Managing Floodgates for Environmental and Flood Management Outcomes – the Hexham Swamp Rehabilitation Project

Dean Chapman¹, Amanda Hyde²

¹ Hunter-Central Rivers Catchment Management Authority, Private Bag 2010, Paterson NSW 2421, dean.chapman@cma.nsw.gov.au
² Hunter-Central Rivers Catchment Management Authority, Private Bag 2010, Paterson NSW 2421, amanda.hyde@cma.nsw.gov.au

ABSTRACT

The Hexham Swamp Rehabilitation Project involves the progressive opening of floodgates on Ironbark Creek to restore 750 hectares of estuarine wetland in the internationally recognised Hexham Swamp, near Newcastle in New South Wales. The first of eight floodgates was opened in December 2008 achieving a major milestone for the project that has seen 12 years of planning, research and stakeholder consultation. The project will reinstate tidal inundation while retaining flood protection for urban and rural properties in proximity to the wetland.

The floodgates were originally installed in the early 1970s as part of the Lower Hunter Flood Mitigation Scheme to stop floodwater from the Hunter River entering the swamp in minor flood events. However, the closed floodgates eliminated tidal inundation with the negative environmental impacts recognised almost immediately.

The rehabilitation project was initiated in response to the recommendation to actively manage the floodgates as identified in the Ironbark Creek Total Catchment Management Study in 1996. After 12 years and total costs of $7 million, the required land acquisition, bund construction and fauna and flora surveys were finalised and the opening of the first gate was approved in 2008. The remaining floodgates will be opened sequentially, with monitoring before and after each opening.

The project aims to improve the balance of environmental, economic and social outcomes. It will create a healthy estuarine wetland, provide educational and tourism opportunities, increase productivity of the fishing and prawning industries along the New South Wales coast, and at the same time maintain flood protection. This paper will detail the complicated process involved in gaining approval of the NSW Planning Department, the development of innovative “easements for inundation” and the results to date of ecological changes to the swamp.

INTRODUCTION

Hexham Swamp is located some 10 km from Newcastle CBD and consists of nearly 2,000 hectares of freshwater and estuarine wetlands that have become severely degraded from restricted tidal inundation since floodgates were constructed on Ironbark Creek in the early
Hexham Swamp is designated under State Environmental Planning Policy No 14 (SEPP 14), is located adjacent to a Ramsar listed wetland and is listed in the Directory of Important Wetlands in Australia. This paper will report on recent developments in managing the Ironbark Creek floodgates to restore estuarine wetland habitat while preserving flood mitigation function.

The Lower Hunter Valley Flood Mitigation Scheme

The Hunter-Central Rivers CMA, one of 13 CMAs in New South Wales, is unusual in that it is also a floodplain management authority – a role it inherited from its predecessor, the Hunter Catchment Management Trust. The Trust was established by the NSW Government in 1950, in response to regular Hunter River flooding and serious degradation of natural resources. The Hunter now has the largest integrated flood mitigation scheme on the coast of New South Wales, with 165 kilometres of levees, 120 kilometres of flood drains, 270 kilometres of protected riverbanks and 245 floodgate structures operated in partnership with the Department of Environment, Climate Change and Water (DECCW). In 2004 the Trust’s assets and functions were transferred to the CMA, which continues to coordinate both flood mitigation and natural resource management programs.

Among its many activities, the Trust had been working with stakeholders since the 1980’s to restore some of the Hunter’s estuarine wetlands lost due to 200 years of clearing, draining and filling for agriculture and development. In 1996 the Trust identified the need to reinstate tidal inundation to 750 hectares at Hexham Swamp.

Flooding in Hexham Swamp

Much of the Hexham Swamp catchment is subject to severe flooding – from rain falling within the immediate catchment, and also mainstream flooding from the Hunter River. To reduce the frequency of Hunter River flooding, and also to control saline intrusion, flood mitigation works were constructed in 1971 and 1972. These comprise a levee system to prevent Hunter River floods of up to about 1 in 10 year average recurrence interval from entering the swamp, and a floodgate structure consisting of eight 2.1 metre culverts with one-way steel flaps.

These flood mitigation works provide low lying rural areas with effective relief from moderate levels of riverine flooding. The main beneficiaries were graziers with land in and around the swamp. The adverse environmental impacts were recognised almost immediately however the benefits of improved agricultural production from cattle grazing were then considered to outweigh the estimated losses of estuarine habitat (DPW, 1972). To allow limited tidal exchange and reduce the impact on the swamp, one of the eight gates was left open 150 mm in non-flood times, (increased to 300mm from 2001 to 2008) - but the resulting tidal flow was minimal compared to pre-existing natural conditions.

Ecological Impacts of restricting tidal inundation

The changes in habitat as a result of reduced tidal inundation has had serious implications for the ecology of the Hunter estuary, with a dramatic decrease in saltmarsh by 99% and mangroves by 75%, (1954-2000) (Morrison, 2000) both of which are listed under the Threatened Species Conservation Act as endangered ecological communities (EEC). These EEC habitats supported a...
regionally important nursery for fish, prawns and other marine organisms. This nursery is of economic value as a significant contributor to the region’s commercial fishing industry.

Over 200 species of birds (a quarter of the known species in Australia) have been recorded in the catchment of Hexham Swamp, which prior to the floodgates was important habitat for fifteen migratory wading bird species protected under CAMBA and JAMBA agreements.

With reduced tidal inundation, the freshwater reed *Phragmites* has expanded its range by 2,862% - from 170ha in 1966 to 1005ha in 2004 (Winning, 2006), reducing the value of the swamp as water bird habitat with the number of bird species reduced to around 40. Weeds and pest species such as alligator weed, pampas grass, water hyacinth, feral pigs and foxes have increased. Oxidation of acid sulfate soils, lowering pH levels in several tributaries and raising soluble iron levels in the local waterways has also been reported (ICTCMC 1996).

**HEXHAM SWAMP REHABILITATION PROJECT**

Continuing degradation of Hexham Swamp had become a contentious community matter as individual agencies had been unable to satisfactorily address all the issues. Following a request from the NSW Government to resolve the floodgate issue, the Trust initiated a ‘Total Catchment Management Study’ to investigate floodgate impacts and management options, and other concerns such as flooding, catchment erosion, and land use pressures, and to determine strategies to better manage the catchment.

In 1996 the Trust’s Ironbark Creek TCM Strategy recommended reinstating tidal inundation by lifting the gates in non-flood times to allow a balance of saltwater and freshwater wetlands to re-establish. To achieve this, the floodgates would be opened sequentially in 3 stages until pre-floodgate level of inundation is achieved. Modelling indicated that of the area of land that would be inundated, more than half was owned by the National Parks and Wildlife Service (as part of the Kooragang Nature Reserve) and Newcastle City Council. The remaining 800 hectares of land was in private ownership and would need to be acquired or covered by ‘easements to inundate’ – an innovative solution requiring a legal agreement between each property owner and the CMA.

**IMPLEMENTING THE STRATEGY**

The process of bringing the project to the point of approval has been complex and time consuming because of the scale and complexity of land acquisition and environmental factors, the large number of affected parties and the legislative processes. The process took 10 years from receiving funding in 1998 to opening the first floodgate in 2008. The lengthy process was necessary to adequately resolve the vast range of issues, which included:

- Property negotiations with 47 landowners and seven infrastructure owners. Property purchases requiring subdivision of land involving valuations, property surveys, development applications, and resolution of many unforeseen legal issues.
- Many subdivisions were complicated by local environmental controls and adjoining land use issues unrelated to the project.
- ‘Easements to inundate’ developed for private properties requiring time in negotiations, valuations and legal issues.
Maintaining existing use of Hexham Swamp for major infrastructure: Main Northern Railway line; main water supply pipeline to Newcastle; 330 kV transmission line and other minor power lines; former Richmond Vale to Hexham rail line; four radio masts; and Hunter Wetlands Centre Australia.

Location in close proximity to many existing urban and residential centres and to current and future residential growth areas – Hexham Swamp is intensively developed on its eastern, south-eastern and southern margins, with the south west a major growth area.

Construction of a number of low level earthen bunds and placing fill to restrict intrusion of salt water onto private land not acquired by the CMA or not covered by easements to inundate.

A detailed environmental monitoring program conducted before opening of the floodgates and during each stage of the sequenced openings.


Detailed modelling of the impacts on water levels behind the floodgates during flood and non-flood times, and to satisfy concerns of local landholders at numerous public and private meetings.

PROJECT APPROVAL

The Project was assessed under section 75B, Part 3A of the Environmental Planning and Assessment Act (1979) as a Major Project requiring Ministerial determination. The Project was approved by the Minister for Planning, Hon Frank Sartor, in November 2006 with 57 conditions including that the flood mitigation function of the gates continues to be implemented in accordance with the Lower Hunter River Flood Procedures Manual (DECCW, 2009). DECCW will continue to manage the structure for flood protection, by directing the closure of the floodgates on receipt of a Flood Watch for the Hunter River issued by the Bureau of Meteorology. In non-flood times, the gates will be managed by the CMA in conjunction with DECCW to allow tidal inundation as per consent conditions.

The first of eight gates was opened in December 2008. In accordance with Condition 3 of the Project Approval, environmental performance has been closely monitored during Stage 1 and reported as follows.

Environmental Performance

A rigorous monitoring program has been conducted for Stage 1 (1 gate open for 6 months) to collect data on environmental variables including wetland hydraulics, groundwater, water quality, benthic invertebrates, fish and aquatic invertebrates, birds, amphibians, mosquitoes, vegetation and creek bank condition. The impacts of Stage 1 were expected to be minimal, as monitoring confirmed. During Stage 1, the floodgate was completely closed on 3 occasions due to flood warnings on the Hunter River. Riverine flooding did not eventuate, and the gate was re-opened on cancellation of the flood warnings. The gate was also reduced to 300mm during king tide events for mosquito control purposes. It was therefore difficult to characterise the specific
impact of opening one floodgate on hydraulics and ecology within the Project area. In addition, above average rainfall was recorded during Stage 1, with freshwater catchment inputs having an impact in the swamp.

Overall, no significant impacts were observed as a result of opening one gate, and the project is currently being assessed for approval to proceed to Stage 2 – 2 gates open for a minimum of 12 months. The following monitoring results are reported in the Stage 1 Environmental Performance Assessment Report (BMT WBM, 2009).

- Wetland Hydraulics
  Compared to the previous 300mm opening, Stage 1 resulted in an increase of 0.1 to 0.2 metres tidal range. Tidal hydraulics was found to be dominated by low tides and the ability of the swamp to drain through all 8 gates due to the one-way flap mechanism. Thus, low tides in the swamp largely reflect low tides in the adjacent Hunter River South Arm while high tides are restrained from reaching maximum potential.

- Water Quality
  Salinity and dissolved oxygen were found to drop significantly in the event of catchment-based freshwater inputs and at times when the gates were completely closed due to flood warnings issued on the Hunter River. Recovery of salinity and dissolved oxygen within the swamp is delayed until the gates are re-opened following the cancellation of the flood warning. During dry periods, salinity was recorded to penetrate into the upper reaches of tributaries.

Hexham Swamp has been identified by Industry and Investment NSW as a significant potential acid sulphate soil (ASS) hotspot with further investigations required. Further saline inundation is expected to have a positive effect on ASS due to the alkaline nature of seawater.

- Mosquitoes
  Two key pest species of mosquito have been monitored around Hexham Swamp for several years. The freshwater mosquito *Culex annulirostris* was found to be in greatest abundance towards the end of the summer season following significant rain events, and therefore not as a result of increased tidal inundation. The saltwater mosquito *Aedes vigilax* typically breeds in pools of saline water following high tides. As a precautionary measure, the gates were closed to 300mm in the two king tide events that occurred during Stage 1 to limit the extent of tidal inundation and the pooling of tidal waters in depressions. Monitoring concluded the abundance of *A. vigilax* in Hexham Swamp was relatively low, with more suitable breeding habitat in other lower Hunter wetlands where large tides can penetrate low-lying lands. Overall it was concluded that Stage 1 has resulted in no substantial change in pest mosquito populations.

- Vegetation
  Limited dieback of vegetation was expected as a result of saline water intrusion into freshwater reed communities and this has been confirmed by monitoring. No change has been recorded in areas of mangrove and saltmarsh, however existing mangroves are exhibiting renewed vigour.
CONCLUSION

The CMA’s role in managing Hexham Swamp is a balance between flood mitigation and wetland restoration. Together with the cooperation of many stakeholders, the CMA has been successful in returning the tide to the Hunter’s largest wetland – while maintaining flood protection for adjacent rural areas.

The land acquisition and approvals processes have been assisted by the generous support of Freehills Solicitors who have provided pro-bono legal advice throughout the project. The CMA has acquired title to 650 ha and easements to inundate over a further 300 ha of land. The acquired land, together with a further 900 ha protected in the Hunter Wetlands National Park brings the total area of protected wetlands to 1,850 ha. The CMA-acquired land will be progressively transferred to the National Park.

With the project progressing to Stage 2, it is expected that positive environmental outcomes will come to fruition as tidal waters further penetrate into the swamp. The investments in cost and time by many have been considerable, but the balanced triple bottom line of environmental, economic and social outcomes will provide lasting benefits for present and future communities, and beyond.

TAKE HOME MESSAGES

• Communications - keep all stakeholders including property owners and the community well informed of the progress and delays throughout the project.
• Rigorous monitoring - extensive monitoring of environmental factors has provided valuable information to support the project proposal. In particular, wetland hydraulics data has been essential in informing the land acquisition areas. Continued monitoring throughout Stage 1 has been essential for adapting management processes to adequately address Stage 2 expected outcomes.
• Balanced outcomes – the project supports that flood mitigation and environmental improvement can be successfully managed to coexist with the resulting balance considering environmental, economic and social outcomes.

REFERENCES


Department of Environment, Climate Change & Water (2009). Flood Procedures Manual for the Lower Hunter Flood Mitigation Scheme, DECCW.

Department of Public Works (1972). Hexham Swamp Environmental Impact Report, Department of Public Works.


Ironbark Creek Total Catchment Management Committee (1996). Ironbark Creek Total Catchment Management Strategy, Volumes 1 & 2, Hunter Catchment Management Trust, Maitland.


