard to the Hexham Swamp Plan of Management identified in Appendix L of the EA.

The EMP must be submitted for the approval of the Director-General no later than one month prior to the commencement of any works the subject of this approval, or within such period as otherwise agreed by the Director-General. Notwithstanding, where any work is to be undertaken in stages, the Proponent may, subject to the agreement of the Director-General, stage the submission of the EMP consistent with the staging of activities relating to that work.

No work associated with this approval may commence until written approval has been received from the Director-General. Upon receipt of the Director-General's approval, the Proponent must make the Plan publicly available as soon as practicable.

52. As part of the EMP for the Project, required under condition 51 of this approval, the Proponent must include, but not be limited to the following Sub-Management Plans:

(a) an **Erosion and Sedimentation Control Management Plan** to detail measures to minimise erosion and the discharge of sediment and other pollutants to land and/ or water during works associated with the Project. The Plan must include, but not necessarily be limited to:

(i) demonstration of best practice methods to be applied for the on-site control of run-off, sediments and other pollutants including specification of performance criteria for erosion, sediment and pollution control devices, including diversionary works, discharge points etc;

(ii) demonstration that erosion and sediment control measures will conform with, or exceed, the relevant requirements and guidelines provided in Landcom's publication *Managing Urban Stormwater: Soils and Construction* (2004);

(iii) description of procedures to ensure that the measures implemented to control sediment and erosion on site are maintained in working order at all times;

(iv) description of landscaping and other measures to be used to stabilise the bunds; and

(v) details of an erosion monitoring programme throughout the life of the Project, particularly in relation to the creek banks, including measures to address erosion, should it occur, and to rehabilitate/ stabilise disturbed areas of the site;

(b) a **Noise Management Plan** to detail measures to minimise noise emissions associated with the construction of the Project. The Plan must include, but not necessarily be limited to:

(i) identification of all major sources of noise that may be emitted as a result of the construction of the Project;

(ii) specification of the noise criteria as it applies to a particular activity;

(iii) identification and implementation of best practice management techniques for minimisation of noise emissions;

(iv) procedures for the monitoring of noise emissions; and

(v) description of the procedures to be undertaken if any non-compliance is detected;

(c) a **Traffic Management Plan** to outline measures to minimise potential conflicts between different user groups arising as a result of the Project. The Plan must be prepared in consultation with the RTA and Council and must include, but not necessarily be limited to:

(i) details of traffic routes to be used by heavy vehicles associated with the Project;

(ii) procedures for informing the public where any road access will be restricted as a result of the Project;

(iii) minimum requirements for vehicle maintenance to address noise and exhaust emissions, particularly along roads in close proximity to residences;

(iv) speed limits to be observed along routes to and from the site and within the site; and

(v) details of the expected behavioural requirements for vehicles drivers travelling to and from the site and within the site.

53. The Proponent must undertake an annual review of the Environmental Management Plan (EMP), having regard to the outcomes of the AEMR required under condition 56. The review must ensure that the EMP is up-to-date and all changes to procedures and practices since the previous review have been fully incorporated into the EMP. The Proponent must notify the Director-General of the completion of each review, and must supply a copy of the updated EMP to the Director-General on request.

ENVIRONMENTAL REPORTING

Incident Reporting

54. The Proponent must notify the Director-General and any relevant Government authority of any incident with actual or potential significant off-site impacts on people or the biophysical environment within twenty-four hours after the occurrence of the incident ("initial notification"). The Proponent must provide written details ("written report") of the incident to the Director-General and any relevant Government authority within seven days of the date on which the incident occurred.

55. The Proponent must 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 54 of this approval, within such period as the Director-General may require.

Annual Reporting

56. The Proponent must, throughout the life of the Project, prepare and submit for the approval of the Director-General, an **Annual Environmental Management Report** (AEMR). The AEMR must review the performance of the Project against the Environmental Management Plan (refer to condition 51 of this approval), the conditions of this approval and any other licences and approvals relating to the Project. The AEMR must include, but not necessarily be limited to:
    (a) details of compliance with the conditions of this Project;
    (b) results of all environmental monitoring required under this approval, including interpretations and discussion of these results;
    (c) a comparison of the environmental impacts and performance of the Project against the environmental impacts and performance predicted in the EA and as modified by the conditions of this approval;
    (d) a list of all occasions in the preceding twelve-month period when environmental performance goals for the Project have not been achieved, indicating the reason for failure to meet the goals and the action taken to prevent recurrence of that type of incident;
    (e) identification of trends in monitoring data over the life of the Project to date;
    (f) a copy of the Complaints Register (refer to condition 49 of this approval) for the preceding twelve-month period (exclusive of personal details), and details of how these complaints were addressed and resolved;
    (g) a list of variations obtained to approvals applicable to the Project and to the site during the preceding twelve-month period; and;
    (h) environmental management targets and strategies for the following twelve-month period, taking into account identified trends in monitoring results.

57. The Proponent must submit a copy of the AEMR to the Director-General, DEC and Committee every year, with:
    (a) the first AEMR to be submitted not more than fourteen months from commencement of operation of the Project;
    (b) the second and subsequent AEMRs to be submitted every twelve months thereafter; and
    (c) must be made publicly available upon request.

Appendix 1 – Land Description

#	Title Details	Street Address	Interest to be Acquired for Project
1	Lot 1 DP 90465	Hexham Swamp Nature Reserve	
2	Lot 129 DP 725084	Hexham Swamp Nature Reserve	
3	Lot 322 DP 592513	107 Marsden St, Shortland, 2307	Easement in gross
4	Lot 1 DP 1048213	280 Minmi Road, Fletcher 2287	Easement for inundation
5	Lot 2 DP 1024376	282A Minmi Road, Fletcher 2287	Easement for inundation
6	Lot 74 DP 573628	29 Alister Street, Shortland 2307	Easement in gross
7	Lot 58 DP 755232	17 / 272 Maitland Road, Sandgate 2304	Freehold
8	Lot 59 DP 755232	16 / 272 Maitland Road, Sandgate 2304	Freehold
9	Lot 60 DP 755232	15 / 272 Maitland Road, Sandgate 2304	Freehold
10	Lot 94 DP 184589	4 / 272 Maitland Road, Sandgate 2304	Freehold
11	Lot 127 DP 755232	5 / 272 Maitland Road, Sandgate 2304	Freehold
12	Lot 68 DP 755232	7 / 272 Maitland Road, Sandgate 2304	Freehold
13	Lot 67 DP 755232	8 / 272 Maitland Road, Sandgate 2304	Freehold and easement
14	Lot 66 DP 755232	9 / 272 Maitland Road, Sandgate 2304	Freehold and easement
15	Lot 71 DP 755232	10 / 272 Maitland Road, Sandgate 2304	Freehold
16	Lot 64 DP 755232	11 / 272 Maitland Road, Sandgate 2304	Freehold
17	Lot 63 DP 755232	12 / 272 Maitland Road, Sandgate 2304	Freehold
18	Lot 62 DP 755232	13 / 272 Maitland Road, Sandgate 2304	Freehold
19	Lot 61 DP 755232	14 / 272 Maitland Road, Sandgate 2304	Freehold
20	Lot 1 DP 41394	6 / 272 Maitland Road, Sandgate 2304	Freehold and easement
21	Lot 95 DP 184589	3 / 272 Maitland Road, Sandgate 2304	Freehold and easement
22	Lot 96 DP 184589	2 / 272 Maitland Road, Sandgate 2304	Freehold and easement
23	Lot 97 DP 184589	1 / 272 Maitland Road, Sandgate 2304	Freehold and easement
24	Lot 28 DP 16703	202 Marsden Street, Shortland 2307	Easement in gross
25	Lot 20 DP 16703	172 Marsden Street Shortland 2307	Easement in gross
26	Lot 23 DP 16703	184 Marsden Street Shortland 2307	Easement in gross
27	Lot 11 DP 1044935	290 – 290B Minmi Rd, Maryland 2287	Easement for inundation
28	Lot 25 DP 659461	190 Marsden Street Shortland 2307	Easement in gross
29	Lot 441 DP 524581	49 Milne Street Shortland 2307	Easement in gross
30	Lot 1 DP 500143	55 Marsden Road Shortland 2307	Easement in gross
31	Lot 2 DP 874409	31 Sparke Street Hexham 2322	Easement in gross
32	Lot 3 DP 874409	21 Sparke Street Hexham 2322	Easement in gross
33	Lot 27 DP 16703	198 Marsden Street Shortland 2307	Easement in gross
34	Lot 1 DP 529512	186 Marsden Street Shortland 2307	Easement in gross
35	Lot 2 DP 529512	188 Marsden Road Shortland 2307	Easement in gross
36	Lot 2 DP 1048213	2/155 King Street, Shortland 2307	Freehold
37	Lot 10 DP 1044935	290B Minmi Road, Fletcher 2287	Freehold
38	Lot 5 DP 199322	1 / 8 Railway St, Hexham 2322	Freehold

#	Title Details	Street Address	Interest to be Acquired for Project
39	Lot 4 DP 199322	2 / 8 Railway St, Hexham 2322	Freehold
40	Lot 3 DP 199322	3 / 8 Railway St, Hexham 2322	Freehold
41	Lot 2 DP 584500	4 / 8 Railway St, Hexham 2322	Freehold
42	Lot 2 DP 199322	5 / 8 Railway St, Hexham 2322	Freehold
43	Lot 1 DP 199322	6 / 8 Railway St, Hexham 2322	Freehold
44	Lot 1 DP 742036	1 / 14 Railway St, Hexham 2322	Freehold
45	Lot 2 DP 742036	2 / 14 Railway St, Hexham 2322	Freehold
46	Lot 302 DP 1023342	1 / 55 King Street, Shortland 2307	Freehold
47	Lot 21 DP 1024373	288B Minmi Rd Fletcher 2287	Freehold
48	Lot 455 DP 998893	288C Minmi Road, Fletcher 2287	Freehold
49	Lot 21 DP 836450	284A Minmi Rd Fletcher 2287	Freehold
50	Lot 12 DP 1037030	99 Hardes Av, Maryland 2287	Freehold
51	Lot 1 DP 611441	83 King St, Shortland 2307	Consent to inundate
52	Lot 2 DP 611518	4 / 4A Anderson Drive, Tarro 2322	Consent to inundate
53	Lot A DP 339943	4 / 2 Aden Street Shortland 2307	Consent to inundate
54	Lot 1 DP 408005	5 / 2 Aden Street Shortland 2307	Consent to inundate
55	Lot 210 DP 832198	293 Maryland Drive, Maryland 2287	Consent to inundate
56	Lot B DP 339943	3 / 2 Aden Street Shortland 2307	Consent to inundate
57	Lot A DP 400052	2 / 2 Aden Street Shortland 2307	Consent to inundate
58	Lot 1 DP 805274	81 King St, Shortland 2307	Consent to inundate
59	Lot 2 DP 535220	1 / 2 Aden Street Shortland 2307	Consent to inundate
60	Lot 3 DP 171105	50A Sparke Street Hexham, 2322	Consent to inundate
61	Lot 4 DP 171105	50A Sparke Street Hexham, 2322	Consent to inundate
62	Lot 1 DP 163423	6 / 2 Aden Street Shortland 2307	Consent to inundate
63	Lot 2 DP 716666	111A Marsden Street Shortland 2307	Easement in gross
64	Lot B DP 350274	170 Marsden Street Shortland 2307	Easement in gross
65	Lot 45 DP 1064180	17 Hardes Avenue, Maryland 2287	Easement for inundation
66	Lot 262 DP 517002	196 Marsden Street Shortland 2307	Easement in gross
67	Lot 421 DP 998816	12 Railway St, Hexham 2322	Freehold / easement
68	Lot 1 DP 584500	10 Railway St, Hexham 2322	Freehold / easement
69	Lot 1 DP 874409	41 Sparke Street, Hexham 2322	Freehold / easement
70	Lot 1 DP 1065599	176A Marsden Street Shortland 2307	Easement for inundation
71	Lot 2 DP 1065599	176A Marsden Street Shortland 2307	Freehold
72	Lot 35 DP 663814	45 Marsden Street Shortland 2307	Easement in gross
73	Lot 24 DP 599877	14 Minmi Rd, Wallsend 2287	Consent to inundate
74	Lot 45 DP 218633	18 Coral Sea Av, Shortland 2307	Consent to inundate
75	Lot 54 DP 755232	2 / 2 Astra Street Shortland 2307	Consent to inundate
76	Lot B DP 340105	144 Sandgate Rd, Wallsend 2287	Consent to inundate
77	Lot 12 DP 246123	1 / 18 Coral Sea Av, Shortland 2307	Consent to inundate

#	Title Details	Street Address	Interest to be Acquired for Project
78	Lot 28 DP 253998	39 Alister St, Shortland 2307	Consent to inundate
79	Lot 107 DP 593379	156A Marsden Street, Shortland 2307	Consent to inundate
80	Lot 3 DP 1043133	Astra St, Shortland 2307	Consent to inundate
81	Lot 25 DP 599877	40 Creek Rd, Maryland 2287	Easement
82	Lot 302 DP 1063967	206A Marsden Street Shortland 2307	Easement in gross
83	Lot 29 DP 16703	204 Marsden Street Shortland 2307	Easement in gross
84	Lot A DP 350274	168 Marsden Street Shortland 2307	Easement in gross
85	Lot 1101 DP 570856	16 Old Maitland Road, Sandgate 2304	Easement in gross
86	Lot 325 DP 709247	83 Marsden Street Shortland 2307	Easement in gross
87	Lot 5 DP 233520	2 / 434 Sandgate Rd, Shortland 2307	Consent to inundate
88	Lot 2 DP 1043133	3 / 434 Sandgate Rd, Shortland 2307	Consent to inundate
89	Lot 1 DP 1069498	434 Sandgate Rd, Shortland 2307	Consent to inundate
90	Crown reservation around Ironbark Ck		Consent to inundate
91	Lot 7014 DP 1052281	6 Railway Street, Hexham 2322	Consent to inundate
92	Lot 51 DP 593732	142 Sandgate Rd, Birmingham Gardens 2287	Easement in gross
93	Lot 712 DP 1075020	31 Whistler Pde Maryland 2287	Easement in gross
94	Lot 1100 DP 570856	22 Old Maitland Road, Sandgate 2304	Easement in gross
95	Lot 99 DP 184589	22 Old Maitland Road, Sandgate 2304	Easement in gross
96	Lot 98 DP 184589	22 Old Maitland Road, Sandgate 2304	Easement in gross
97	Lot 200 DP 867471	10 Old Maitland Rd, Sandgate 2304	Easement in gross
98	Lot 62 DP 590003	57 Marsden St, Shortland 2307	Easement in gross
99	Lot 28 DP 864756	33 Hardes Avenue, Maryland 2287	Easement to inundate
100	Lot 1 DP 502669	105 Marsden Road Shortland 2307	Easement in gross
101	Lot 102 DP 606506	59 Creek Rd, Maryland 2287	Easement in gross
102	Conveyancing Book 319 No 833		Freehold
103	Pt 25 DP 755232		Freehold

APPENDIX B. AMENDMENTS TO THE PROPOSAL

Joanna Bakopanos - Implementation of Mitigative Works - Hexham Swamp Rehabilitation Project

From: "Brett Peterkin" <brett.peterkin@bigpond.com>
To: "Joanna Bakopanos" <Joanna.Bakopanos@planning.nsw.gov.au>
Date: 18/10/2006 5:39:30 pm
Subject: Implementation of Mitigative Works - Hexham Swamp Rehabilitation Project
CC: "Johnston, Jason" <Jason.Johnston@freehills.com>

Joanna

As per our telephone discussion please find attached advice from WBM with regards to altering the timing of the mitigative works for the Project.

The HCRCMA is requesting an alteration to the timing of the proposed works in the EIS. Should you require further information please contact me.

Regards

Brett Peterkin

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Our Ref: PEH: L.N0310.047

18 October, 2006

Hunter-Central Rivers Catchment Management Authority
Private Bag 2010
Paterson NSW 2421

Attention: Brett Peterkin,

Dear Brett,

RE: IMPLEMENTATION OF MITIGATIVE WORKS FOR HSRP

It is understood that, following detailed design and costings for proposed works associated with the Hexham Swamp Rehabilitation Project (HSRP), financial restrictions may inhibit the ideal order of completion and timing for some of the works.

A more detailed review of the requirements for the works has been carried out based on the expected levels and extents of inundation associated with the different stages of floodgate opening. Outlined below are the minimum requirements for the works.

Before 1 gate open

The predicted peak king tide level in Hexham Swamp with 1 gate open is 0.32 to 0.36m AHD. To mitigate inundation and associated impacts on private property, the following works will be necessary:

- Construction of Marsden Street bund (refer Section 2.5.1 of EIS document);
- Construction of BAL bund (refer Section 2.5.2 of EIS document);
- Minor fill on private properties at end of Marsden Street (refer Section 2.5.9 of EIS document);
- One way tidal flapgates, located at (refer Section 2.5.10 of EIS document):
  - Ironbark Creek, 2 gates on Council land / 2 gates on Crown land (refer Figure 1);
  - Dark Creek, 1 gate on Council land (refer Figure 2);
  - The Wetlands Centre, 2 gates adjacent to Ironbark Creek (refer Figure 3);

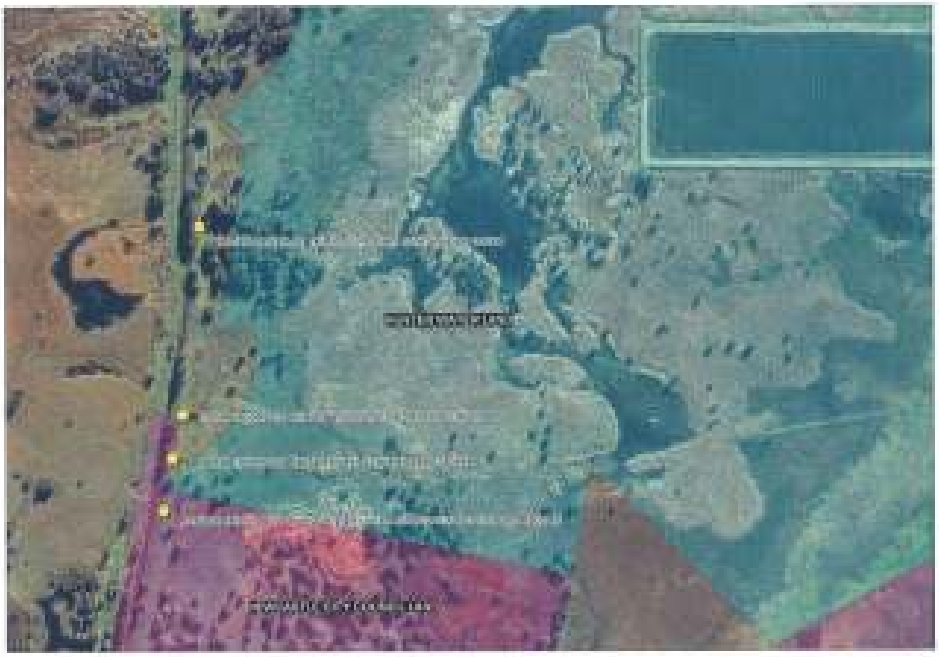

Figure 1 One-way flapgates required on Ironbark Creek

Figure 2 One way flapgate required on Dark Creek

Figure 3 One way flapgates required in The Wetland Centre

Before 2 gates open

The predicted peak king tide level in Hexham Swamp with 2 gate open is 0.40 to 0.50m AHD. To mitigate inundation and associated impacts on private property, the following works will be necessary:

- Track raising at selected locations within The Wetlands Centre (refer Section 2.5.6 of EIS document);

Before 4 gates open

The predicted peak king tide level in Hexham Swamp with 4 gate open is 0.47 to 0.64m AHD. No additional works would be required to mitigate inundation and associated impacts on private property.

Before 8 gates open

The predicted peak king tide level in Hexham Swamp with 8 gate open is 0.51 to 0.78m AHD. No additional works would be required to mitigate inundation and associated impacts on private property.

As necessary basis, subject to monitoring results

Monitoring of tidal levels and inundation extents will be carried out during the course of the project. On the basis of this monitoring, additional works may need to be carried out, if it is determined that tidal levels inundate private land / infrastructure, or are within a suitable threshold of inundating private land / infrastructure (0.1m say). These additional works include:

- Minor infill at Watts property, Hardes Avenue, Maryland (refer Section 2.5.9 of EIS document);
- Raising of Wallsend airstrip (refer Section 2.5.4 of the EIS document);

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- Raising of ARTC access track and turning bay adjacent to main northern rail line (refer Section 2.5.7 of EIS document);
- Raising of Transgrid access track adjacent to Transgrid transmission lines for areas outside The Wetlands Centre (refer Section 2.5.8 of EIS document);
- Raising of Hunter Water access track adjacent to Chichester pipeline (refer Section 2.5.6 of EIS document);
- Construction of bunds in front of culverts under the abandoned Richmond-Pelaw railway line (refer Section 2.5.3 of EIS document);
- Construction of one-way flapgate structure downstream of 2HD ponds (refer Section 2.5.10 of EIS document).

In addition, groundwater monitoring will be carried out adjacent to the Waliisair airstrip. If the monitoring shows that groundwater levels have increased at this site as a result of the Project, the airstrip will be raised as per Section 2.5.4 of the EIS document.

Further, the informal causeway on Muckeye Creek may be removed by the HCRCMA (refer Section 2.5.11 of EIS document) in an effort to locally increase inundation extents at any stage during the gate opening sequence (it is predicted that this causeway would inhibit tidal ingress along Muckeye Creek from the first gate open stage).

Yours faithfully
WBM Pty Ltd

Philip Haines
Associate
NSW Water and Environment Manager

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APPENDIX C. PROJECT OBJECTIVES

Table 1.1 Objective and Targets for HSRP

	Objective	Target
	Nature Conservation	
1	To increase habitat diversity by restoring estuarine habitats within the project area	➢ Estuarine Habitat diversity increased through increases in tidal inundation to a minimum of 600ha by 2010
2	Improve habitat for estuarine fauna (waterbirds, migratory birds) and aquatic fauna (fish, amphibians, crustaceans, and invertebrates)	➢ Increase biodiversity of estuarine and aquatic flora and fauna above baseline levels by 2010
3	Encourage the integration of the Hexham Swamp Rehabilitation Project into a regional protected natural area network	➢ Resolve the long-term management of the Hexham Project area in conjunction with the Kooragang Wetland Rehabilitation Project area, The Wetlands Centre and other areas
4	Control of weeds and pests	➢ Implementation of weed and feral animal control programs within two years of land acquisition ➢ Mosquito breeding monitored, in association with Kooragang Wetland Rehabilitation Project and Newcastle City Council, to measure the effect of increased tidal inundation on mosquito numbers

INTRODUCTION 1-4

	Objective	Target
5	Improve quality levels of water exported from Hexham Swamp	➢ Nutrients reduced from baseline levels ➢ Dissolved oxygen increased from baseline levels ➢ Pollutants, suspended solids, bio-chemical oxygen demand (BOD) and faecal coliform decreased from baseline levels
6	Increase flushing of small tributaries that have become stagnant and restore creek beds	➢ Creeks open to tidal flushing by 2010
7	Encourage research into the optimal management of the Swamp	➢ Develop a research and monitoring program
	Other Objectives	
8	To ensure that the floodgates close during Hunter River floods	➢ Floodgates managed to ensure Hunter River floods up to 1.8m AHD are excluded
9	Infrastructure access maintained in consultation with utilities	➢ Maintain access for the servicing of existing infrastructure
10	Enhance opportunities for passive recreation and nature appreciation	➢ Involve stakeholders, including the community, in the development of an access plan for recreational purposes
11	Encourage the use of Hexham Swamp for educational purposes	➢ Passive activities, such as canoe tours from The Wetlands Centre, maintained ➢ Open days, information days held at least three times per annum, at different venues around Hexham Swamp ➢ Identify and develop a plan for education opportunities, complimentary to the recreational access plan, that could be offered through existing organisations ➢ Managed education programs that build awareness of the HSRP objectives

Source: Table 1.1 of the EA