MAJOR PROJECT ASSESSMENT:
Tillegra Dam
Localities of Tillegra and Munni, near Dungog, NSW
MP07_1056

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

November 2010

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ABBREVIATIONS

ASL	Above Sea Level
CIV	Capital Investment Value
Department	Department of Planning
DGRs	Director-General's Requirements
Director-General	Director-General of the Department of Planning
EA	Environmental Assessment
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPI	Environmental Planning Instrument
FSL	Full Supply Level
HWC	Hunter Water Corporation
MD SEPP	State Environmental Planning Policy (Major Development) 2005
Minister	Minister for Planning
PAC	Planning Assessment Commission
Part 3A	Part 3A of the *Environmental Planning and Assessment Act 1979*
PEA	Preliminary Environmental Assessment
PFM	Planning Focus Meeting
PPR	Preferred Project Report
Proponent	Hunter Water Corporation
RtS	Response to Submissions
SoC	Statement of Commitments
WM Act	*Water Management Act 2000*

DEFINITIONS

Transparent dam release	where all dam inflows are released downstream at certain times as though there was no dam
Translucent dam release	where a specific proportion of dam inflows occurring at certain times are passed downstream

EXECUTIVE SUMMARY

Hunter Water Corporation (the Proponent) is seeking the Minister for Planning's approval to construct and operate Tillegra Dam on the Upper Williams River, in the Hunter Region of NSW. The project is in the Dungog Local Government Area, approximately 70 kilometres north of Newcastle.

The proposal involves the construction of a new water storage which would store 450 GL of water for use by the Proponent for urban water supply purposes. The proposal would address an existing shortfall in water supply experienced in the Hunter Region and also provide drought security and water supply for the projected population growth in the Hunter Region. The proposal is anticipated to provide additional water supply capacity for the region to 2050. The proposal has an estimated capital investment of $396 Million.

The proposal is subject to Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) by virtue of an Order made by the Minister for Planning under section 75B of the Act on 13 November 2007. The proposal was also declared a critical infrastructure project by the then Minister for Planning on 13 May 2009, as the project was deemed essential for the State for economic and social reasons.

The Proponent submitted an Environmental Assessment to the Director-General in August 2009. The Environmental Assessment was placed on public exhibition for an extended period from 10 September 2009 until 13 November 2009 and submissions invited in accordance with Section 75H of the EP&A Act.

The Department had a significant response to the exhibition of the proposal and received 2,659 public submissions. Additionally, the Department received nine submissions from public authorities and State Owned Corporations (Department of Environment and Climate Change and Water (DECCW), NSW Office of Water (NOW), Department of Industry and Investment (I&I), Hunter-Central Rivers – Catchment Management Authority (HRCMA), NSW Maritime, NSW Rural Fire Service, Land and Property Management Authority, Dungog Shire Council (DSC) and TransGrid. Of these agencies, DECCW, NOW, I&I, HRCMA and DSC raised significant concerns about the proposal.

Of the public submissions, 97% of submissions objected to the proposal, 1% did not state a position and 2% stated qualified support for the proposal. The key issues raised in the submissions included the need and justification for the dam, water resources impacts, aquatic and terrestrial flora and fauna impacts and impacts on the Hunter Estuary Wetlands Ramsar Site.

Given the number of submissions received and the technical complexity of some of the issues of the proposal, the Department commissioned five independent experts to review the following aspects of the proposal:

1. Need and justification;
2. Socio-economic evaluation;
3. Hydrology modelling of the Williams River;
4. Hunter Estuary hydrodynamics and water quality modelling; and
5. Ecological impacts on the Hunter Estuary Wetlands Ramsar Site.

The Department has considered the Proponent's EA and Submissions Report, issues raised in agency and public submissions, the findings of the independent experts and undertaken a comprehensive merit assessment of the proposal. The Department has considered all relevant documents in accordance with the objects of the EP&A Act and has carefully

considered the principles of ecologically sustainable development. Based on this assessment, the Department's key conclusions are:

1. Whilst the Proponent has demonstrated that it requires augmentation of its water supply system to address an existing shortfall in water supply and to provide for increased demand from future population growth it has not fully demonstrated that the proposed dam is the best option to meet the long term water supply needs of the region. The Department considers other options are available to the Proponent and these should be given full consideration for future proposals for water supply augmentation.
2. Significant gaps remain in the hydrodynamics and water quality modelling presented. These gaps include an evaluation of the impacts of the dam filling period (which could be up to 18 years under drought conditions); analysis of the changes to specific flow scenarios which would be of more relevance to the Hunter Estuary Wetlands Ramsar Site; an analysis of worst case scenarios; and an analysis of the cumulative impacts of the proposal, specifically considering that the Proponent operates existing water supply infrastructure on the Williams River. The Department, therefore, considers that significant uncertainty remains about the possible impacts of the proposal to the Hunter Estuary across the filling and operational phases of the proposal.
3. The Department considers that due to the high level of uncertainty about the possible flow and water quality changes in the Hunter Estuary, resulting from the proposal, particularly in the vicinity of the internationally recognised Ramsar wetlands, it is not possible to draw sufficiently accurate conclusions about the impacts of the proposal on the ecological character of the Ramsar wetlands. Given the high levels of uncertainty about predicted impacts to the Ramsar wetlands, particularly during the filling period, the Department has significant concerns that irreparable damage could possibly occur to the Ramsar wetlands and that any approval of the project would therefore be contrary to the precautionary principle.
4. The Department considers there is significant uncertainty about the impacts of the proposal on other licensed water users throughout the Hunter system at this time. There is a risk that if the project was approved in advance of the ecologically sustainable diversion limit for the Hunter Estuary, currently being developed by NOW, as part of a strategic water reform process, that this could lead to future reductions in entitlements for existing licence holders.

The Department therefore considers that the precautionary principle should be invoked on the basis of the significant residual uncertainty about the impacts of the project within the Williams River, the Hunter Estuary, the Ramsar Wetlands and other water users within the Hunter System and Tidal Pool. Additionally, the Proponent has other water supply options available that it could pursue to achieve its needs. Subsequently, the Department is of the view that the proposal is not in the public interest and should be refused.

1. BACKGROUND

1.1 Context

In November 2006, the then Premier of New South Wales (NSW) announced a plan to build a new dam in the Upper Williams River Valley (Tillegra Dam) and a water grid to secure the water supplies for the Hunter and Central Coast regions for the next 60 years. The NSW Government's State Plan lists providing a secure and sustainable water supply as a priority and the proposed dam and water grid "*will deliver that in the Hunter and Central Coast for generations to come*"[1].

The then Premier's long term water resource plan announced in 2006 included:

- A new 450 gigalitre dam in the upper Williams River – Tillegra Dam;
- Upgrade of Balickera Pump Station to provide increased capacity to capture flood flows from the Williams River for pumping into Grahamstown Dam;
- An industrial water recycling scheme – Kooragang Industrial Water Scheme; and
- Increase in capacity of the water supply pipeline between the Hunter and Central Coast regions.

The Hunter Water Corporation (HWC), (the Proponent) is seeking project approval to construct a new 450 gigalitre[2] dam within the localities of Tillegra and Munni, near Dungog. The proposed new dam is one of a suite of measures proposed by HWC to drought-proof the Hunter region for the next 50-60 years. Two of the other initiatives announced by the then Premier (upgrading of the Balickera pumps and increasing the capacity of the pipeline to the Central Coast regions) have already been completed by HWC. The planning and design of the Kooragang Recycled Water Plant is underway and construction will commence once agreements have been reached with potential end users.

In December 2008, HWC released the $H_2$50 Plan, which provides a long-term strategy to meet the water supply needs for the lower Hunter for the next 50 years. HWC prepared the $H_2$50 Plan in response to several changes that had occurred since HWC published the Integrated Water Resources Plan (IWRP) in 2003. The main changes included:

- Improved information about the long-term implications of climate change;
- Change in the assessment of HWC's system yield which indicated an existing shortfall between current demand and reliable yield;
- A need to improve drought security for existing customers in the lower Hunter; and
- Increased predicted population growth in the Lower Hunter over the next 25 years.

In the $H_2$50 Plan Plan, Tillegra Dam is listed as a key proposal to provide drought security to the region and to meet projected demand for many decades to come.

Tillegra Dam is also listed in the NSW State Infrastructure Strategy 2008-2018 which is a rolling 10 year plan for the State Government's infrastructure projects. Tillegra Dam has also been identified in the Central Coast Regional Strategy[3] as providing a long-term benefit for the Central Coast water supply system.

The Proponent has considered the construction of Tillegra Dam as far back as the 1950s and has been purchasing land in the project area since the early 1980s. The Proponent currently owns most of the land required for the proposal (approximately 94 per cent). The Proponent requires the purchase of 38 properties in full or partial acquisitions and has purchased 33 properties, with one under offer and accepted with four outstanding properties to be purchased. Of the remaining land required, two full acquisitions and one partial acquisition

[1] Premier of NSW Australia – News Release 13 November 2006
[2] One gigalitre is a billion litres of water
[3] Tillegra Dam was not identified in the Lower Hunter Regional Strategy which was published in October 2006, one month prior to the then Premier's announcement to build Tillegra Dam in November 2006.

are required with the remainder being Crown land, including an area of vegetated Crown Land near Tillegra Bridge, the bed of the river, the travelling stock route and road reserves.

1.2 Project Setting

The proposal is in the Upper Williams River catchment in the Dungog Local Government Area, within the Hunter Region of NSW, approximately 70 kilometres north of Newcastle (refer to Figure 1). The Williams River drains part of the eastern portion of the Barrington Tops National Park[4] with its northern headwaters bordered by the Barrington Tops plateau, which is part of the Great Dividing Range. The Williams River then flows generally in a south-easterly to southerly direction and joins the Hunter River in the lower estuarine reaches, eventually draining into the upper Hunter Estuary near Raymond Terrace.

The Williams River catchment is approximately 1,300 km^2 at its confluence with the Hunter River and of this, the Tillegra Dam subcatchment is approximately 194 km^2, comprising about 15 per cent of the total Williams River catchment area. The average flow at Tillegra Bridge over the 77 year period of record is 261 ML/day, with a median inflow of 51ML/day[5]. Whilst the Tillegra Dam subcatchment is approximately 20 per cent of the catchment at Glen Martin, it contributes approximately 40 per cent of the total flow at Glen Martin. The average and median flow at Glen Martin is 881 ML/day and 118 ML/day respectively[6].

The upper Williams River catchment is characterised by steep vegetated slopes while the lower catchment terrain has rolling hills with a significant part of the vegetation cleared for agricultural uses. The Tillegra Dam subcatchment has steep vegetated slopes up to 1,500 metres above sea level (ASL) in the northern part of the catchment and the elevation reduces to around 87 metres ASL at the site of the proposed dam wall at Tillegra Bridge. The upper reaches of the catchment include the Barrington Tops National Park. The project would span approximately 19 kilometres of the Williams River and would inundate an area of approximately 2,100 hectares at Full Supply Level (FSL).

Approximately five kilometres downstream of the proposed dam site on the Williams River is the confluence with the Chichester River. The Chichester Dam is located on the Chichester River, approximately 12 kilometres upstream of the confluence with the Williams River, near Bendolba. Chichester Dam is part of HWC's water supply system and is discussed further in **Section 1.3**.

The Williams River flows approximately 85 kilometres downstream from the project site (at the proposed dam wall) to the Seaham Weir Pool. The Balickera Pumping Station and Balickera Canal transfers water from the Seaham Weir Pool to Grahamstown Dam. Further details about the Proponent's existing water supply infrastructure are provided in **Section 1.3**. Downstream of Seaham Weir is the estuarine reach of the Williams River which is approximately a 15 kilometre stretch of river before its confluence with the Hunter River. Downstream of the Williams River and Hunter River is the upper Hunter River Estuary.

The entire Williams River catchment area falls under the *Hunter Water (Special Areas) Regulation 2003.* The Regulation states that it is an offence to pollute waters within a special area including the Williams River.

[4] The Barrington Tops National Park is inscribed on the World Heritage List and is approximately 10km upstream of the upper reaches of the proposed inundation area.
[5] Source: Aurecon (2009) page 5.10
[6] Source: Aurecon (2009) page 5.10

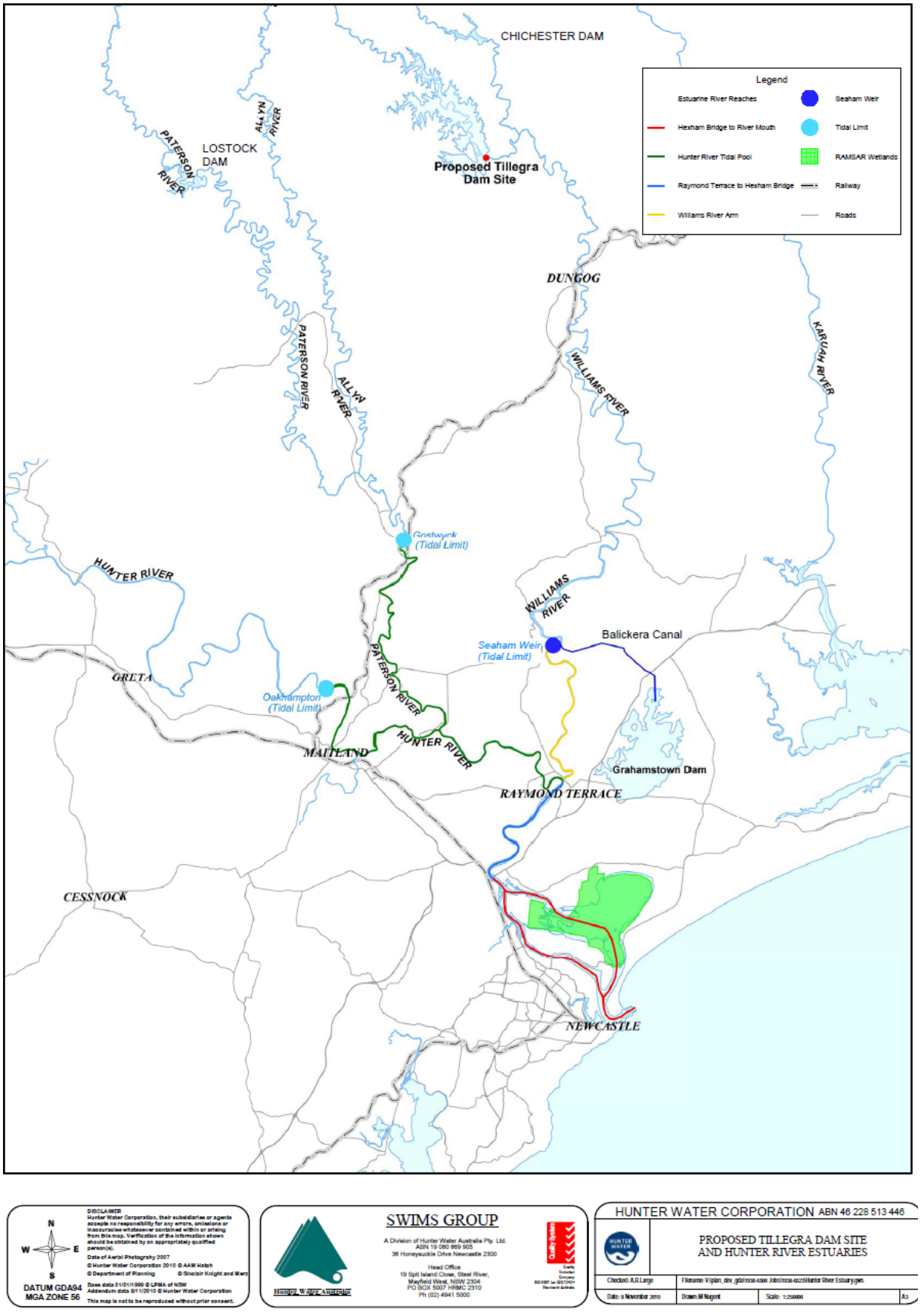

Figure 1: Site Location (source HWC)

1.3 Land Use

Approximately ten kilometres upstream of the northern inundation area of the dam is the Barrington Tops National Park. The Barrington Tops National Park contains Gondwana Rainforests and is on the World Heritage List for its ecological, geological and biological evolution values. In addition to the rainforest within the National Park, pockets of undisturbed bushland also occur on the footslopes of the Barrington Top Ranges.

The landuse downstream of the Barrington Tops National Park and upstream of the northern limit of the dam inundation area is generally agricultural and consists of a mixture of cleared rural land mainly used for grazing. Small areas of other agricultural uses also occur including cropping, dairying and grazing on irrigated pastures. There are also heavily forested areas to the north, north-east and north-west of the project area.

The proposed inundation area mainly includes cleared agricultural land and improved pastures used for raising of beef cattle and dairying and occupies the alluvial plains and gently inclined slopes. Goat, deer and horse grazing also occurs in the broader area on a limited scale. Native vegetation within the inundation area is generally limited to fragmented habitat remnants.

The project area is located immediately within the Tillegra and Munni townships. The town of Salisbury is about 6 km upstream of the inundation area.

The proposed dam will inundate 38 properties and approximately 21 residences. Within the 38 properties, there are four dairy farms, 14 grazing enterprises, 17 hobby farms, one landscape business and one horse riding business. The four dairy farms occupy about 682 ha of land and produce about 3.5 million litres of milk annually. The Proponent also estimates that up to a dozen beef cattle grazing enterprises occur within the area[7].

There are two main transport corridors to Dungog. The Dungog Road (MR101) is a north-south route connecting the New England Highway at Maitland to Dungog. It passes through the towns of Paterson and Martins Creek. Other transport routes include the Seaham Road and Clarence Town Road (MR301) which provides a link of about 52 kilometres from the Pacific Highway at Raymond Terrace to the community of Wirragulla, south of Dungog. The main route to the dam from Dungog would be via Chichester Dam Road and then Salisbury Road. Approximately eight kilometres of the existing Salisbury Road and two kilometres of Upper Chichester Road would be submerged by the proposed inundation area. Property access would be maintained and the preferred route for the realignment took this into account. Overall the realignment would be approximately 200 metres shorter than the existing route.

1.4 Relationship of Project with HWC Water Supply Infrastructure

A schematic description showing the key features of HWC's infrastructure and area of operations is provided in **Figure 2**.

The key elements of the Proponent's existing water supply infrastructure include:

- Chichester Dam on the Chichester River (a tributary of the Williams River);
- Seaham Weir which creates the Seaham Weir Pool;
- Balickera Pumping Station and Balickera canal, which pumps water from the Seaham Weir Pool into the Balickera Canal, to Grahamstown Dam;
- Grahamstown Dam, an off river water storage; and
- Tomago and Anna Bay sandbeds (which are not part of the Williams River water supply infrastructure).

[7] Information on land uses provided in an email from HWC, dated 23 September 2010

Chichester Dam was constructed between 1917 and 1926. It has a capacity of 21.5 gigalitres and a transparent flow release up to the 95th percentile, which is 14 megalitres (ML) per day. Water is harvested from Chichester Dam via the Chichester Truck Gravity Main (CTGM) to reservoirs in Maitland, Cessnock and Newcastle.

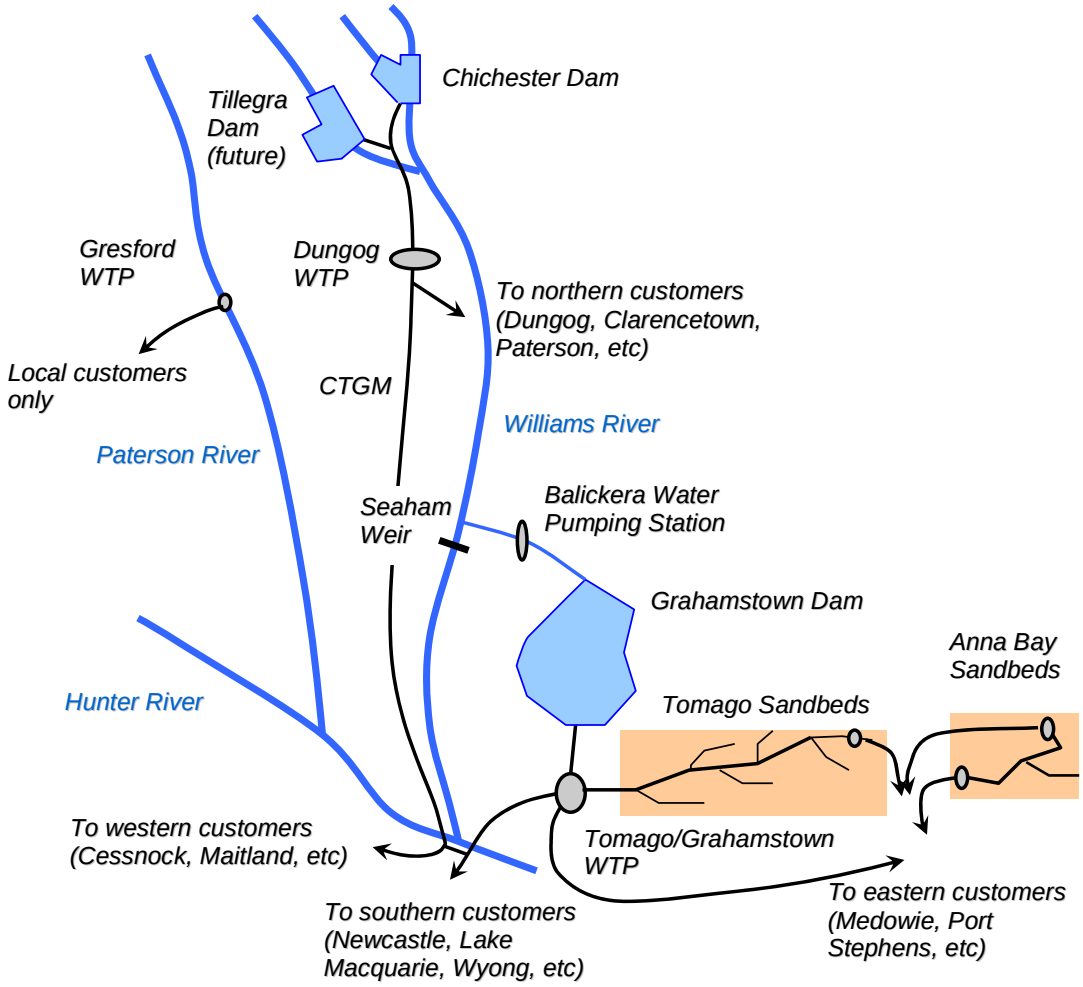

Figure 2: Schematic of HWC Water Supply System[8]

Seaham Weir was constructed in 1967 to provide a back-up freshwater supply Seaham Weir Pool, to the Grahamstown Dam supply. The weir was founded on bedrock by dredging upstream and downstream of the weir to create deep pools on either side. Floodgates were incorporated into the weir structure in the 1970s to handle minor flows and larger flood events overtop the weir. The 23 kilometre reach of the Williams River from Glen Martin (approximately ten kilometres south east of Dungog) to Seaham Weir is known as the Seaham Weir Pool. The Proponent currently extracts about 60,000 ML/year from the Williams River via Chichester Dam and pumping from Seaham Weir. HWC's extraction of water from the Williams River varies according to a number of factors such as storage availability in Grahamstown Dam. Recent extractions for both Williams River and Grahamstown Dam are shown in **Figure 3**. As can be seen from **Figure 3**, the recent historical extraction from the Williams River has been within the range of 10,000 to 40,000 ML/year, with the exception of the year ending 2007, when almost 80,000 ML/year was extracted; and the last two years where 0 ML/year and 4,000 ML/year were extracted for the year ending 2009 and 2010, respectively.

[8] Source: HWC (2010) "Précis of Tillegra Dam EAR Hydrological Modelling" 12 July 2010

Grahamstown Dam was constructed between 1955 and 1965 and is an off-river storage used to store water extracted from the Williams River. It has an available water capacity of 190,000 ML. Water extracted from the Williams River at Seaham Weir Pool is transferred to Grahamstown Dam via the Balickera Canal. HWC may operate the Balickera Pumps under certain flows only and as the Seaham Weir Pool is required to remain within specific water level ranges depending on whether the weir pool is in drainage mode, high flow mode or normal mode. While water is primarily transferred into Grahamstown Dam from the Williams River, additional contributions to the dam occurs from rainfall onto the dam surface and inflows from its own catchment.

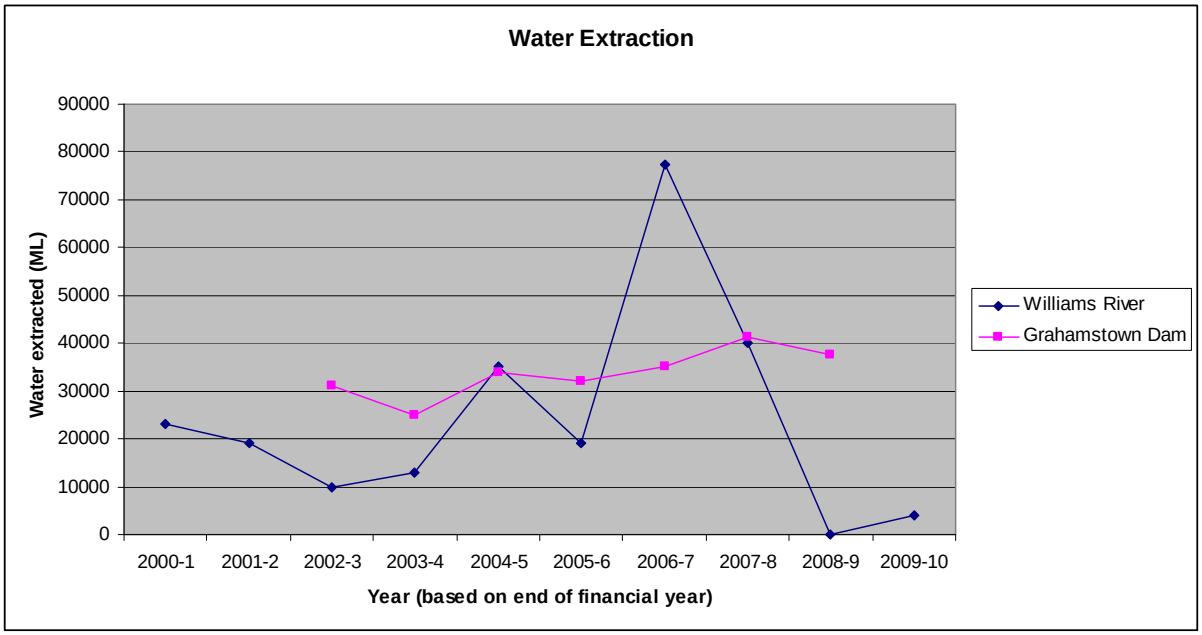

Figure 3: Historical extraction of Williams River and Grahamstown Dam[9]

The Proponent's objective for seeking approval to construct Tillegra Dam (the proposal) is to provide additional water storage to meet the existing water yield/supply shortfall of 7.5 GL/year, to provide drought security and also to service the future predicted population increase for the Hunter Region, over the next 50 years. The project would have a maximum capacity of 450 gigalitres which would provide additional yield of 52.5 GL/year to HWC's water supply system. Water would be transferred to Seaham Weir Pool via run of river transfers from the dam and be pumped through the Balickera Canal and stored at Grahamstown Dam. The Proponent proposes to extract approximately an additional 60 GL/year (or 60,000 ML/year) from the Williams River, which would double the Proponent's current extraction from the Williams River catchment.

The Proponent has advised that the capacity of Grahamstown Dam would not need to be increased to store the additional water being extracted from the Williams River, instead Grahamstown Dam would be worked harder in that water would be pumped into and out of it more frequently than the current situation.

Further details regarding the proposal are provided in Chapter 2.

[9] Data for the Williams River and Grahamstown Dam was derived from HWC Environmental Performance Indicator Reports (available from www.hunterwater.com.au), with the exception of data for the Williams River for the financial year ending 2009 and 2010, which was supplied by HWC via email dated 11/8/2010.

2. PROPOSED DEVELOPMENT

2.1 Project Description

The major components of the proposal are summarised in **Table 1** and described in detail in the EAR (Appendix B) and the Submissions Report (Appendix C). The key elements of the proposal are shown in Figure 4 and Figure 5and the dam design layout is shown in **Figure 6**.

Table 1: Major Components of the Proposal

Aspect	Description
Project Summary	**Construction and operation of a 450 gigalitre water storage facility (a dam) at Tillegra, on the Upper Williams River in the Hunter Region.**
Dam	The proposed dam would have a surface area of 2,100 hectares and the key elements include: • Dam wall - likely to be a concrete face rockfill dam, approximately 76 metres (m) high and 800 m long, at Tillegra. • Chute spillway - 40 m wide at the crest and about 600 m long. • Multi-level off-take tower – to allow the selection of water at optimum quality for releases. • Mini hydroelectric power plant at the dam outlet - to take advantage of environmental flow releases and bulk water transfers from the dam. The plant could generate up to 3,000 mWh of electricity annually which is roughly equivalent to the energy demands of 500 households. • A new 315 kVA or 500 kVA substation sited close to the generator - to provide the connection point for the mini hydroelectric power plant. A short section of 11kV overhead line or underground cable would need to be extended from the substation to one of the existing 11kV poles of the Chichester/Salisbury rural distribution feeder. • Transfer pipeline and pump station from the dam to the Chichester Trunk Gravity Main (CTGM) - transports water from Chichester Dam to Dungog Water Treatment Plant and then delivery to various towns and settlements in the Lower Hunter. The pipeline would run within the road reserve of Salisbury Road and could be used as a backup to the existing water supply from Chichester Dam, in the event of a water quality problem in the Chichester catchment. • Chlorination plant at Tillegra Dam – to disinfect water prior to treatment at the Dungog Water Treatment Plant. Disinfection is proposed as there are non-standard connections to the CTGM that allow residential supply
Site Access	• Dam access roads to provide access to the dam wall and a bypass road around the dam construction site, part of which would be retained for future access to the dam wall. A bridge across the Williams River would be constructed to replace the Tillegra Bridge and a footbridge across the crest of the spillway would also be constructed. The dam site would be accessed via an access road from Salisbury Road.
Realignment/relocation of existing infrastructure	• Realignment of approximately 17 kilometres (km) of Salisbury Road to the eastern side of the storage, which would include the construction of three waterway crossings; • Realignment of about 7.5 km of Quart Pot Creek Road, to be located above the inundation area; • Relocation of the existing 11 kV Country Energy electricity distribution feeder for approximately 20 km; • Relocation of telecommunications (copper service lines and an Optic fibre cable) for a route of 20 km and construction of a new copper line to the Quart Pot Creek area; • Relocation of Quart Pot/Munni Cemetery as it is located within the inundation area of the dam. The cemetery comprises 0.85 ha and contains about 80 known burials within 55 graves; and • Relocation of the Bendolba Rural Fire Service Station to a site above the

Aspect	Description
	storage.
Ancillary Infrastructure	The main ancillary works are summarised as follows: • Walking tracks on Proponent owned land • Fish stocking (Australian Bass) • Bushfire risk management works • Weather station and telemetry • Dam security components (eg, CCTV and fencing) • Office buildings and storage sheds • Two caretakers cottages • Visitor/walking track lookouts and associated access • Visitors/interpretative centre and associated parking, access and amenities • Interpretative signage • Designated boating, non-boating and swimming only areas including appropriate boundary markings (eg signage and buoys) • Picnic, barbeque areas/facilities and associated amenities/water tanks and playgrounds • Boat ramp and associated access infrastructure, including service road and trailer parking • Installation of memorials, heritage signage, parking and supporting facilities for access to relevant areas • Salvage and clearing of structures, improvements, trees and assets (including power poles and transformers) from within the storage area to allow the recovery of materials that could be economically recycled and that would also reduce or remove safety risks associated with providing public access to the storage.
Project Stages	o Construction - road construction would be undertaken in two phases spanning three years and beginning prior to dam construction. Dam construction would be programmed to occur over three phases, beginning in Year 2 and finishing in Year 6 of the construction program. River flows during dam construction are proposed to pass through the diversion channel with little attenuation of flows except during flood times (flows greater than 10,000 ML per day); o Filling - At the start of the filling phase, the diversion tunnel would be plugged and environmental flows would be diverted through the bypass pipe parallel to the diversion tunnel. Environmental flows would be released through the bypass pipe until the base of the inlet tower is inundated which would occur when the storage has a depth of about 10 metres. The duration of the dam filling phase would depend on local rainfall and water releases. The EAR provides two estimates of filling times depending on whether environmental releases would occur[10]. The main volume of the EAR[11] provides the proposed environmental flow release strategy during the filling phase of the project. o Operation - The FSL would be set at RL 152.3 m Australian Height Datum (AHD) which would provide a total storage volume of 450,566 megalitres. The dead storage level (the level below the multi-level offtake tower) is at RL 99 m AHD, giving a dead storage level of about 2,700 mega litres. HWC's intention is to maintain storage levels between 90 per cent FSL and FSL. Once the dam is complete and full, the inundation area would be about 2,100 ha.

[10] Section 3.4.2 and Figure 3.3 of Working Paper A (Volume 3) provides estimates of filling times based on no releases and shows filling times could range from three to 12 years whereas Section 5.3.3 of Working Paper D (Volume 3) shows the rate of filling for the first five years based on three different flow scenarios.
[11] Refer to Table 10.9 of Volume 1 of the EAR

Aspect	Description
Operating Protocol and Release Strategy	The Proponent has developed an operating protocol and release strategy for the run-of-river transfers to Grahamstown Dam. The release strategy for the dam is as follows: • Implementation of a transparent environmental flow (where all dam inflows are released downstream at certain times as though there was no dam[12]) from the dam within existing low to moderate flow classes to preserve approximately 70 per cent of the smaller flows and freshes in the river that would otherwise normally occur; • Releasing run-of-river transfers within a specifically tailored even based transfer protocol of 4,300 ML, consisting of a peak discharge of 1,500 ML declining over a 10 day period; • Including additional event based discharges from the dam consisting of a peak discharge of 270 ML, reducing over a four day period (these discharges would be released to provide a minimum number of variable flows important for fish passage below the dam wall should run of river releases not occur); • Ensuring releases occur at the correct time of year to maintain the seasonality of flows within the river; and • Installation of a multi-level offtake tower to allow the physio-chemical properties of releases to be matched to dam inflows. The Proponent has designed the dam release strategy to capture and store flood flows while maintaining the existing water availability in the river in lower, moderate "A" and "B" class flows
Approximate Employment	• Construction: 280 people full time • Operation: 3 people full time
Capital Investment Value	Stated as $250 Million on the Project Application, however has increased to a net cost of $397 Million (Table 3.1 of EA) following a review in 2010 to account for inflation and construction cost escalation – the gross cost will be $477 Million, however, the Proponent proposes to divest unneeded parcels of land and assumes that after these parcels are resold that the net cost of the proposal would be $397 Million.

2.2 Changes to the Proposal Since Exhibition

Following exhibition of the EAR, the Proponent amended specific aspects of the project as stated in the Submissions Report (Appendix C) and outlined below:

- **Construction workforce accommodation** - construction contractor to establish a camp to provide accommodation for construction employees. Preferred location is on the south-eastern outskirts of Dungog at Melbee Circuit on land owned by Dungog Council. An alternate site has been identified at Munni on land owned by the Proponent. A separate development application would be lodged with Dungog Council.
- **Location of Bendolba Rural Fire Service Station** - the Rural Fire Service (RFS) Brigade expressed a preference for an alternative site owned by the Proponent near Moolee Creek adjacent to the existing Upper Chichester Dam Road. This site is cleared pasture and owned by HWC. No additional or different environmental impacts are considered likely.

[12] NSW Office of Water website. http://www.water.nsw.gov.au/Water-management/Water-sharing-plans/Environmental-rules/Rivers/Rivers/default.aspx

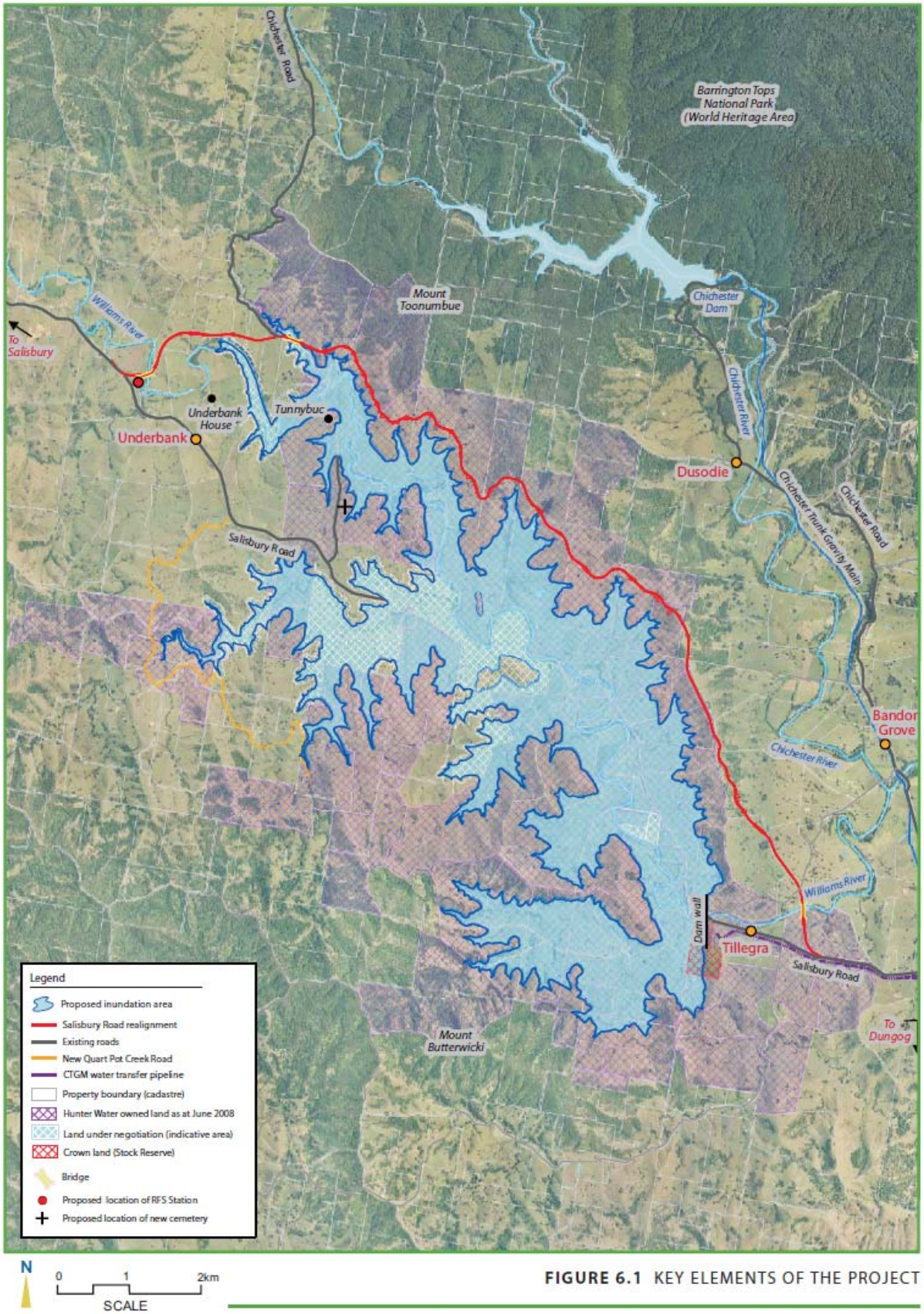

Figure 4: Key Elements of the Project

Source: Aurecon (2009 pp.6.2)

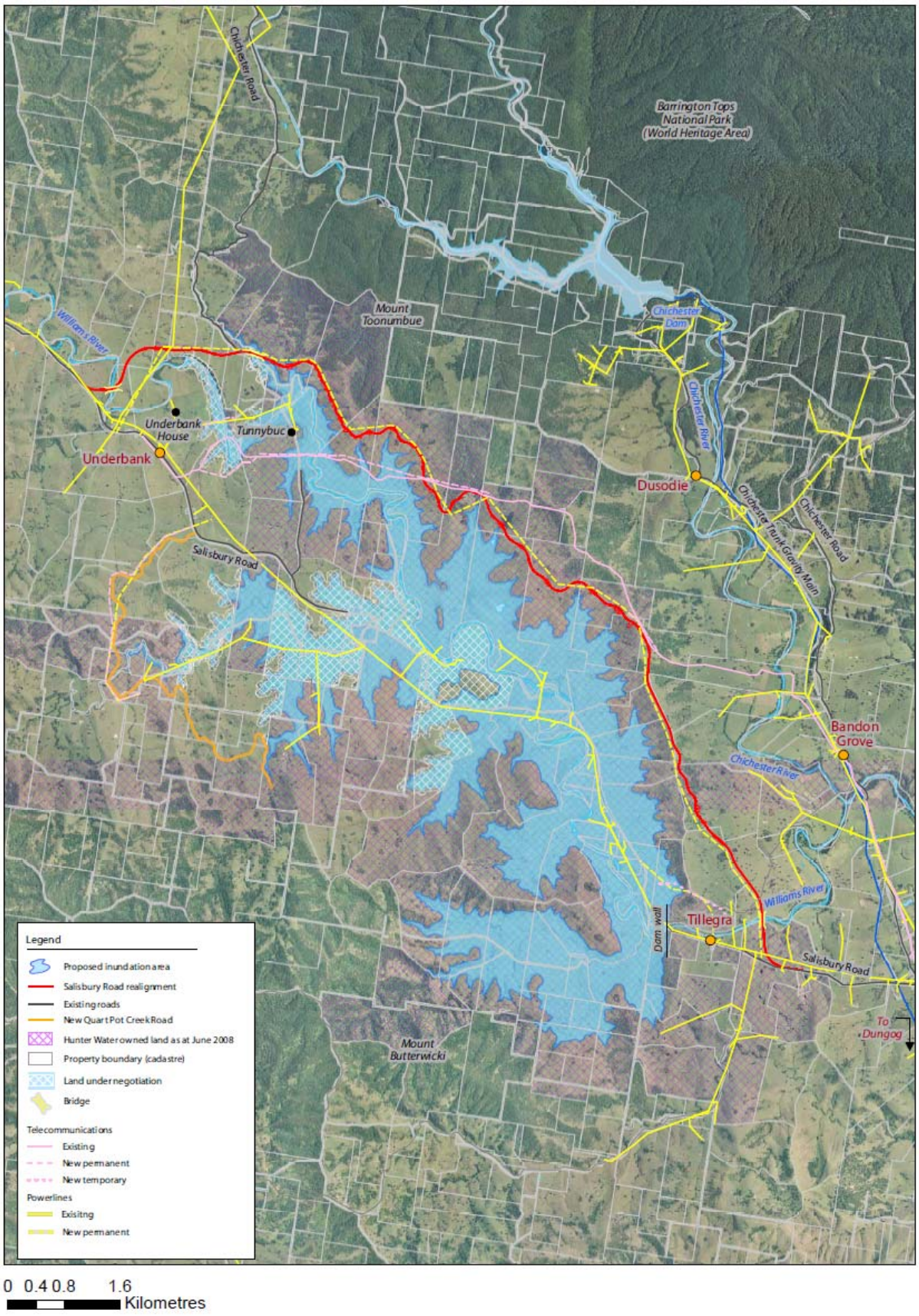

Figure 5: Relocation of Utilities

Source: Email from HWC dated 2/7/10

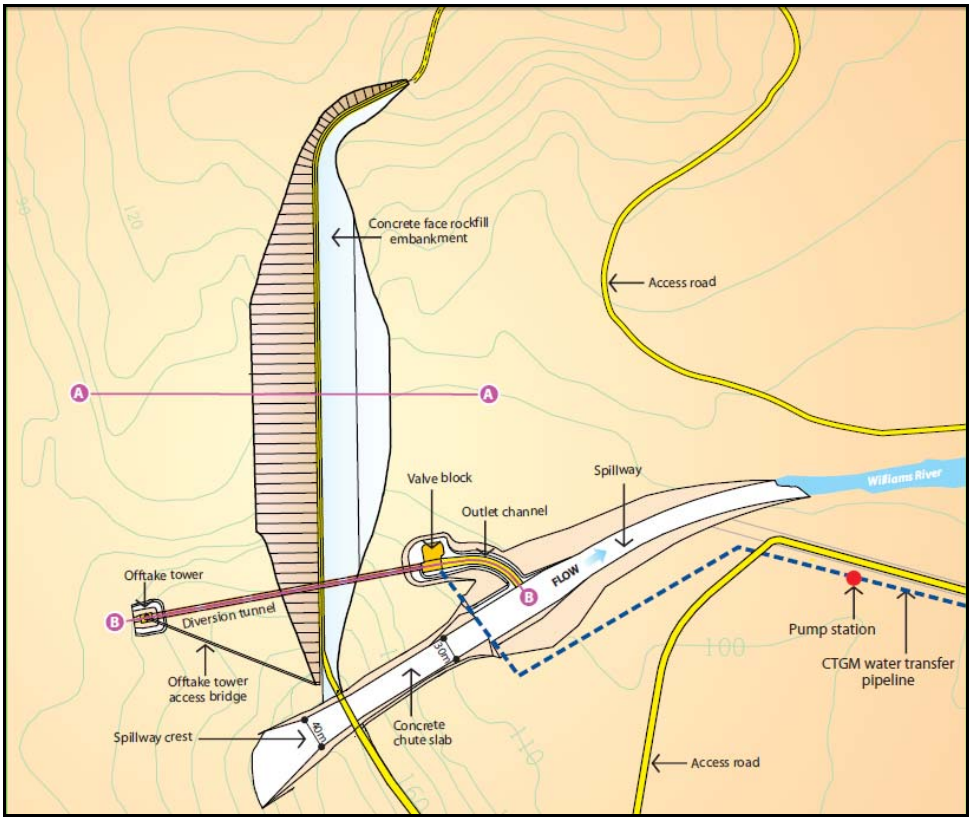

Figure 6: Proposed Dam Design Layout

Source: Aurecon (2009) Figure 6.2, pp.6.9

- **Maintenance of Chichester Dam Road and Salisbury Road** - Whilst Dungog Council would retain ownership and ultimate responsibility under the *Roads Act*, HWC would assume responsibility during the construction period for the maintenance of Chichester Dam Road from the outskirts of Dungog to the intersection of Salisbury Road, and for Salisbury Road from its intersection with Chichester Dam Road through to Underbank in the vicinity of its intersection with the replacement section of Salisbury Road. The Proponent has also agreed to contribute an additional $1 Million to Dungog Shire Council (as part of the NSW Government's $2 Million package for road and bridge maintenance works). This is in addition to the $171,000 for road safety works and $142,000 for road maintenance proposed in the draft Statement of Commitments in recognition of the potential impacts of construction traffic on shire roads.
- **Recreational access to the storage** - vehicle access to the storage near the right abutment of the dam wall and adjustment of the exclusion zone for the multi-level offtake tower and spillway is proposed. Basic visitor facilities would be installed and access would allow the launching of small watercraft such as canoes, kayaks and small aluminium car topping vessels. A formal boat ramp would not be provided at this location due to the steepness of the local topography.
- **Biodiversity Conservation** - Replacement of the proposed carbon offset and biodiversity corridor with a consolidated package of available land to the north-east of the storage. The corridor would be expanded by including the area between the proposed dam and the existing dam at Chichester. This land package would be dedicated as a National Park; would increase the total amount of land dedicated to carbon and biodiversity offsetting to 2,800 ha and would provide an additional 1,000 ha dedicated to offsetting than that originally proposed in the draft Statement of Commitments (1,822 ha). Within the 2,800 ha offset, the proposed National Park

comprises 1,323 ha which includes an area of 97 ha of river flat floodplain forest suitable for rehabilitation to EEC[13] River-flat Eucalypt Forest on Coastal Floodplains.

- **Cultural Heritage** - an alternative offset for the impacts on Munni House is proposed and includes:
    - funding the establishment of a visitor centre downstream of the dam;
    - assisting Dungog Shire Council with its community facilities; and
    - assisting the Dungog Historical Society with the conservation of heritage resources in the Dungog LGA.
- **Environmental Contingency Allowance** - reserve a minimum of 2,500 ML of water annually within the storage as an environmental contingency allowance (ECA) for environmental purposes. The Proponent considers the reservation of this volume is comparable to other ECAs held within NSW State Water storages for environmental flow purposes and has committed to working with both the NSW Office of Water and NSW Department of Industry and Investment to ensure the highest benefit is obtained from water specifically allocated for environmental purposes. The Proponent has suggested that the water could be used to increase transparent (where all dam inflows are released downstream at certain times as though there was no dam)[12] or translucent flows (where a proportion of dam inflows occurring at certain times to be passed immediately downstream)[12] across Seaham Weir or through a high flow event release to target a specific river management issue.

[13] Endangered Ecological Community under the *Threatened Species Conservation Act 1995*

3. STATUTORY CONTEXT

3.1 Major Project

The proposal is a project to which Part 3A of the EP&A Act applies by virtue of an Order made by the Minister for Planning under section 75B of the Act on 13 November 2007. Consequently, the Minister for Planning is the approval authority for the project.

3.2 Critical Infrastructure

On 13 May 2009, the Minister for Planning formed an Opinion under section 75C of the EP&A Act that the project is essential for the State for economic and social reasons and therefore declared the project to be a critical infrastructure project.

3.3 Controlled Action

The project was declared to be a 'Controlled Action' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (EPBC reference no. 2008/4551) on 23 January 2009. This means that the project would also require approval from the Commonwealth Minister for Environment. The former Department of Environment, Water, Heritage and the Arts (now the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)) referral decision (reference no. 2008/4551) states that the EPBC Act Part 3, Division 1 controlling provisions are sections 16 and 17B as the project is likely to have a significant impact upon wetlands of international importance.

The project has been assessed in accordance with clause 13.2 of the Bilateral Agreement between NSW and the Commonwealth, made under the EPBC Act, relating to environmental impact assessment. The assessment will be done in the manner specified in Schedule 1 of the Bilateral Agreement.

To enable the assessment of the action under the EPBC Act, the Director-General's requirements issued for the project on 8 January 2008 were supplemented pursuant to section 75F(3) of the EP&A Act with additional requirements relating to EPBC matters on 1 May 2009.

3.4 Permissibility

The Proponent has identified that the project (including the dam and associated structures, inundation area, transfer pipeline, new Salisbury Road alignment etc) would be located on land zoned Rural 1(a) under the *Dungog Local Environmental Plan 2006* (Dungog LEP). Additionally, part of the dam wall and spillway would be located in the Environment Zone 7(a) and a part of the upper reach of the storage would be located on land zoned Recreation 6(a) when the storage is at FSL. Notwithstanding, the project (and its components) would be permissible without consent under the Dungog LEP in all zones through the operation of clause 24 of the LEP which states that development consent is not required for development for the purpose of a utility installation carried out by a public utility undertaking.

3.5 Environmental Planning Instruments

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

3.6 Public Exhibition

The Proponent submitted an Environmental Assessment with the Director-General in August 2009. Pursuant to Section 75H and 75I(2)(g) of the EP&A Act, the Director-General was satisfied that the Environmental Assessment had addressed the environmental assessment requirements specified in Director-General's requirements issued for the project on 8

January 2008 and supplementary requirements issued on 1 May 2009. A copy of the Environmental Assessment is attached (see Appendix B).

The Environmental Assessment was placed on public exhibition for an extended period from 10 September 2009 until 13 November 2009 and submissions invited in accordance with Section 75H of the EP&A Act. The exhibition meets the minimum statutory period for exhibition (that is, 30 days) required by the EP&A and EPBC Acts.

Exhibition of the Environmental Assessment was also advertised in locally and nationally circulating newspapers in accordance with the requirements of the EP&A and EPBC Acts. The Environmental Assessment was also made publicly available on the Department's website. Following the exhibition period, the Director-General directed the Proponent to respond to the issues raised in submissions. The Response to Submissions (see Appendix C), including a final Statement of Commitments, was prepared by the Proponent and made publicly available on the Department's website. The Submissions Report was also provided to government agencies for comment (where the additional information provided by the Proponent was relevant to that agency). This included: the Department of Planning's Heritage Branch; Dungog Shire Council; Department of Environment, Climate Change and Water; NSW Office of Water; Industry and Investment; Hunter-Central Rivers Catchment Management Authority; and Commonwealth Department of the Environment, Water, Heritage and the Arts.

3.7 Objects of the *Environmental Planning and Assessment Act 1979*

Section 5 of the EP&A Act details the objects of the legislation which are:

"(a) to encourage:
- *(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment;*
- *(ii) the promotion and co-ordination of the orderly and economic use and development of land;*
- *(iii) the protection, provision and co-ordination of communication and utility services;*
- *(iv) the provision of land for public purposes;*
- *(v) the provision and co-ordination of community services and facilities;*
- *(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats;*
- *(vii) ecologically sustainable development;*
- *(viii) the provision and maintenance of affordable housing; and*

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State; and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment."

Of particular relevance to the environmental impact assessment and eventual determination of the subject project application by the Minister, are those objects stipulated under section 5(a). The objects stipulated under (i), (ii), (iii), (vi) and (vii) are significant factors informing determination of the application (noting that the proposal does not raise significant issues relating to land for public purposes, community services and facilities or affordable housing).

With respect to ecologically sustainable development, the EP&A Act adopts the definition in the *Protection of the Environment Administration Act 1991*, including the precautionary principle, the principle of inter-generational equity, the principle of conservation of biological diversity and ecological integrity, and the principle of improved valuation, pricing and incentive mechanisms.

It is important to recognise, that while the EP&A Act requires that the principles of ecologically sustainable development be encouraged, it provides other objects that must equally be included in the decision-making process for the project.

The Department has considered the need to encourage the principles of ecologically sustainable development, in addition to the need for the proper management and conservation of natural resources such as water resources, the orderly development of land considering landuse, the need for the project as a whole and the protection of the environment.

In its assessment of the proposal, the Department has considered closely the precautionary principle. The precautionary principle is applied through the EP&A Act and also through the EPBC Act. The EP&A Act adopts the definition in the *Protection of the Environment Administration Act 1991* which states under the precautionary principle,

"that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

(i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and

(ii) an assessment of the risk-weighted consequences of various options."

As outlined in Chapter 5, the Department considers that there is significant residual uncertainty about the impacts of the proposal and has carefully considered the information available to ensure that serious and irreparable damage does not occur to the environment which are relevant to the consideration of objects (i) and (vi) in particular. Furthermore, the Department considers that there has been insufficient targeted evaluation by the Proponent on specific impacts arising from worst case scenarios, cumulative impacts and the range of flows of greatest importance to the lower estuary. This has lead to significant doubt and uncertainty about the possible impacts of the proposal on the Hunter Estuary Ramsar Wetlands Site during the filling and operational phases.

To address potential adverse environmental impacts in the Williams River, the Proponent has offered to implement an adaptive management framework[14]. However, the Department considers that in this instance, an adaptive management approach can only be considered once there is adequate certainty about the predicted impacts of the proposal and that the threat of serious or irreversible damage to the environment is not present. The Department does not consider this to be the case. Accordingly, in its consideration of the precautionary principle, the Department considers that there are threats of serious or irreversible environmental damage as a result of the proposal and that there is significant uncertainty as to whether these threats can be minimised or managed to acceptable levels.

Agency and community consultation undertaken as part of the assessment process (see Sections 3.6 and 4 of this report), address objects 5(b) and (c) of the Act.

[14] The adaptive management process allows for new information to be used in a feedback loop and incorporated into the operational management of the proposal. However, to successfully achieve this, monitoring, evaluation and review systems are critical to assess the effectiveness of the management approach and adjust it (through adaptive management) as required. Therefore, for adaptive management to be successful, monitoring and evaluation steps are vital and an integral part of this approach.

3.8 Minister's Approval Power

The Department has met all its legal obligations so that the Minister can make a determination regarding the project.

4. ISSUES RAISED IN SUBMISSIONS

4.1 Public Submissions

The Department received a total of 2,659 public submissions on the proposal which is a significant community response. Of these submissions:

- 19 form letters were received;
- 1 form letter comprised 1,587 individual submissions;
- 97% of submissions objected to the proposal;
- 1% did not state a position; and
- 2% stated some qualified support for the proposal but identified, for further consideration, specific issues of concern.

The key issues identified in the public submissions are summarised in **Figure 7**.

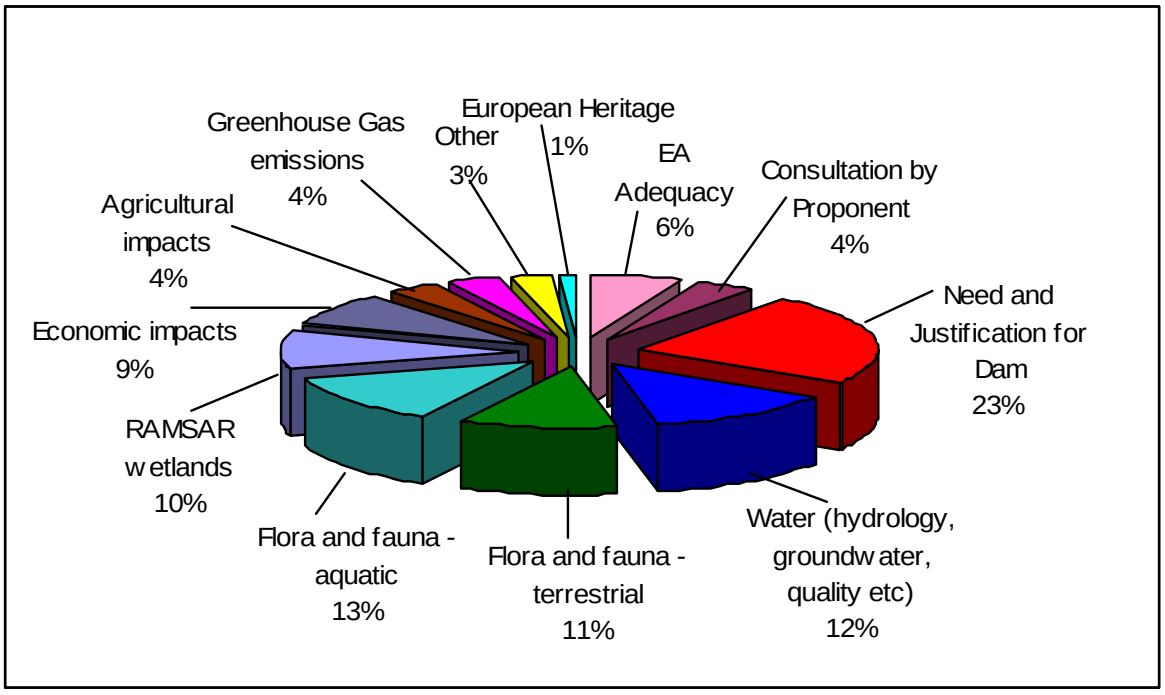

Figure 7: Summary of Issues Raised in Public Submissions

4.2 Submissions from Public Authorities

Nine submissions were received from public authorities as follows:

- NSW Department of Environment and Climate Change and Water;
- NSW Office of Water;
- NSW Department of Industry and Investment;
- Hunter Central Rivers – Catchment Management Authority;
- NSW Maritime;
- NSW Rural Fire Service;
- Land and Property Management Authority;
- Dungog Shire Council; and
- TransGrid.

Department of Environment, Climate Change and Water (DECCW)

- Recommends that the project be undertaken in a way to prevent the visible emission of dust and considers the proponent's commitments regarding erosion and sediment control and water quality to be appropriate;

- Recommends that the National Carbon Accounting Toolbox be used to confirm the proposed carbon sequestration in the habitat corridor is adequate to meet the carbon offset objectives. Also requires the Proponent to ensure proposed carbon offsets through reforestation or afforestation in the habitat corridor are consistent with the proponent's capacity to deliver biodiversity offsets in accordance with DECCW's Principles for Biodiversity Offsets.
- Notes that the construction of the project has the potential to cause noise impacts on sensitive receivers and considers the Statement of Commitments to be inadequate. As such, recommends conditions of approval for the purposes of managing potential noise impacts.
- Considers the biodiversity offsetting measures to be inadequate and that a compensatory habitat package consistent with DECCW's Biodiversity Offsetting principles be agreed prior to project approval.
- Concerned that the analysis of the proposed flow regime associated with the operation of the Tillegra Dam and Seaham Weir is insufficient to assess the likely behaviour and characteristics of the impact of the changes to the flow regime and the area over which these impacts may occur.
- Considers that the cumulative effects of water extraction in the lower Hunter River system have not been addressed.
- Requires the Proponent to provide further information on the annual flow reduction expected compared with a natural "base" case.
- Requires the Proponent to undertake further assessment of the reduced flows considering climate change scenario impacts.
- Considers that the Proponent's Aboriginal cultural heritage assessment is deficient in its consideration of impacts from ancillary infrastructure and finds that additional assessments need to be undertaken. As such recommends the Department require additional assessments prior to construction.

NSW Office of Water

- Concerned that the information provided for the project is inadequate to frame environmental flow provisions for either Seaham Weir or Tillegra Dam at this stage
- Investigations of the relative contributions of the Hunter River and the Williams River to the estuary are required to ensure that there are is no redistribution of water away from essential service industries in the Upper Hunter and that the Ramsar wetlands are protected.
- Notes the outcome of finalising water sharing arrangements may reduce the expected yield from the system.
- Notes the EA does not provide an adequate discussion on a whole of catchment approach.
- States that a high level of investment and commitment is required by the proponent to ensure the mitigation of geomorphological impacts.
- Notes the EA has not adequately considered the Water Management Principles of the *Water Management Act 2000.*
- Notes the assessment of the Hunter Estuary infers that the Williams River is a minor contributor of river inflows to the Hunter Estuary which is incorrect, and under certain climatic conditions the Williams River may be the primary contributor or river inflows to the Hunter Estuary.
- Considers the existing cumulative impacts of Chichester, Seaham Weir and Grahamstown extractions will be increased by the construction of Tillegra Dam, amounting to a cumulative annual reduction in flows of 36% from the Williams River System.
- Notes the EA includes estuary wide statements which are not supported by the technical reports in the EA.
- Considers that model assessment using daily flow variability, over years and decades is necessary to show the long-term variability of the system and that the ELCOM model is not suitable for long-term simulation.

Industry and Investment

- Notes the construction of a dam at Tillegra is inconsistent with the objects of the *Fisheries Management Act 1994* and several NSW Government policies including the NSW Weirs Policy and the Department's Policy and Guidelines – *Aquatic Habitat Management and Fish Conservation* (1989).
- Notes that the Williams River has the highest catch per unit effort of any of the rivers in the Hunter-Sydney metropolitan region of NSW and there will be significant direct and indirect impacts on Australian Bass populations due to the loss of 35% of the habitat that they require.
- Notes that the construction of a fishway would be the most beneficial option to offset the impacts of the dam, however, without a fishway there are potential effects with fish mortality for fish overtopping the dam.
- Notes the EA is unclear on the modelling to justify the need for the dam and the potential impacts of the dam on downstream habitats and ecology.
- Concerned about the EA's findings that a reduction of the freshwater inflows to the estuary by up to 35% over the long-term could not have a significant long-term effect on estuarine processes and productivity, with flow on effects to the commercial fishing industry which relies upon the estuary as a breeding and nursery area for its product.
- Concerned about the potential impacts to freshwater inflows to the estuaries and impacts to water quality due to the filling stage of the project.
- Requests the inclusion of consent conditions addressing impacts on fish stocks, riverine health and commercial fishing and a condition requiring the implementation of the "Tillegra Dam Aquatic Ecosystems Offset Package".
- Raises questions regarding the ability to meet adequate access and use of the dam by recreational anglers.
- Notes that there will be potential operational socio-economic impacts, including impacts to aquaculture and agricultural resources.
- Notes the EA fails to assess the cumulative impact of reduced flows on the tidal pools and underestimates the potential commercial impacts of the dam on the regional economy.

Hunter-Central Rivers Catchment Management Authority (HRCMA)

- Considers that the EA does not use the most up to date climate change information on modelling, as per the Hunter-Central Rivers Catchment Management Plan (CAP). Also recommends independent examination of the climate change and drought management scenarios to determine the correct business case for applying a range of options.
- Considers the environmental costs of all the options are not addressed and Table 3.1 fails to recognise the environmental impacts of the dam. The cost analysis also fails to value the biodiversity impacts and has not included information provided by the CMA on an assessment of costs to meet the "improve or maintain" principle based on market costs.
- Considers that the native vegetation offset proposal does not meet its requirements. Also considers that information regarding vegetation clearance within the EA is inconsistent with previous advice provided by the Proponent to Hunter-Central Rivers Catchment Authority. Also disagreed with the conclusions of the riparian vegetation assessment, finding that the vegetation loss would be significant, as opposed to moderate impact.
- Considers that the impacts of the proposed dam to river and water management have not been adequately addressed in the EA. This is mainly because: further erosion analysis is required to be undertaken for scenarios where the storage levels are lower than 96 per cent; the potential for mass slope failure has not been addressed; formation of a delta as a result of the backwater inundation effects has not been considered in the EA and as such there could be unknown impacts to the

geomorphology and follow-on effects to landholders; assessment of impacts on the upstream environment and users has not been highlighted in the EA; the existing geomorphology has not been accurately identified and considered; and impacts to aquatic ecology have been underestimated in the EA.

NSW Maritime

- Provided a submission noting that it had no comment on the proposal or any consent conditions but would welcome the opportunity to review any relevant additional information that became available.

NSW Rural Fire Service

- Proponent should consider the management of vegetation and access within the catchment area with regards to fire fighting and hazard reduction operations to minimise the impacts of bushfire on water quality.
- Proponent should consider the provision of asset protection zones, access arrangements, water supply utilities, building construction and design and emergency management procedures for infrastructure associated with the proposal, in accordance with Planning for Bush Fire Protection 2006.
- Site of the new Rural Fire Service Shed has been agreed to and the new site is south of the junction of the new Salisbury Road and intersection of Chichester Road.

Land and Property Management Authority

- Notes that processes for acquisition of relevant Crown lands by HWC are either underway or have been completed and that the Authority will assist in the resolution of any outstanding Aboriginal Land Claims.
- Notes that if Crown roads need to be constructed to service the development, these need to be transferred to an appropriate roads authority (either Dungog Council or the NSW Roads and Traffic Authority), prior to construction.
- Recommends appropriate consent conditions be applied to land zoned environmental protection to allow consideration of suitable tourist development proposals on merit.
- Recommends the creation of Crown reserves in partnership with HWC and Dungog Shire Council to retain the land in public ownership and maximise opportunities available for future use and development.

Dungog Shire Council

- Concerned about the inadequate assessment of the project's impact on the community and Council's infrastructure.
- Concerned about the lack of information and failure to apply the precautionary principle in relation to geology, fluvial geomorphology, project justification and ecology.
- Considers that the EA failed to adequately assess social, environmental and economic costs of the project, including implications for the local economy and community.
- Raised concerns regarding roads and other infrastructure: a Traffic Impact Assessment has not been undertaken for the construction phase; there are various inaccuracies or omissions on the EA for traffic count data, structural details of bridges, estimated increases in traffic; and lost opportunity costs for bridges constructed on HWC's advice.
- The geology data provided in the EA is at a concept level and the complexity of geology in the dam area raises concerns regarding community safety and the final cost of the project.
- Raised concerns regarding the potential impacts or adequate mitigation measures for fluvial geomorphology upstream of the dam, within the dam storage area and below the dam.
- Considers that impacts to terrestrial and aquatic ecology have not been comprehensively addressed in the EA, including impacts on stream ecology and the riparian corridor and potential impacts on the Kooragang wetland.

- Raised concerns about the justification of the project and recommended a reassessment of the various options using the Benefit Cost Analysis model, taking into account all costs for each option including social, environmental and economic.
- Considers that the proposed cost of relocating Munni House may not provide the optimum outcome and that at a similar cost a new and more practical and functional centre could be established containing salvaged elements from Munni House and other heritage artefacts for the area.

TransGrid

- States that the area covered by the project is clear of any existing TransGrid interests and there are no Board-approved proposals that may have a future impact on this area. As such, stated that it has no objections to the project.

4.3 Submissions Report

At the end of the exhibition period, the Department directed the Proponent to prepare a response to the submissions received. The Proponent subsequently prepared a Submissions Report which included proposed changes to its proposal (refer Section 2.2).

The Submissions Report was made publicly available on the Department's website and a copy provided for comment to the DECCW, NOW, DI&I, HCRCMA and Dungog Shire Council. The further issues raised by these agencies are summarised below.

Department of Environment, Climate Change and Water (DECCW)

- With regards to greenhouse gas emissions, DECCW found that further information provided in the Submissions Report did confirm the predicted number of hectares and trees required to offset the project's total carbon emissions. However, DECCW also found that the Proponent is yet to detail recommended actions to address any identified shortfalls in emissions reductions.
- Accepts the Proponent's response regarding noise management in the Submissions Report. As such, requests that the relevant commitments made by the Proponent be incorporated into any Project Approval, should the project be approved.
- Agrees to the proposed alternative biodiversity offset package submitted by the Proponent to DECCW in December 2009, subject to an environmental audit of the proposed offset land and development of an agreed transfer package.
- Recommends construction and operational conditions for the management of water quality, flora and fauna, changes to the water catchments due to climate change, survey and salvage of Aboriginal heritage and waste material.

Office of Water (NOW)

- Considers further investigation is required regarding the relative contributions of the Hunter River and the Williams River to the Hunter Estuary to ensure that there is no redistribution of water from essential services and utilities in the Upper Hunter and that the Ramsar wetlands are protected.
- Considers that if the Tillegra Dam filling period was to coincide with a drought in the Hunter River, that it would have a major impact on total Hunter River estuary inflows. Contingencies addressing this concern need to be developed so that the risk to other Hunter catchment water users can be assessed.
- Under the National Water Initiative, the NOW is required to manage the entire Hunter Valley within an ecologically sustainable diversion limit and this limit will only be determined once NOW is satisfied that there is a robust estuary model. If the future risk of reduced entitlements is not assigned to HWC, then under the WM Act the risk will be assigned to water users with supplementary water licences.
- States that NOW is currently assessing the effectiveness of the two water sharing plans that affect surface water sources in the Hunter Catchment with respect to supplying estuary flow requirements (the *Hunter Regulated River Water Sharing Plan* and the

Hunter Unregulated and Alluvial Water Sources Water Sharing Plan). Considers that it would be most effective for the Part 3A approval (should the project be approved) to contain a condition requiring the Proponent to comply with the relevant requirements of the water sharing plans.
- Supports the Proponent's commitment to work cooperatively with NOW to develop and finalise Seaham Weir transparency/translucency rules.

NSW Department of Industry and Investment (DI&I)
- Reiterates that the construction of a new dam at Tillegra is inconsistent with the objects of the *Fisheries Management Act 1994* and NSW Government policies, including the DI&1's *Policy and Guidelines – Aquatic Habitat Management and Fish Conservation* (1999) and the *NSW Weirs Policy*.
- Considers that in relation to fisheries issues, the majority of the issues raised in response to the EA have been adequately addressed in the Submissions Report and the final Statement of Commitments (SoC). However, SoC 3.1 does not reflect the Proponent's commitment to work with DI&I on the delivery of the Environmental Contingency Allowance to promote river and estuarine health. As such, DI&I requests that a new SoC be included, which requires the Proponent to establish an Environmental Flows Reference Group, consisting of representatives of the Proponent, NOW and DI&I, to develop a management strategy for the release of the 2.5 GL/year Environment Contingency Allowance (ECA) to promote river and estuarine health. This Group would also assist in providing advice to the Proponent on outcomes of monitoring and adaptive management for the preferred operational release strategy and ECA for the dam, to improve overall river and estuarine health.
- Requests inclusion of the provision of access points and recreational fishing amenities be included in the final SoCs.
- The use of the ECA, in relation to agriculture issues, to provide for increased transparent flows from Seaham Weir is not regarded as a justification to construct the dam.
- Requests that mitigation actions proposed for riparian landholders between the proposed dam and the Chichester River confluence be included in the final SoCs. Also recommends that the weed *Egeria densa* be included on the list of weed species to be monitored.

Hunter-Central Rivers Catchment Management Authority (HRCMA)
- Notes that a revised biodiversity offset package has been proposed following advice from DECCW and H-CRCMA that the original offset package was inadequate, but considers that the riparian offsets still need to be enhanced to ensure the principles of 'improve or maintain environmental outcomes' are met. The use of mechanisms such as Property Vegetation Plans or covenants, could achieve appropriate riparian outcomes in strategically higher priority areas on private land and recommends a better offset proposal for riparian vegetation be prepared in consultation with DECCW, DI&I and H-CRCMA.
- With regards to greenhouse gas emissions, states that climate change analysis appears to still not use the most up-to-date information.
- With regards to offsets for ongoing downstream impacts of the dam, H-CRCMA considers that these are not adequately addressed in the Submissions Report and recommends that, if approved, a condition be imposed requiring the Proponent to assess ongoing impacts of the dam downstream and provide for rehabilitation through inclusion in the price of water through the Independent Pricing and Regulatory Tribunal (IPART).

Dungog Shire Council (Council)
- Considers the Submissions Report does not adequately respond to the issues raised by the Council. Requests that if the proposal is approved, the Proponent in consultation with the Minister for Planning, the Department of Planning and Council representatives, review the commitments made to date to ensure that equitable and socially responsible measures are in place to counter the impact of the project on the local community.

- Considers that the Proponent has undertaken an inadequate assessment of impact on community and council infrastructure and the precautionary principle has not been applied.
- States that the Proponent should provide a comprehensive analysis of social, environmental and economic costs using the Millennium Ecosystem Assessment and Cost Benefit Analysis.
- A comprehensive construction traffic assessment has not been undertaken.
- The geology assessment does not confirm the suitability of material for various uses proposed in the dam and road construction.
- Considers that operational impacts to river and ecology through the formation of deltas has not been addressed, including impacts from erosion. Also impacts on the Kooragang wetlands are not holistically considered and the contribution of the Williams River has been underestimated.

5. ASSESSMENT OF ENVIRONMENTAL IMPACTS

In assessing the merits of the proposal, the Department has considered:

- the Environmental Assessment, public and agency submissions, the Submissions Report, further responses to the Submissions Report and all other information provided by the Proponent;
- relevant environmental planning instruments, guidelines and policies;
- the objects of the EP&A Act, including the object that encourages ecologically sustainable development; and
- relevant statutory requirements of the EP&A Act and EP&A Regulation;
- the following independent reviews commissioned by the Department and provided at Appendices D - H:
  - **Justification Review** (Appendix D)
    - SMEC (2010) "*Independent Review Tillegra Dam: Project Justification"* 17th November 2010;
  - **Socio-economic Evaluation** (Appendix E)
    - The Centre for International Economics (2010) "*Tillegra Dam*: *socio-economics. An independent review"* October 2010;
  - **Williams River Hydrology** (Appendix F)
    - Bewsher Consulting Pty Ltd (2010) "*Independent Review of Tillegra Dam Hydrology"* 27 September 2010;
  - **Hunter Estuary Modelling** (Appendix G)
    - WRL (2010a) "*Independent Review Tillegra Dam: Hydrological and Water Quality Impacts on Hunter Estuary*" 23 June 2010;
    - WRL (2010b) "*Second Independent Review, Tillegra Dam: Hydrological and Water Quality Impacts on Hunter Estuary*. 13 September 2010;
    - WRL (2010c) "*Review of Numerical Modelling of the Estuarine Impacts of the Proposed Tillegra Dam"* 17 November 2010;
  - **Hunter Estuary Wetlands Ramsar Site** (Appendix H)
    - Cumberland Ecology (2010a) "*Tillegra Dam – Hunter Estuary Wetland Impacts"* October 2010*;*
    - Cumberland Ecology (2010b) Letter dated 15 November 2010 titled "RE*: Peer Review of Ecological Impacts of Tillegra Dam on Kooragang Wetlands – Site Inspection*".

The Department has identified the following key issues associated with the proposal, requiring detailed consideration:

- Need and justification for the project;
- Williams River hydrology;
- Hunter Estuary hydrodynamics and water quality;
- Hunter Estuary Wetlands Ramsar Site; and
- Other Water Licence Holders.

5.1 The Need and Justification for the Project

Issue

The Proponent has identified that there is a shortfall of approximately 7.5 gigalitres per annum (GL/y) in its water supply system (*i.e.* that current demand exceeds supply by 7.5 GL/y). This identified shortfall has resulted from a revision of yield assessment using a more recently developed and conservative calculation method based on the assumption that even a low risk of water supply failure is unacceptable and that water supply authorities must be able to ensure an acceptable supply level even under the most extreme conditions.

The primary justification for the project was identified as the need to provide drought security in the context of future population growth (as identified in the Lower Hunter Regional Strategy). The Proponent has also identified the unknown effects of climate change, in particular the

potential for reduced rainfall, as a key element of the proposal's justification. It is generally accepted that the effects of climate change in the region will result in a ±10 per cent change in rainfall. The Proponent has calculated that a 10 per cent reduction in rainfall would equate to a 25 per cent reduction in stream-flow in the Williams River catchment.

The Proponent considers that Tillegra Dam (in partnership with the Kooragang Recycling Initiative) is an integral component in providing a secure and sustainable water supply for the Lower Hunter. It is also listed in the NSW State Infrastructure Strategy 2008-2018; is considered an important infrastructure requirement to support the objectives of the Lower Hunter Regional Strategy; and has also been identified in the Central Coast Regional Strategy as providing a long term benefit for the Central Coast water supply system.

Consideration

The issue of need and justification of the proposal was raised in 23 per cent of submissions received (or more than 600 of 2669) on the project and was the most commonly raised issue. Given the level of public response to the project, in particular to the need and justification of the project, the Department sought an independent review of the Proponent's project justification[15] (referred to as the SMEC Review). This comprised a review of available information and sought responses to specific questions relating to the Proponent's approach to determining yield and drought security; the stated level of service; and the use of climate change predictions in modelling of the preferred dam option only.

Current Water Demand and Yield Assessment

The Lower Hunter Regional Strategy[3] identifies a population growth forecast of 160,000 people by 2031. It also recognises that population growth can lead to increasing pressure on the environment, including increased demand for drinking water supply. However, despite population growth and natural variability in water supply, total water demand in the Lower Hunter has remained constant since 1982 at around 70-80 GL/y. Notwithstanding this, the Department accepts that there may be some increased demand for water as a result of the predicted growth in the region over the next 25 years, albeit the precise extent of this increase is not known.

As discussed previously, the Proponent has adopted an alternative method of calculating system yield, since the release of its Integrated Water Resource Plan (IWRP 2003)[16]. The revised calculation method was adopted in preparing the subsequent $H_2$50 Plan (2008) and identifies a shortfall between current demand and reliable yield of about 7.5 GL/y. The need and justification for the project are largely underpinned by this shortfall and the need to ensure a minimum level of supply during drought to existing and future customers. The Department accepts that the Proponent has identified a shortfall in yield from its current water supply sources to address existing demand and must find an alternative source to augment the region's water supply now and into the future.

The Proponent's revised yield assessment methodology is based in part on the assumption that any risk of supply failure, however small, is unacceptable. On this basis, the Proponent has adopted a scenario of the 100 year Average Recurrence Interval (ARI) drought followed by four years of inflows equivalent to the lowest 12 months on record and identified that there is a 1 in 10 million probability of this scenario occurring. This is compared to the 1 in 100,000 probability of a worst case scenario adopted by Sydney Water.

The SMEC review undertaken for the Department indicated that although the risk profile adopted by the Proponent is likely to be highly improbable, the consequences of this improbable event (*i.e.* water supply system failure), particularly in a major centre or region such as the Lower Hunter are near catastrophic. SMEC also noted that although some of the technical assumptions used in the Proponent's modelling requires further clarification and

[15] SMEC (2010) ""*Independent Review Tillegra Dam: Project Justification"* 17th November 2010 (Appendix D)

[16] Hunter Water Corporation (2003)

testing, the Proponent appears to have adopted a "current best practice" approach to determine its risk profile.

Whilst the SMEC justification review identified a number of areas of uncertainty or where the robustness of the assessment could be improved, overall it concluded that currently a shortfall of supply exists. The review further concluded that whilst there are significant environmental concerns for damming a flowing river, the arguments against Tillegra as a preferred option do not appear to outweigh the information supporting it as the preferred option.

Justification of Dam as Preferred Option

Notwithstanding the above conclusions of the justification review, the Department also sought an independent review of the socio-economic assessment of the project which considered the appropriateness of the economic valuation technique, modelling and assumptions used for all alternative water supply options considered including a desalination plant or upgrading other dams[17]. The review further considered whether the Proponent's analysis supported its conclusion that Tillegra Dam is the best option to meet future water supply needs or whether alternatives could deliver similar economic and social benefits. The key conclusion of this review is that it is not clear on the evidence presented:

- that the preferred option (Tillegra Dam) is the best option to meet the long term water supply needs of the region;
- that the dam is superior to the desalination plant option considered; or
- that the methodology used has provided a robust assessment of all available options.

These conclusions were based on a range of issues identified, including that:

- key features of a best practice approach to delivery future water needs have either not been addressed or have only been considered in a limited or superficial way;
- the methodology adopted by the Proponent does not allow alternative options to be compared on the same basis; and
- the analysis is limited to a small range of options and that a more common approach is to consider a portfolio or suite of options rather than individual options.

The range of alternatives considered by the Proponent included both climate dependent options (new dams, upgrades to existing dams) and climate independent options (desalination). One of the factors put forward by the Proponent in justifying the project was the need to diversify water sources and that the proposed Tillegra Dam would achieve this, as the Proponent considers it being situated in a different catchment to other existing supply sources.

Whilst the Department accepts that the Tillegra Dam would be located in a different sub-catchment to Chichester Dam, it does not believe the Proponent has clearly demonstrated that the construction of Tillegra Dam would achieve diversification of supply. Approximately 96 per cent of total demand is supplied by the Proponent's three main sources of Chichester Dam (38 per cent), Grahamstown Dam (46 per cent) and the Tomago Sandbeds (12 per cent). Although Grahamstown Dam is an off-river storage, it is supplied by water transfer from the Lower Williams River. This means that 84 per cent of the Proponent's current water supply is provided by the Williams River catchment. This would mean that virtually all of the region's water supply remains dependent on a single river catchment. Although it is acknowledged that capture of the streamflow and more direct transfer may result in augmented supply, it is considered questionable as to whether the objective of diversified supply would be achieved. The Department considers that this would render the regional water supply subject to increased vulnerability with this scenario and could be further exacerbated by the potential effects of reduced rainfall resulting from climate change.

Whilst the Proponent acknowledges that a desalination plant would overcome issues of climate dependence and diversified supply source, it did not progress it as the preferred option on the basis of cost effectiveness. The CIE review noted that all recent decisions by water

[17] The CIE (2010) "*Tillegra Dam*: *socio-economics. An independent review"* October 2010

supply authorities across Australia have resulted in the adoption of climate independent options, largely desalination plants of varying scales. The approach adopted by the Proponent does not provide diversity in that the regional water supply will continue to rely on a climate dependent option during a time where future climate dependence cannot be guaranteed.

In further considering the issue of cost effectiveness of desalination as an alternative supply option, the CIE noted that the Proponent's analysis of options assumes that its Drought Management Plan (DMP) would be suspended for up to six years of the analysis period for the dam option, however this is not similarly adopted for other options, in particular the desalination plant. A DMP is a standard document held by water supply authorities which outlines contingency measures to ensure ongoing water supply to its customers at an identified level of service through any drought sequence. The CIE identified the implication of suspending the DMP is that it would lower the cost of implementing the dam relative to other options and potentially make it appear more favourable from a cost effectiveness/benefit analysis. As well as potentially making the dam option appear more favourable, should a scenario be adopted where the DMP is suspended such as during construction of the dam, this could compromise water supply and leave the region vulnerable to drought, as there would be no contingencies in place. Given that one of the key drivers of the project is to ensure security of the regional water supply, the decision to suspend the DMP even temporarily, would seem to contradict the overall project justification.

The CIE concluded that based on a range of limitations in the methodological approach adopted, it did not believe that the Proponent's analysis clearly demonstrated that the dam was the best option to meet the future water supply needs of the region. It also noted that, despite the estimation of costs for the dam appearing broadly reasonable, concerns remain regarding cost estimates relating to the desalination option (as the most likely alternative and a climate independent option). Overall the CIE found that the evidence presented does not clearly demonstrate that the dam is superior to other alternatives.

Conclusion

In conclusion, the Department does not dispute the need for augmentation of the Proponent's water supply system to cater for existing yield shortfall and future increases in demand relating to forecast population growth or security of supply against drought. However, the magnitude of the required supply augmentation to cater for future increases in demand is not known at this time. Also, with the future risk of climate change, other water supply authorities are generally moving towards the development of climate independent water sources to safeguard their future water supply.

Furthermore, based on environmental performance and the independent reviews of justification and socio-economic analysis, the Department is not satisfied that the Proponent has sufficiently demonstrated that:

- construction of Tillegra Dam is the most cost effective and appropriate method of addressing the shortfall; or
- climate change scenarios have been appropriately used in determining implications for the preferred option, particularly given the choice of a climate dependent option within a catchment which already supplies a significant proportion of the Proponent's resource.

Coupled with significant uncertainties regarding the environmental impacts of the proposal (as discussed below), the Department therefore considers that there is inadequate justification for the proposed dam to proceed at this time.

5.2 Williams River Hydrology

Issue

The Department received many submissions regarding the impacts of the proposal on the reduction in streamflows and consequent environmental impacts. The Proponent's hydrology modelling underpins the assessment of impacts on the Williams River and is also used as an input to the hydrodynamics modelling of the Hunter Estuary (discussed further in Section 5.3).

Consideration

The Department reviewed the Proponent's assessment on water resources issues and considered the veracity of the hydrology modelling by the Proponent critical in evaluating impacts on the Williams River and inflows to the Hunter Estuary. The hydrology modelling undertaken by the Proponent underpins the predicted changes in flow that would result from the proposal and is a key input into the assessment of impacts on other aspects such as geomorphology and aquatic ecology. Additionally, hydrology data (including predicted changes in the Williams River streamflow) are used as inputs into the hydrodynamics modelling to assess the predicted changes in flow, salinity and water quality within the Hunter Estuary. Predictions from the hydrodynamics modelling are subsequently used to assess the resultant impacts on the Hunter Estuary Wetlands Ramsar Site (discussed further in **Sections 5.3** and **5.4** respectively).

Given the importance of the hydrology modelling and the use of this data in many aspects of the Proponent's assessment, the Department considered it appropriate to commission an independent expert to undertake a detailed review of the hydrology modelling. Additionally, criticism was received in submissions on the Proponent's documentation that the predicted changes to the hydrology were generally discussed in annual average terms only and therefore the range of impacts that could occur from the proposal was unclear. Subsequently, the Department commissioned Bewsher Consulting Pty Ltd to review the validity, appropriateness and accuracy of the hydrology modelling undertaken by the Proponent.

Additionally, Kingsford and Hankin (2010)[18] released a report in June 2010 which independently reviewed the predicted flow changes in the Proponent's EAR and discussed the subsequent impacts on the Hunter Estuary Wetlands Ramsar Site. The Department subsequently broadened the Terms of Reference for Bewsher Consulting to also include a review of the analysis and findings of the hydrology assessment presented by Kingsford and Hankin (2010). The Bewsher Review (Bewsher Consulting Pty Ltd 2010)[19] is included in **Appendix F** and the key issues are discussed below.

Modelling validity

The Bewsher Review concluded that the Proponent's model had not been properly verified for its ability to predict streamflows in the Williams River and that the "*validity and appropriateness of the modelling is diminished by the lack of adequate verification against recorded streamflows*". The Bewsher Review found that the Proponent's model was underestimating volumes in the Williams River, compared to recorded data. This underestimation occurs for data from Glen Martin downstream to Seaham Weir and over the full period of data since 1931. The Proponent's model is underestimating simulated flows on average about 14%. Additionally, this has led to errors on a mass balance basis, which shows that the Proponent's model is underestimating flows in the Williams River in the order of 30-50 GL/yr.

If the Proponent's model was corrected, it would show an increase in flows from the Williams River to the estuary and subsequent increase in the relative contribution of the Williams River to the estuary. However, without further analysis it would not be known over which flow ranges this error occurs. It is also acknowledged that if the model was corrected against

[18] Kingsford, R, T. and Hankin, C.J. 2010) "The Impact of the Proposed Tillegra Dam on the Hunter River Estuary, it's Ramsar Wetland and Migratory Shorebirds" Australian Wetlands and Rivers Centre, University of NSW. This report was independently published and has been treated as a submission by the Department.

[19] Bewsher Consulting Pty Ltd (2010) is referred to in this report as the Bewsher Review

observed data, there would likely be a relatively small reduction in the predicted changes to streamflow as a result of the proposal.

Since the completion of the Bewsher Review, the Proponent has undertaken further analysis of the differences in the modelled and observed flow data at Glen Martin as shown in Figure 8.

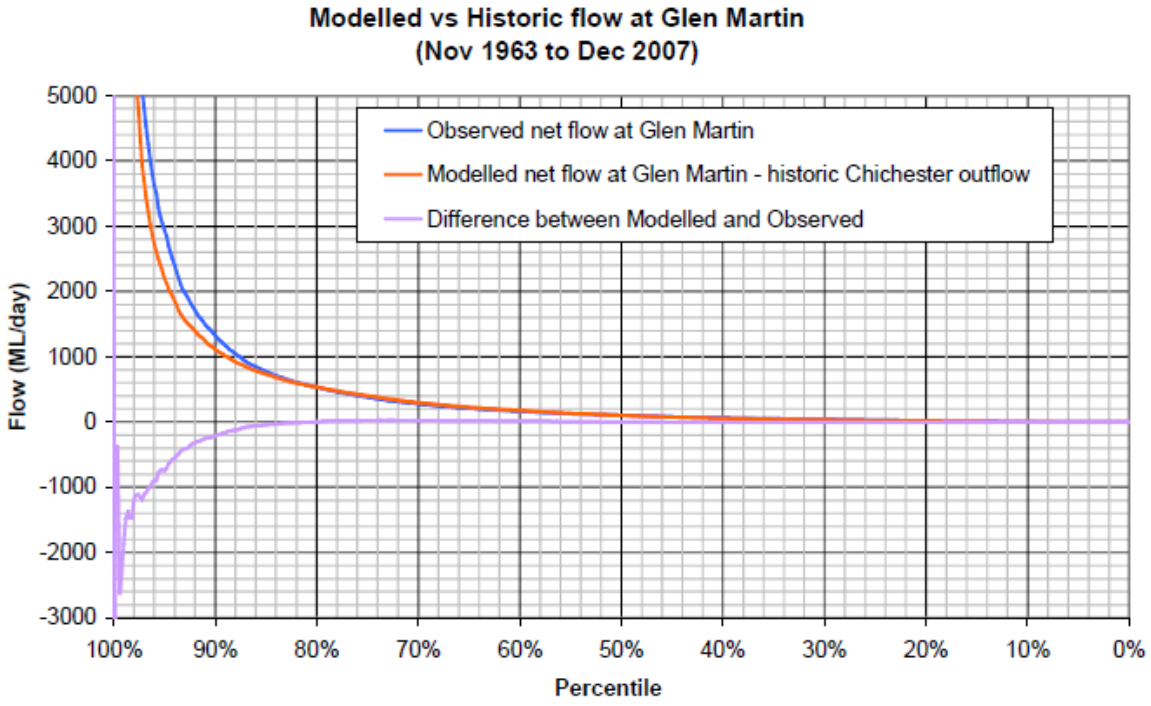

Figure 8: Modelled vs Historic Flow at Glen Martin

Source: Hunter Water Corporation "Tillegra Dam Response to DoP Questions" October 2010 (Appendix I)[20]

Figure 8 shows the error in the Proponent's modelling leads to the underestimation of the higher flows (flows with an annual exceedance probability of 16%; discharge range of 700-5,000^{+} ML/day). The Department considers these flow ranges to be within the range of flows of particular relevance to the Hunter Estuary, as they would contribute to the inflowing freshwater flows which reach the lower estuary within the vicinity of the Hunter Estuary Wetlands Ramsar Site. Subsequently, this error in modelling raises uncertainty about the data used for Seaham Weir (Williams River) estuary modelling as it would underestimate the relative contribution (and importance) of Williams River flows to the estuary. This issue is discussed further in Sections 5.3 and 5.4.

Dam Filling

The Bewsher Review found that the dam filling phase could be longer than that predicted by the Proponent in the EAR, and using the climate data from the previous 77 years it could take three to 18 years to fill with the most likely filling period being about eight years. The Department has adopted the filling phases calculated by the Bewsher Review. As the filling phase could occur for a considerable length of time (up to two decades) and over a range of climatic scenarios during that time, this phase (as well as the operational phase) requires detailed assessment in the Hunter Estuary modelling discussed further in Section 5.3.

Reduction in Flow

The Bewsher Review confirmed that the proposal is predicted to reduce annual average flows from the Williams River to the Hunter Estuary by about 22%. Furthermore, the Proponent's

[20] This data was provided following the completion of the Bewsher Review and has not been reviewed by Bewsher Consulting Pty Ltd.

existing water supply infrastructure on the Williams River (Chichester Dam and Seaham Weir) has presently reduced average annual flows from the Williams River to the estuary by some 21% and together with the proposed Tillegra Dam, this would lead to an overall cumulative reduction of flows from the Williams River of 43%.

On smaller timescales such as monthly and daily flows, the actual reduction in volumes from Williams River could be larger. The Bewsher Review found that monthly streamflow volumes downstream of Seaham Weir could be reduced as much as 80% in individual months following construction of the dam (which was also consistent with the findings of Kingsford and Hankin (2010)). Although there could be some corresponding increases in monthly volumes from the Williams River in other months, this finding highlights the variability of flows from the catchment and the need to assess and evaluate a large range of downstream flow scenarios for the hydrodynamics modelling.

Relative Contribution of the Williams River to the Hunter Estuary

The Proponent had not analysed the contribution of the Williams River to the Hunter Estuary and therefore the Department requested Bewsher Consulting Pty Ltd to examine the relative contribution of the Williams River to the Hunter Estuary. The results of the Bewsher Review analysis are provided in Appendix F.

The Bewsher Review found that although the Williams River contributes (on a median basis) 16% (annually) and 10% (monthly) flows respectively to the Hunter Estuary, at the 10th percentile exceedance[21], the contribution is 24% and 26% respectively. On a daily basis, the Williams River contributes 28% of flows at the 10th percentile exceedance probability, which is predicted to reduce to 20% post-Tillegra, for this range of flows. During the autumn and winter months, the Williams River contribution is relatively higher, ranging from 31% to 28% for 10th percentile exceedance flows and 13% to 9% for the median flows. Although the proposal during the operational phase is predicted to reduce the relative median contribution of the Williams River by 2% to 5%[22], a slightly greater reduction in the relative contribution of flows is predicted at the 10th percentile exceedance, ranging from 3% to 6%. It is these larger flows (10th percentile exceedance) which are most likely to be more important to the lower estuary and these flows also demonstrate the largest reduction in volumes from the proposal. This issue is discussed further in Section 5.3.

The Department is also aware that due to the deficiencies in the Proponent's modelling which underestimates flow volumes (as noted in the Bewsher Review and discussed above), there are errors in the data presented above and the actual relative contribution of the Williams River to the Hunter Estuary is likely to be greater than presented for some flow ranges. It is noted that as those errors are most likely to occur for the higher range of flows (that is, at the 10th percentile exceedance probability), there is significant uncertainty about the actual contribution and predicted impacts from the proposal for the range of flows that are most important for the lower estuary.

The Department is also concerned that the Proponent's assessment does not provide an analysis of the seasonal differences in flows from the three key tributaries (Williams, Patterson and Hunter Rivers). Also, given the large size of the Hunter catchment, rainfall patterns and intensities are likely to vary across such a large area and rainfall may occur in some catchments and not in others at a point in time and different rainfall intensities would likely be experienced across the catchments. This can lead to a large variability of flows from the three key inflowing catchments (Williams, Patterson and Hunter Rivers) and is material to the impact assessment.

[21] 10th percentile exceedance probability refers to 10% of all flows that are equal or equivalent to (a high flow).

[22] The Bewsher review predicts that under certain scenarios (daily basis, summer months and spring months) there will be a slight increase in the median relative contribution of post-dam flows, which is most likely due to the proposed upgrade of the fishway at Seaham Weir which will increase the baseflow across Seaham Weir from 5ML/day to 20ML/day.

The analysis in the Bewsher Review also identified that the impacts of the dam filling phase are actually greater than impacts for the operational phase (at maximum demand) for certain flows and conditions. This phase could cause a further 2% reduction (at the 10th percentile exceedance) of the relative contribution of Williams River flows to the estuary.

Cumulative Effects
The Department has also given careful consideration to the cumulative effects of the proposal. The Proponent has existing water supply infrastructure on the Williams River (Chichester Dam and Seaham Weir) which has been found to have reduced the Williams River flows by 21% and the proposal is predicted to reduce flows by a further 22% (on an annual average basis). Therefore the cumulative effect of the existing water supply infrastructure and the proposal would lead to a reduction in the annual average flows from the Williams River of 43%.

The Department also recognises that the relative contribution analysis (discussed in the preceding section) was undertaken on the existing Williams River flows at Seaham Weir[23] and predicted changes in flows from the Williams River (at Seaham Weir), to evaluate the relative impacts of the proposal only. The existing flow in the Williams River has already been reduced by the Proponent's existing water supply infrastructure. Therefore, if the cumulative impacts of the proposal were assessed (by considering the proposal together with the existing impacts of Seaham Weir and Chichester Dam) this would cause a comparatively higher reduction of the Williams River inflows to the Hunter Estuary. The lack of consideration of this issue by the Proponent presents a significant flaw in the impact assessment of the proposal and also has significant implications for the assessment of the Williams River flow contribution into the Hunter Estuary.

Conclusion
One of the key findings of the Bewsher Review is that the validity and appropriateness of the modelling undertaken by the Proponent "*is diminished by lack of adequate verification against recorded streamflows*"[24] and that the daily streamflows at Glen Martin and Seaham Weir are likely to be underestimated. The Department considers that the inaccuracies identified in the Bewsher Review raise serious concerns about the accuracy of the Proponent's assessment for the Williams River and the hydrodynamics modelling. The flows from the Williams River to the Hunter Estuary are predicted to be reduced by an annual average of 22%. When considering the relative contribution of the Williams River to the estuary, some key flows (10th percentile exceedance) are predicted to be reduced by 5 to 8%. The Department considers that under certain climatic scenarios the reduction in flow from the Williams River could actually be higher and these have not been assessed by the Proponent.

Therefore, the Department has serious concerns that the errors in the modelling, together with the lack of cumulative impact assessment and recognition of the Williams River relative contribution to the Hunter Estuary, presents significant flaws in the Proponent's assessment of the proposal. This has lead to significant levels of uncertainty about the actual reduction of freshwater inflows to the estuary as a result of the proposal, under various climatic conditions and on a cumulative basis. Subsequently, without this analysis, downstream impacts on the receiving waters of the Hunter Estuary have not been fully addressed, leading to residual uncertainty about the effects of the proposal within the Hunter Estuary.

5.3 Hunter Estuary

Issue
The Upper Estuary is of specific interest as it contains over 200 licensed water users in the Hunter Tidal Pool. The Lower Estuary is also a specific area of interest as it includes the Hunter Estuary Wetlands Ramsar Site (Kooragang and Shortland Wetlands) and the proposal has been identified as a "controlled action" under the EPBC Act for potential impacts to the

[23] The existing Williams River flows refer to flows at Seaham Weir, computed by the Proponent's water source model.
[24] From Bewsher Consulting (2010) "*Independent Review of Tillegra Dam Hydrology*" 27 September 2010

Ramsar Wetlands. Estuaries are complex environments and interrelated systems and have many other inherent values in addition to those listed above and therefore the Department has considered the impacts of the proposal on the estuary overall. To address the concerns of stakeholders, the Proponent utilised several hydrodynamics models[25] which are the key assessment tools used to predict potential physical changes in the Hunter Estuary from the proposal. The ELCOM[26] model was used to identify the sensitivity of the lower estuary to various scenarios about the phase of the proposal and specific flow conditions. The TUFLOW-FV model was used to specifically assess the impacts of the proposal on the Upper Estuary and the Tidal Pool Users.

Consideration

The Department considers that estuarine environments are inherently complex and dynamic systems and numerical modelling undertaken can only provide approximations of reality. The Department recognises the technical complexity of the numerical modelling undertaken and notes that many stakeholders raised issues about the modelling and impacts on the Hunter Estuary. Given the complexity of the modelling and importance in relying on the predictions of the modelling to evaluate impacts to the Hunter Estuary, the Department considered a technical review of the numerical modelling was warranted by an independent expert. The Department commissioned Dr Bill Peirson of the Water Research Laboratory (WRL) of the University of New South Wales to review the validity, accuracy and appropriateness of the hydrodynamics modelling. The focus of the WRL Review was to check that the models used by the Proponent were valid and appropriate to assess the hydrodynamic and water quality impacts of the proposal on the Hunter Estuary. WRL prepared an initial review of the documentation associated with the ELCOM, TUFLOW and TUFLOW-FV models and found that there were significant gaps in the documentation and, therefore, it was not possible to determine whether the approach adopted by the Proponent and conclusions made were reliable (refer to WRL (2010a) in **Appendix G**).

In response to WRL's findings, the Proponent commissioned two supplementary reports by its consultants (BMT WBM 2010[27] and Ecological 2010[28]) to provide further documentation about the modelling undertaken. These reports were subsequently reviewed by WRL (WRL 2010b) and the WRL Review is attached in **Appendix G**. The key findings of the WRL Review (2010b) include:

1. The impact of the dam during the filling period does not appear to have been assessed in detail;
2. There is a significant irregularity in deriving the Hunter flood hydrograph and consequent model validation; and
3. Neither the TUFLOW-FV nor ELCOM model is valid and appropriate for the assessment of dry weather flows and salinity intrusion to the Upper Estuary.

The WRL (2010b) review also recommended that the Proponent should be able to quantify the proposal's impact on key ecological processes such as examining the frequency of flood inundation and salinity intrusion.

The Proponent prepared an additional response (Appendix I) to the outstanding issues in WRL (2010b) and responded as follows:

- **Dam Filling Phase** – the Proponent considered that the sensitivity scenarios simulated in the ELCOM modelling showed that the first fill-up phase was not a critical scenario;

[25] The Proponent has undertaken modelling of the Hunter Estuary using three models, ELCOM (3-D Flow and Salinity model), TUFLOW (2-D Flood model) and TUFLOW-FV (2-D Flow and Salinity model).

[26] ELCOM is the Estuary, Lake and Coastal Ocean Model

[27] BMT WBM (2010) "Estuarine Impacts of the Proposed Tillegra Dam: A Collated Assessment" Report No. R.N1651.003.00.docx August 2010

[28] Ecological (2010) "Tillegra Dam Ramsar Wetland Impact Assessment - Response to Independent Review" Prepared for Hunter Water Corporation, 23 August 2010

- **Flood calibration** – the Proponent considers the flood model is appropriate and that the calibration issue relates to the upstream boundary of the model and is not relevant;
- **Upper Estuary** – the Proponent states that the proposal does not affect dry weather inflows to the estuary and consequently, salinity intrusion.
- **Quantifying impacts** – the Proponent considers that as the modelled output data shows very small changes that it is not possible to present maps of data with nil changes.

Given the importance of relying on the numerical modelling predictions for determining the impacts of the proposal on the Hunter Estuary and the Hunter Estuary Wetlands Ramsar Site, and that key concerns remained outstanding, the Department sought further advice from Dr Bill Peirson of WRL (WRL 2010c), presented in Appendix G.

In summary, the WRL advice (WRL 2010c) concluded:

- **Dam Filling Phase** – no detailed unsteady flow modelling has been undertaken to address the dam fill-up phase. The dam fill-up phase could take a long period (a decade or more) and could have a significant effect on the estuary if inflows are substantially reduced. Further, impacts of the fill-up phase occurring concurrently with a drought has not been assessed;
- **Frequency and duration of medium to high flows** – numerical modelling has been completed however sufficient analysis of the results has not been undertaken to quantify changes; and
- **Estuary impacts when the Hunter River is in drought and the Williams River is a major contributor of freshwater inflows to the estuary** – notes that this is a difficult issue to address and would require simulations of estuarine flow and salinity behaviour that incorporated a wide range of recorded climatic conditions (over several decades) to ensure that representative conditions are included. The TUFLOW modelling *may* include such conditions.

The Department also reviewed the additional information provided by the Proponent's consultants by BMT WBM in August 2010 (BMT WBM 2010) and the most recent report (HWC 2010[29]) in October 2010 and considers there are significant issues which causes uncertainty about the predicted impacts of the proposal on the Hunter Estuary. The major areas of uncertainty at this point in time include:

1. Assessment of flow scenarios

The Department notes the ELCOM modelling included 16 different sensitivity scenarios of the proposal and an additional three scenarios to simulate sea level rise (BMT WBM 2010 pp.122). BMT WBM (2010) compared these various scenarios to generally conclude that the estuary was not sensitive to hydrological changes from the proposal.

The Department has reviewed the 19 scenarios and considers that some of these scenarios are not relevant to the assessment of the proposal as some include certain translucency rules[30] for the operation of Seaham Weir which do not form part of the proposal. Additionally, the impact assessment of the Hunter Estuary and the Wetlands Ramsar Site needs to be undertaken on the characteristics of the wetland "at a given point in time", not on the basis of sea level rise projections[31]. Of the total 19 scenarios, the Department considers that scenarios summarised in Table 2 are most relevant (from those presented in BMT WBM 2010)

[29] Hunter Water Corporation (October 2010) "Tillegra Dam – response to DoP Questions, Project No. 003618/01/08/06, DoP Ref: 09/00891

[30] Translucency rules involves the release under specific conditions, of some or all inflows coincident with their occurrence.

[31] The Department acknowledges that sea level rise will have future impacts in the estuary, however the review of the proposal's merits needs to be undertaken on the condition of the Ramsar wetlands "at a given point in time"; the Commonwealth Government's guidelines (Commonwealth of Australia 2009 "Matters of National Environmental Significance" Significant Impact Guidelines 1.1) state that "at a given point in time" refers to the time of designation for the Ramsar list.

to assess the impacts of the proposal, as they describe the proposal under specific flow conditions, with and without Tillegra Dam.

Table 2 - Summary of ELCOM sensitivity scenarios – operational phase

Scenario	Daily flow at Seaham Weir (ML/day)	Description of sensitivity scenario[32]	Comparison
1	5	• Median flow conditions for the Hunter, Patterson and Williams River • Existing configuration and flow release conditions at Seaham Weir • Mean tide • Tillegra Dam not included	Comparison of scenarios 1 and 3 allows comparison of pre and post Tillegra Dam, assuming 50% flow conditions and the proposed new fishway is installed.
3	20	• Median flow conditions for the Hunter, Patterson and Williams River • Seaham Weir transparent to 20 ML/d (proposed) • Mean tide • Tillegra Dam included	
11	5	• 25%[33] flow conditions for the Hunter, Patterson and Williams River; • Existing configuration and flow release conditions at Seaham Weir • Mean tide • Tillegra Dam not included	Comparison of scenarios 3 and 11 compares operation of Tillegra Dam during median flows with 75% exceedance flows without Tillegra Dam
13	1005	• Median flow conditions for the Hunter and Patterson Rivers • 90%[34] flow conditions for the Williams River • Existing configuration and flow release conditions at Seaham Weir • Mean tide • Tillegra Dam not included	Comparison of scenarios 3 and 13 compares operation of Tillegra Dam during median flows with different flow conditions and without Tillegra Dam
14	805	• Median flow conditions for the Hunter and Patterson Rivers • 90% flow conditions for the Williams River; • Existing configuration and flow release conditions at Seaham Weir • Mean tide • Tillegra Dam is operational	Comparison of scenarios 13 and 14 compares the same flow conditions (median flows for the Hunter and Patterson and 10% exceedance for the Williams) with and without Tillegra Dam

Source: The scenario numbers, Seaham Weir flow and scenario descriptions are sourced from BMT WBM (2010, pp.122); the discussion of comparisons forms part of the Department's assessment

Notes: 1. To isolate the effect of the dam, it is useful to compare scenarios based on the same flow conditions.

2. Shaded rows denotes the "base case" for comparison with sensitivity scenarios

The Department has reviewed the predicted changes in water levels and salinity of the sensitivity scenarios presented in Table 2 and agrees that the predicted changes for the scenarios considered, in the vicinity of the Ramsar wetlands are small and are highest immediately downstream of Seaham Weir. BMT WBM (2010 pp.124) also notes that the greatest change can be seen for scenario 14, which includes 90% flow conditions for the Williams River with 50% flow conditions for the Hunter and Patterson Rivers. Under this scenario, there is a predicted reduction in flows from Seaham Weir of 200 ML/day, which is the largest reduction considered in the sensitivity scenarios presented in Table 2.

[32] The BMT WBM report (2010, pp.122) adopts the reverse description for describing percentile flows such that a 25% flow condition is actually the 75th probability exceedance, that is, flows that occur for up to and including 75% of the time (low flow).

[33] The 25% flow condition referred to in BMT WBM (2010) refers to the 75th exceedance probability, which are flows that occur for up to and including 75% of the time (low flow).

[34] The 90% flow condition referred to in BMT WBM (2010) refers to the 10th percentile exceedance, which are flows that occur for up to and including 10% of the time (high flow).

Figure 9 shows the predicted reduction of combined freshwater inflows to the estuary, post Tillegra Dam.

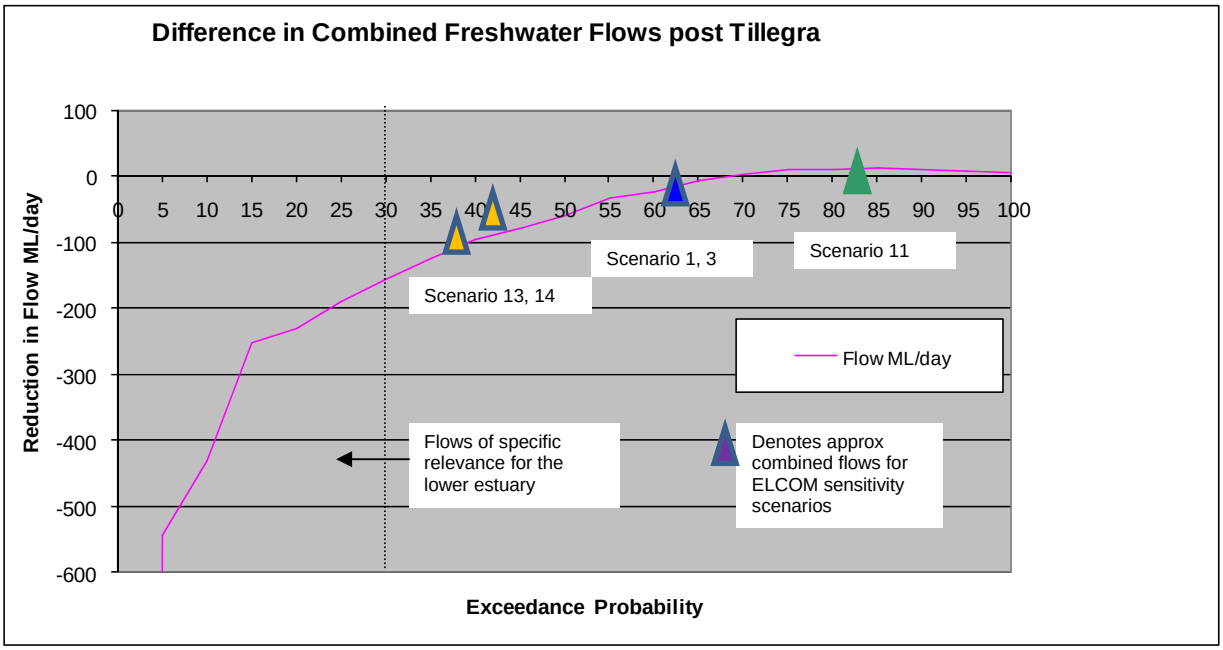

Figure 9: Reduction in Combined Freshwater Inflows post Tillegra Dam

Source: Data sourced from Ecological (2010, pp.69)
Notes:

1. The first data point (0 exceedance probability – 19,341 ML/day) was eliminated from the graph so that the difference in flow for other probabilities could be seen.
2. The data for Seaham Weir (including the predicted reduction as a result of the proposal) is derived from the HWC model which underestimates flows, particularly in the 0-10th percentile exceedance range (refer to Section 5.2).
3. The approximate flows for the Williams and Patterson Rivers for each scenario were estimated from flow duration curves (Figure 2-8 in BMT WBM 2010, pp.15), and Seaham Weir inflows were obtained from Table 2. The total (combined) freshwater inflow for each scenario were compared to data in Table 1, Appendix C of Ecological (2010, pp.69), to derive approximate exceedance probabilities for the combined freshwater inflows.

As can be seen in Figure 9, the sensitivity scenarios selected by the Proponent are for combined flow conditions that are in the range of median to low flows. Further, combined freshwater flows in this range are not predicted to be reduced significantly, which could be part of the reason why predicted changes in these sensitivity scenarios are small. The Department considers that the estuary requires a range of inflows including the higher, median and lower range of flows. As can be seen from Figure 9, the sensitivity scenarios are useful to assess the relative impact of the proposal when applied to the moderate and low flow scenarios stated by BMT WBM (2010).

From Figure 9, it can be seen that the range of flows to be most affected by the operational phase of the proposal are combined freshwater flows up to and including the 30th percentile exceedance probability. These flows (30th percentile exceedance probability) are less frequent however contain a higher volume. However, the Proponent's combined flow scenarios are all within the range of approximately 40th to 85th percentile exceedance probability. The Department notes that the Proponent's assessment and conclusions about estuarine impacts relies substantially on the results of the sensitivity analysis of the ELCOM modelling. The Department considers the ELCOM scenarios discussed in Table 2 can be applied to those specific flow classes, however, caution should be exercised in applying those findings to other flows, such as the high flows (up to and including the 30th percentile exceedance probability).

One of the Proponent's consultants reports, Ecological (2010 pp.70) notes that the flows in the class above the 30th percentile exceedance are likely to carry into the lower estuary, although

higher flows greater than the 5th percentile exceedance are required for substantive flushing and reset of the salinity structure[35]. The Department adopts a precautionary approach and therefore considers that all flows up to and including the 30th percentile exceedance can have varying levels of influence within the lower estuary and considers it has not been clearly demonstrated that it is only the very large events (200 GL/day) that have a significant influence on the lower estuary. Accordingly, the Department considers that lower flow ranges such as 20 GL/day (approximately the 5th percentile exceedance probability) could be considered as having an important role in estuary dynamics and wetland system functioning. It may also be possible that even smaller and more frequent high flow events to the 30th percentile exceedance (about 2,500 ML/day) are important for the lower estuary. In such a dynamic environment, the importance of these events to the estuary will vary according to many factors such as antecedent[36] conditions.

Although the Proponent has considered moderate to low flows in the ELCOM modelling, the Department considers that it is critical that other flow scenarios require thorough consideration (through appropriate numerical modelling), to adequately understand whether the flow ranges that are predicted to be most reduced (refer to Figure 9), would cause changes to the flow dynamics and salinity of the estuary. This includes a comprehensive evaluation of the range of medium to high flows (though not flood flows which were assessed by the proponent using the TUFLOW model) which may reach the lower estuary.

The Department also has concerns that the Proponent is very reliant on the ELCOM modelling (a steady state model[37]) which provides predictions based on instantaneous flows, that is, flow conditions occurring at a single point in time. The Department considers that the application of these modelling predictions to impacts on the lower estuary is limited, given the model is not able to account for antecedent conditions which have a significant role in estuary dynamics.

2. Assessment of the filling phase of the proposal

The Department notes the WRL Review (2010c) concludes that unsteady state modelling[38] is required to assess the fill-up phase of the proposal. However, the Proponent considers the sensitivity scenarios used in the ELCOM model (a steady state model) are sufficient to address the fill-up phase.

The ELCOM modelling included a sensitivity analysis of some fill-up phase scenarios[39], however, of these fill-up phase scenarios, Scenarios 7, 12 and 15 include transparency rules for Seaham Weir which are not part of the proposal and therefore have not been further considered. One fill-up phase scenario (Scenario 2) could be compared with a scenario which has all the same flow conditions and does not include Tillegra Dam (Scenario 6). These two scenarios were for median flow conditions in the Hunter and Patterson Rivers and for the 75%[40] flow condition for Seaham Weir. The Department notes that the predicted change between Scenario 2 and 6 is small but is also cautious about relying on one sensitivity assessment by the ELCOM modelling to conclude that the estuary is not sensitive to the fill-up phase, particularly considering the filling phase could occur for up to almost two decades.

[35] BMT WBM (2010) and Ecological (2010) consider that infrequent large flood events (being floods exceeding 200 GL/day) are required to displace saltwater from the lower reaches of the estuary, suggesting that only floods of this size reaches the lower estuary.

[36] Antecedent conditions refers to the preceding conditions, such as whether the estuary has received little freshwater flows (due to drought conditions in the inflowing catchments) or whether there has been a preceding wet period with a number of high flow events.

[37] A steady state model uses instantaneous flow and therefore is based on a single point in time and cannot account for antecedent conditions.

[38] Unsteady state modelling allows variable flows throughout the estuary (ranging from the freshwater end to the tidal flows at the entrance) whereas steady state modelling incorporates instantaneous flow only, that is, what is happening at the present time.

[39] Scenarios 2, 7, 12 and 15 in BMT WBM (2010) are for fill-up phase conditions.

[40] 75% flow conditions in BMT WBM (2010) refers to the 25th percentile exceedance probability

The Proponent (HWC 2010[41]) considers that based on the ELCOM modelling results, the first fill-up phase is not critical and that the dam will always be in various stages of a fill up phase, particularly after being emptied following a drought. As the Proponent contends that the ELCOM model shows the fill-up phase is not critical, further modelling by the TUFLOW-FV (an unsteady state model) was not undertaken (HWC 2010 pp.3-4).

A range of climatic scenarios and corresponding greater range of flows should have been assessed to provide greater certainty about the potential impacts of the proposal during this phase. The Department notes that the Proponent's existing water supply infrastructure, Seaham Weir, exerts considerable existing influence over the Williams River flows. However, scenarios such as what would happen to the estuary during the filling phase under protracted drought conditions or when the Williams River is the major contributor of freshwater flows to the estuary should have been examined closely by the Proponent.

This lack of assessment presents significant uncertainty about the impacts of the filling phase on the Hunter Estuary which is likely to be around eight years but could be up to 18 years under drought conditions. The Department considers that without proper and thorough assessment of the impacts of the filling phase on a range of flows and scenarios, particularly those which are of greatest importance to the Ramsar wetlands, there is significant residual uncertainty about the proposal's impacts during this phase. In the absence of greater certainty, it is unknown whether irreparable damage could be caused to the estuary, including the Hunter Estuary Wetland Ramsar Site during the filling phase.

3. Worst-case scenario analysis

The Department has carefully evaluated worse-case scenarios across the range of construction, filling and operational phases of the proposal. The consideration of these worst-case scenarios are critical to understanding the most significant impacts that could occur within the Williams River system, the receiving waters of the Hunter Estuary and resultant impacts on the Hunter Estuary Wetland Ramsar Site.

The most recent assessment by the Proponent of the worst case scenario is discussed in Ecological (2010, pp.45-46). In its assessment, Ecological (2010) consider that the dam will always be in a filling phase as it will never be full (the target storage volume is slightly above 90%) and, therefore, the first filling phase of the dam is not a critical scenario. Further, they consider the key parameter for assessment is the physical volume of water taken out of the system and potential effects could be compounded through antecedent conditions such as a low flow period or extended drought. To examine the effect of the extracted volume out of the system they have relied upon the TUFLOW-FV modelling which analysed daily time series data of the 1940s drought period, which was the worst drought period on record within the Hunter region. Ecological (2010) has therefore considered this to be the worst case scenario and has concluded that there would be negligible changes as a result of the proposal. Finally, they state that through all the numerical modelling undertaken, there would be no worst case scenario for the Hunter Estuary Wetlands Ramsar Site as all the modelling has showed "no detectable" change or "very minor" effects on the existing environment, well within the range of natural variation.

The Department considers that further analysis should have been undertaken on the worst case scenario to put beyond doubt the issue of whether the proposal would cause a significant threat of irreversible damage to the Hunter Estuary Wetland Ramsar Site. This could be achieved through the examination of additional scenarios to test the sensitivity of the estuary to other thresholds; for example, scenarios which incorporated flows of the 5th -10th percentile exceedance probability[42] for the Williams River coupled with low flow conditions for the

[41] Hunter Water Corporation (October 2010) "Tillegra Dam – response to DoP Questions, Project No. 003618/01/08/06, DoP Ref: 09/00891 pp.3-4

[42] 95% flow conditions in BMT WBM (2010) refers to the 5th percentile exceedance probability, that is flows that occur for up to and including 5% of the time (high flows). Under these conditions, the effect of Seaham Weir on flows is diminished according to Figure 5-8 in BMT WBM (2010)

Patterson and Hunter Rivers (for example 90th – 95th percentile exceedance [43]), mimicking the scenario where the Williams River is a major contributor of freshwater flows to the estuary as the Hunter and Patterson Rivers are experiencing drought conditions. There could also be other scenarios where the Williams River is a major contributor to the estuary (greater than 50%) whilst the Hunter and Patterson Rivers are in drought.

Other scenarios could also be tested within the range of flows that are most likely to be affected by the operation and filling phase of the proposal. For example, the filling phase (which is predicted to cause a higher reduction in flows under certain flow conditions and seasons than the operational phase – as discussed in **Section 5.2**) could have been modelled over a historical time series (which includes known drought conditions) to evaluate the effects of the filling phase during drought conditions.

Of the three catchments, the Williams River catchment is the closest catchment to the coast and with its headwaters in the Barrington Tops National Park can experience quite different rainfall patterns and intensities from coastal storms and orographic rainfall, compared to the larger catchment of the Hunter River. The Department considers the lack of assessment of certain flow scenarios which could be worst case scenarios causes significant uncertainty about the impacts of the proposal under certain climatic conditions during the filling or operational phase of the dam. The Proponent has not examined such scenarios and their resultant impacts and this has caused a significant degree of risk and uncertainty in the impact assessment of the proposal.

4. Cumulative effects

The numerical modelling undertaken by the Proponent uses the existing flows from the Williams River as a basis to assess the relative impacts of the proposal. However, no additional analysis was undertaken by the Proponent to assess the cumulative effects of the Proponent's existing extractions from its water supply infrastructure on the Williams River (Chichester Dam and Seaham Weir) and the proposed dam to predict the possible hydrodynamic changes to the Hunter Estuary on this cumulative basis[44]. The Bewsher Review noted that the Proponent's existing water supply infrastructure (Chichester Dam and Seaham Weir) has reduced the annual average flows from the Williams River by 21% and that the proposal would further reduce the annual average Williams River flows by 22%, causing a cumulative reduction of annual average flows from the Williams River of 43%.

The Department has significant concerns that in only considering the relative impact of the proposal (independent of current impacts to the Hunter Estuary from the Proponent's existing water supply infrastructure) gradual and incremental effects could occur within the Hunter Estuary, which on their own may not present significant concern, but when considered cumulatively, may cause significant impacts. As this analysis has not been undertaken by the Proponent, the Department considers this to be a significant flaw in the Proponent's assessment, with significant residual uncertainty about the cumulative effects of the proposal (with the Proponent's existing water supply infrastructure) on the Hunter Estuary.

Conclusion

The Department considers that the Proponent's assessment of predicted changes to the Hunter Estuary contains fundamental flaws because material issues to the functioning of the estuary and the Hunter Estuary Wetlands Ramsar Site have not been fully addressed. Such issues include the effect of the proposal on the estuary during the filling phase (and under drought conditions which could extend up to two decades), the assessment of additional scenarios in the range of flows that are to be most affected by the proposal and worst case scenarios and specific analysis of cumulative effects of the proposal with the Proponent's existing water supply infrastructure. Given these flaws and the internationally recognised

[43] 5-10% flow conditions in BMT WBM (2010) refers to the 90th-95th percentile exceedance probability, that is flows that occur for up to and including 90-95% of the time (low flows).

[44] The Department considers that a cumulative analysis should have been provided showing the impacts of the proposal and the Proponent's existing water extractions, compared with pre-development "natural" conditions.

ecological significance of the Ramsar wetlands, the Department considers that there is an unacceptable level of uncertainty about the proposal's impacts on the estuary at this time.

5.4 Hunter Estuary Wetlands Ramsar Site

Issue

The Hunter Estuary Wetlands Ramsar Site (Kooragang Component)[45] is internationally recognised for its wetland communities which provide important feeding and roosting habitat for migratory birds and supports waterbirds at critical stages in their life cycles, including breeding, migration stop-over, roosting and drought refuge. The Kooragang Component contains five Ramsar wetland types including estuarine waters, inter-tidal mud, sand or salt flats, saltmarshes, mangrove swamps and freshwater swamp forests and tree-dominated wetlands. It also contains five critical ecosystem components and processes, four of which include: hydrology (tidal regime and freshwater inflows) which provides a major influence on the distribution and extent of saltmarsh; *Sarcicornia* saltmarsh which supports migratory shorebirds; waterbirds, particularly migratory shorebirds; and intertidal mudflats which provide foraging habitat for migratory shorebirds.[46]

There have been significant changes in the critical components and processes of the Kooragang Component since its Ramsar listing, including: an overall decline of 50% of the number of migratory shorebirds between 1984 and 2007; over the same period a decline in the species diversity of migratory shorebirds from 17 to 13 species; and a 41% decrease in the area of saltmarsh since the time of listing since 1984[47]. The ecological assessment relies heavily on the conclusions drawn from the Proponent's hydrodynamics modelling (discussed in Section 5.3).

The Department also notes that the proposal is a "controlled action" under the EPBC Act for impacts on the Hunter Estuary Wetlands Ramsar Site.

Consideration

The Proponent's EAR included an assessment of the ecological impacts on the Hunter Estuary Wetlands Ramsar site, based on the hydrodynamics modelling undertaken by the Proponent's consultants. The assessment concluded that the modelled hydrodynamic data demonstrated that the impacts of the proposal on the hydrological function and sediment/nutrient budgets would be minor and well below any significant ecological thresholds. Additionally, the assessment considered that there is no worst case scenario for the proposal as the modelling results showed only minor deviations in baseline water quality and hydrological parameters.

As discussed in Section 5.3, the Department commissioned an independent expert, Dr Bill Pierson of the Water Research Laboratory to undertake a review of the validity and appropriateness of the models used and the accuracy of the interpretations that have been drawn. The WRL Review is provided in Appendix G. The WRL identified significant gaps in the reports and also considered that the ecological issues under consideration were not clearly defined and the linkages of the ecological requirements into the modelling studies were unclear. Further, the WRL Review recommended that to determine the impacts of the proposal on the Hunter Estuary and its fringing wetlands, an estuarine environmental flow assessment was required.

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[45] The Hunter Estuary Wetlands Ramsar Site comprises Kooragang Nature Reserve and the Shortland Wetlands. However, as the Shortland Wetlands are not directly linked (hydrologically) to the Hunter Estuary, the assessment has focused on the Kooragang Nature Reserve, or Kooragang Component. All references in this report to the Hunter Estuary Wetland Ramsar Site refers to the Kooragang Component only

[46] Brereton, R. and Taylor-Wood (2010, pp.ii-iii) Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site" Report to the Department of the Environment, Water, Heritage and the Arts, Canberra DRAFT REPORT

[47] Brereton, R. and Taylor-Wood (2010, pp.vii) Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site" Report to the Department of the Environment, Water, Heritage and the Arts, Canberra DRAFT REPORT

In response to the WRL Review, the Proponent prepared revised documentation of the hydrodynamics modelling and the ecological assessment[48]. The revised ecological assessment was primarily prepared to respond to the WRL Review and to also address issues raised by Kingsford and Hankin (2010). The Proponent's assessment (Ecological 2010) is based on the numerical modelling results from the BMT WBM (2010) report. For example, Ecological (2010, p.32), stated that "*ELCOM sensitivity modelling undertaken by BMT WBM (2010) has shown that changes to water levels and their immediate surrounds are likely to be altered by Tillegra Dam to a maximum of only 6 – 13 mm. Such a small change in water level is unlikely to result in measureable incursions of saline water into brackish and freshwater wetlands. Ecological impacts to these components of the Ramsar wetlands from saline incursion are therefore unlikely*."

The potential impact of the proposal on the Hunter Estuary Wetlands Ramsar site was a key issue raised in public submissions and agency submissions including DECCW, NOW and HRCMA. Specifically, the proposal has the potential to increase the saltwater intrusion into the estuary as a result of a reduction in freshwater flows from the Williams River leading to changes in wetland communities and habitats. Additionally, the proposal may potentially cause a change in the duration and frequency of important flow events for the wetlands, particularly for specific flow thresholds which trigger ecological responses. The Department agreed that the potential impacts on the Ramsar Site is a key issue and considers that the significance of the wetlands requires a high level of certainty regarding potential impacts of the proposal. Therefore, the Department commissioned an independent expert, Cumberland Ecology, to review the ecological assessment of the proposal and to provide advice to the Department on the accuracy and appropriateness of the Proponent's assessment and whether the Proponent's conclusions were supported. The Cumberland Ecology Review is provided in Appendix H.

Cumberland Ecology (2010a) raised numerous key issues about the Proponent's wetland impact assessment including that the Proponent's assessment should include:

- Consideration as to how the proposal might impact the existing decline of wetland flora and migratory seabirds;
- The need for a species specific impact assessment including a detailed analysis of how different species use different components of the wetlands. The species and plant communities that are at greatest risk from the proposal should be identified;
- Quantifying the impacts through defining and mapping the area of potential impacts on wetlands under different filling and flooding scenarios;
- Providing more detail on the changes in hydrological inputs and potential impacts on migratory waders;
- Providing more information on the cumulative changes and impacts of the proposal (on top of past changes); and
- Providing a detailed analysis of migratory species and wetland types to indicate which species and communities could be most at risk from hydrological and salinity changes under a range of scenarios.

Cumberland Ecology (2010a) also noted that there were outstanding issues associated with the hydrodynamics modelling and that the filling period had not been clearly assessed. The Proponent was provided with the opportunity to respond to the issues raised and provided a supplementary report[49] to answer these questions. The Proponent considered several scenarios including the predicted differences in water level heights at the 25th[50] percentile of flows. At this flow range, heights could change by -6 to 7mm and depending on local topography, the tidal extent of inundation could therefore be reduced by a few centimetres to a

[48] Ecological Australia (2010) "Tillegra Dam Ramsar Wetland Impact Assessment"

[49] Hunter Water Corporation (October 2010) "Tillegra Dam – response to DoP Questions, Project No. 003618/01/08/06, DoP Ref: 09/00891.

[50] The 25th percentile of flows actually refers to the 75th percentile exceedance probability (low flows)

few metres (HWC 2010 pp19)[51]. Overall, the Proponent considered that as its modelling results showed very small changes to the flow and salinity in the vicinity of the wetlands, the ecological implications of the proposal to the wetlands were nil, and therefore, further work as identified by Cumberland Ecology was not required.

Following receipt of the Proponent's report, the Department and Cumberland Ecology conducted a site visit of the Kooragang Nature Reserve on 10 November 2010 (refer to Figure 10). The areas visited included the Kooragang Dykes, Stockton sand spit, Tomago Wetlands and parts of the northern, southern and western sides of Kooragang Island (within the Kooragang Nature Reserve). Subsequently, Cumberland Ecology provided a further letter of advice (included in Appendix H) which confirmed that the low relief of Kooragang Island meant that small changes in water level and topography can cause appreciable changes in flora and fauna. Cumberland Ecology (2010b) also stated that although the predicted scale of impacts as a result of the hydrology modelling is small, there are outstanding issues regarding the modelling which have yet to be resolved and therefore such matters should be put beyond doubt to ensure the assessment of impacts on the wetland is robust. The advice also concluded by reiterating the need for the Proponent to undertake a risk assessment of changes to individual species.

Figure 10: Stands of *Sarcicornia* saltmarsh within the Kooragang wetlands – a critical component of the Ramsar wetland (Department of Planning)

The Department recognises that the conclusions drawn in the Proponent's wetland impact assessment are mainly based on the results of the numerical modelling. The Department and its independent expert on the Hunter Estuary modelling have previously identified material concerns about the numerical modelling (as discussed in Section 5.3). The Department acknowledges the scenarios considered in the numerical modelling show relatively small changes in water levels and salinity in the lower estuary. However, concerns remain that the scenarios considered (operational and for the filling phase) may not be as relevant to the ecological assessment as other scenarios which could have more closely examined the freshwater flow ranges that reaches the lower estuary and how the volume and frequency of these flows could be affected and whether the duration between these flows may increase as a result of the proposal.

[51] Hunter Water Corporation (October 2010) "Tillegra Dam – response to DoP Questions, Project No. 003618/01/08/06, DoP Ref: 09/00891, pp.19

Additionally, as discussed in Sections 5.2 and 5.3, the volume and relative importance of the freshwater inputs from the Williams River can vary across seasons and also depend on the flow volumes and characteristics from the other main catchments (Hunter and Patterson Rivers). As previously discussed, under certain scenarios, the Williams Rivers could be the major contributor to the Hunter Estuary, if the Hunter is in drought. Additionally, the filling phase has not been adequately assessed by the numerical modelling which could have serious implications for the wetlands. The dam filling phase is predicted to be about eight years but if it coincided with a drought it could take 18 years. This phase is critical, as depending on its magnitude, any impacts at this time could be irreversible. Therefore, the Department considers it essential that potential impacts during this phase are fully assessed and clearly understood. As it has been found that this phase has not been adequately assessed (Section 5.3), the Department considers that the possibility of irreversible damage occurring to the wetlands during this phase presents an unacceptable level of risk.

Further, the lack of assessment by the Proponent of the cumulative impacts of the proposal with its existing water supply infrastructure (particularly within the Williams River) presents a serious flaw in the predicted assessment of impacts from the proposal within the Hunter Estuary. It is widely acknowledged that there has been a serious decline in the components of the Hunter Estuary Wetlands Ramsar Site with the Limits of Acceptable Change[52] currently being exceeded for the abundance and species diversity of migratory shorebirds and saltmarsh[53]. The Hunter Estuary Wetlands Ramsar Site is currently facing pressures and threats and loss of its key values that underpinned its original listing. The Department considers that assessing only the "relative" impact of the proposal, rather than also assessing the "cumulative" impact of the Proponent's current water extractions could lead to incremental changes within the Hunter Estuary, which on their own may not be significant, but when considered on a cumulative basis, may reach a "tipping point" posing serious threats of irreparable damage to components within the Hunter Estuary Wetlands Ramsar Site.

Conclusion

The Department is of the view that certain scenarios such as the filling phase, seasonal flow differences, high relative flows from the Williams River and the changes to the frequency and duration of these flows have not been fully evaluated by the numerical modelling. This presents a significant knowledge gap on the predicted impacts of the proposal, leading to considerable uncertainty about the impacts on the Hunter Estuary Wetlands Ramsar Site. There are threats of serious or irreversible damage to the wetlands and considering the values of the wetlands are of international significance there is significant risk from the proposal. The Department's independent ecology expert has identified extensive further work that is needed, such as the species specific assessment and a risk based assessment approach. Additionally, the Department's independent expert states that the Proponent's predictions of no impact on the wetlands are based on the numerical modelling which has been identified as having significant flaws. Given the level of uncertainty and level of risk, the Department considers that based on the precautionary principle the proposed dam should not be approved.

[52] Limits of Acceptable Change (LAC) in this context refers to limits that are within the range of variation of the components, processes and benefits or services that can occur without causing a change in the ecological character of the site. The LAC make it easier to determine when the ecological character is likely to change or when it has changed as a result of development, pollution or other human interference (Department of the Environment, Water, Heritage and the Arts (2008) "National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands" – Module 2 of the National Guidelines for Wetlands. pp.26

[53] Brereton, R. and Taylor-Wood (2010, pp.vii) "Ecological Character Description of the Kooragang Component of the Hunter Estuary Wetlands Ramsar Site" Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. DRAFT REPORT

5.5 Other Water Licence Holders

Issue

The proposal is located on the Williams River which is one of the main freshwater inflows to the Hunter Estuary. The proposal falls within the *Hunter Unregulated and Alluvial Water Sources 2009 Water Sharing Plan*[54] (HUAWSP) which commenced on the 1 August 2009.

The Hunter Estuary receives inflows from the HUAWSP, the *Hunter Regulated River Water Source 2003* (HRRWSP) and the *Patterson Regulated River Water Source 2007* (PRRWS). Under the National Water Initiative, the NSW Office of Water (NOW) is in the process of implementing significant water reforms across New South Wales (under the Water Management Act 2000) since 2000. The focus of the reforms has been consultation with many stakeholders and the development of Water Sharing Plans, which are a regulatory instrument.

Each of the Water Sharing Plans has a long-term annual average extraction limit which sets limits on the amount of water that can be extracted out of the system. The current long-term annual average extraction limits have been based on historical data and current extractions. The WM Act also requires that the water sharing plans are subject to a rolling 10 year review, with the *Hunter Regulated River Water Source 2003* (HRRWSP) due for review by the Natural Resources Commission in about 2013 – 2014.

The NOW is working towards developing an ecologically sustainable diversion limit for the Hunter Estuary, to underpin the forthcoming review of the HRRWSP by the Natural Resources Commission. It is anticipated that the future ecologically sustainable diversion limit will act like a "cap" which will quantify the average annual volume of water that can be extracted from the HUAWSP, HRRWSP and PRRWS (and under what conditions) whilst sustaining the environmental health and values of the Hunter Estuary. However, at this point in time, the ecologically sustainable diversion limit for the Hunter Estuary is not known. The Department considers the water reform process managed by the NOW is a strategic and comprehensive process and that there are significant risks involved if a project of the scale of the proposed dam was approved, which could pre-empt NOW's thorough and strategic water reform process.

Consideration

The Williams River is one of the main tributaries of the Hunter Estuary and the proposed dam is predicted to cause a reduction in annual average inflows from the Williams River to the Hunter Estuary of about 22%[55]. The existing Water Sharing Plan (HUAWSP) contains provision for the operation of Tillegra Dam through a review process to determine whether the long-term average annual extraction limit held by the Proponent needs to be varied. The Water Sharing Plan requires the review to consider the environmentally sustainable level of extraction with regards to:

a) environmental flow releases from the dam to meet:
   i) instream habitat requirements, and
   ii) passage of flow through Seaham Weir to meet estuary requirements, and

[54] Under the Water Management Act 2000 (WM Act), Water Sharing Plans have been developed for water sources and include specific rules for environmental protection, water extractions, managing licence holders' water accounts and water trading. Water Sharing Plans are regulatory instruments and are part of the water reform process led by the NOW since 2000. The WM Act requires that water is allocated for the health of the water source and its dependent ecosystems such as wetlands, floodplains and estuaries as a first priority. This is achieved through the Plan setting aside all water above the long-term average annual extraction limit for environmental needs, thus protecting most of the flows for environmental purposes.

[55] Hunter Water Corporations' existing water supply infrastructure on the Williams River (Chichester Dam and Seaham Weir) has presently reduced average annual flows from the Williams River to the estuary by some 21%, and together with the proposed Tillegra Dam, this would lead to an overall, cumulative reduction of flows from the Williams River, to the estuary of 43%.

b) Seaham Weir infrastructure, operation and extraction[56].

As discussed above, the volume, frequency and duration of flows required from the Williams River to meet estuary requirements will not be known until the NOW completes its modelling of the Hunter Estuary, to develop a sustainable diversion limit for the Hunter Estuary. Until the sustainable diversion limit for the Hunter Estuary has been developed, it is not known whether the reduced flows from the operation of the proposal on the Williams River could lead to reduced entitlements to other licensed water users within the Hunter system. This situation could potentially arise if the reduction in the environmental flow component from the Williams River (to the Hunter Estuary) requires a corresponding increase in the environmental flow component from other tributaries (such as the Hunter River), to protect the health and environmental values of the Hunter Estuary. If this situation occurred, the allocation of additional water entitlements to the Proponent (for the proposed dam) could cause an equivalent reduction in the allocation from other water entitlements in the Hunter System.

Under the WM Act, Supplementary Licence holders have the lowest level of security and therefore these licence holders would be the first to be affected. Currently, Macquarie Generation is the largest holder of Supplementary Licences in the Hunter System (holding 36,000 units which on average equals 36,000 ML/year). Macquarie Generation owns Liddell and Bayswater Power Stations and water is an essential part of the cooling process for electricity generation purposes. About half of Macquarie Generation's entitlements comes from its Supplementary Licences. The next class of licence holders that could be affected include "general security" licence holders, which includes irrigators, dairy farmers, coal mines for dust suppression purposes, horse studs and vineyards.

Until the sustainable diversion limit for the Hunter Estuary is developed, there is significant uncertainty whether the reduction in environmental flows from the Williams River to the Hunter Estuary (as a result of the proposal) would have an effect on other users in the Hunter system such that other licence holders will lose or have their entitlement reduced.

The Department considers that it is premature to recommend approval for a proposal of this scale which could have significant implications for other water licence holders throughout the Hunter System. Until the NOW has completed its hydrodynamics modelling and determined the sustainable diversion limit for the Hunter Estuary, the Department considers there is significant uncertainty about the impacts of the proposal on the existing water entitlements of other licence holders.

Additionally, the effects on other licence holders could be greatest when the Williams River is a major contributor to the Hunter Estuary, particularly if the Hunter and Patterson Rivers are in drought. As stated in Section 5.2, the Proponent's analysis did not contain an analysis of the relative contribution of the Williams River to the Hunter Estuary and further, there has been no statistical assessment of the wet and dry periods of the three main tributaries. Although the Proponent has included the provision of a 2,500 ML/a Environmental Contingency Allowance, the Department considers that this volume is considerably insufficient to ameliorate the effects of the proposal on a catchment wide basis.

Conclusion

The operation of the proposal has the potential to affect other water licence holders throughout the Patterson and Hunter catchments, leading to unequitable water sharing plan arrangements. This is a significant issue in terms of the social and economic impacts of the proposal, particularly if there are adverse impacts on other users that cannot be properly predicted at this time. Reduced entitlements to a range of industries in the Hunter (for example power generators, coal mining, horse studs and agriculture) could cumulatively have a major impact on the regional and State's economy.

[56] Refer to Part 10, Division 1, clause (7) of the Hunter Unregulated and Alluvial Water Sources 2009 Water Sharing Plan

5.6 Other Issues

The Department's assessment included consideration of a range of other issues which, whilst significant, were generally not issues upon which the Department has reached the conclusion that the dam should not be approved. These key issues are outlined in Table 3.

Table 3: Other Key Issues considered by the Department

Issue	Consideration
Dam water quality	The Department acknowledges that the proposal to install a multi-level offtake tower will allow the preferential selection of water at specific depths to mimic the "natural world" or downstream physical and chemical conditions of the river downstream. The Department considers that baseline and event based monitoring would be required to support the Proponent's proposed extraction depth. This issue could be managed through conditions requiring monitoring and evaluation and through this feedback loop, ensuring the most appropriate quality of waters are released through an adaptive management approach.
Stream water quality (Williams River)	The Department recognises that the proposal could cause downstream impacts on stream water quality which would be managed to some degree based on the dam water quality monitoring and use of the multi-level off-take tower. However, the Department considers that that the effects of the project on downstream water quality would require a comprehensive monitoring program which would include hydrological, water quality, geomorphological and ecological parameters.
Geomorphology	The Department considers the Proponent's report is sufficient to inform the type of geomorphological impacts that may occur. However, to properly evaluate the type and extent of actual impacts and undertake remedial measures if needed, an extensive monitoring program would be required to measure such impacts. Specifically, a comprehensive downstream monitoring program to identify if the project is causing geomorphological changes, particularly changes which may have consequent impacts on ecology, riparian vegetation and downstream coastal floodplain Endangered Ecological Communities (EECs) would be required. Downstream coastal floodplain EECs may possibly occur and as their essential habitat includes drainage lines and terraces that are periodically inundated on coastal floodplains, actual changes in the downstream hydrological and geomorphological environment may negatively impact upon such communities and riparian vegetation in general.
Aquatic Ecology	The Department recognises that the proposal would cause downstream impacts and would therefore require environmental performance based conditions to monitor the effect of the dam on the stream aquatic ecology.
Aboriginal Heritage	Whilst there were no objects recorded on Aboriginal Heritage Information Management System (AHIMS) this is likely to be indicative of the lack of previous survey effort in these areas, rather than an absence of Aboriginal objects. However, the Proponent carried out subsurface testing and retrieved 34 artefacts from separate sites. Three sites would likely be impacted during construction and the remaining five sites would be inundated when the dam is filled. DECCW and the Department recognised that some uncertainty remained regarding the assessment of impacts on Aboriginal sites within the ancillary infrastructure elements of the proposal, however this could be dealt with via approval conditions requiring additional survey work, assessment and ongoing consultation with Aboriginal stakeholders.
Non-Indigenous Heritage	The key historic heritage sites that would be inundated by the proposed dam are Munni House (listed as having local heritage significance on the Dungog LEP) and the Quart Pot/Munni Cemetery (listed as having regional heritage significance on the Dungog LEP). The Department's assessment found that further investigative studies and the development of alternative off-setting proposals (to that presented in the Submissions Report) would be required to adequately manage impacts in relation to the historic heritage sites. With regards to the Quart Pot/Munni Cemetery, any decision to retain grave sites in situ or relocate graves and headstones, would require further consultation with any known remaining relatives, additional information regarding the impacts before Government could make an informed decision as to whether or not the cemetery would be relocated.
Biodiversity	Project construction and dam inundation would remove approximately 224 hectares of native vegetation. This includes 0.2 hectares of Subtropical Rainforest and 145 hectares of Riparian Forest, both Endangered Ecological Communities under the Threatened Species

Issue	Consideration
	Conservation Act 1995. In addition, field surveys confirmed that eight threatened fauna species occurred in the area and would potentially be impacted by the proposal. The proponent and DECCW agreed on a final offset package for the proposal, with the key components including dedication of 1,323 hectares of land for the expansion of Barrington Tops National Park ("offset lands") and a 709 hectare carbon and biodiversity "offset corridor" linking to the southern edge of the proposed enlarged National Park.
Visual Impact	Key visual impacts relate to the inundation area and dam infrastructure including the wall and spillway. The Department found that the proposed infrastructure would constitute a significant visual change to the rural character of the area. However, visual mitigation could be appropriately achieved through the commitments of the Proponent for mitigation measures such as screen planting, along with conditions addressing matters such as lighting, materials, reflectivity and landscaping.
Construction Noise	Whilst construction noise impacts would be significant, these could be appropriately managed through measures such as limiting construction hours, proactive engagement with the surrounding community and relocation of affected residents where appropriate.
Air Quality	Construction of the dam and roads would include dust generating activities that could impact on nearby sensitive receivers. The Department noted that the Proponent has purchased the nearest sensitive receiver since exhibition of the EA, whilst standard dust management conditions could be imposed to ensure appropriate mitigation.
Land Use	The project would cause a significant change in land use from substantially agricultural land to a water supply dam. The valley floor is generally good quality land suitable for a range of agricultural activities whilst the hilly side country has significantly reduced carry capacity, and cattle stocking rates vary considerably. Within the area there a number of agricultural enterprises that would be lost, including five dairy farms, one cropping property, 14 grazing enterprises, 17 hobby farms, one landscape business and one horse riding business. The Department notes that the Proponent has purchased much of the land required for the proposal and that some landowners have relocated within the region while others have moved out of the district. The proposal would result in a change in land use not only for the directly affected inundation area but also to adjoining/buffer areas with the need to possibly include covenants or change zonings to restrict types of activity/development with the primary objective of protecting water quality in the storage area. Notwithstanding that there will be a reduction in primary production in the area, the Proponent considers that this will be offset by the potential for increased recreation and tourism based business. The Department accepts that this would be an unavoidable impact of inundation if the proposal were to proceed and considers that the issue could be managed with Council and the Department of Industry and Investment.

6. CONCLUSIONS AND RECOMMENDATIONS

The Department has assessed the EA, submissions on the project and the Proponent's Submissions Report in accordance with the requirements of the *Environmental Planning and Assessment Regulation.*

The Department considers that there is significant uncertainty about the impacts of the proposal on the Hunter Estuary and internationally recognised Hunter Estuary Wetlands Ramsar Site. Additionally, the proposal could cause significant and inequitable impacts on other water licence holders within the Hunter System.

The Department has assessed these issues in significant detail while having regard to the objects of the EP&A Act and has also carefully considered the principles of ecologically sustainable development, including the precautionary principle. The Department has concluded that:

- There is a demonstrated need for the augmentation of the Proponent's water supply to address the existing shortfall and to provide sufficient water supply to meet the projected population growth of the Lower Hunter. However, the Proponent, to date, has not fully demonstrated that the proposed dam is the best option to meet the long term water supply needs of the region. The Department considers other options are available to the Proponent and these should be given full consideration for future proposals for water supply augmentation;
- Although there is demonstrated need for augmentation of the Proponent's water supply system, the Department considers there is significant residual uncertainty on several material issues and therefore the proposal carries significant risks, especially during the filling and operation of the proposal. The filling phase is most likely to be around eight years but during drought conditions could extend to 18 years. The proposal is also expected to be operational for 50 years or more. The Department has significant reservations that the uncertainty of impacts could occur over a long timescale and therefore the proposal carries the risk of causing irreparable environmental damage.
- There is considerable uncertainty about the proposal's impacts on the Williams River, the cumulative impact of the Proponent's existing water supply infrastructure and its importance as a major contributor of freshwater flow to the Hunter Estuary.
- There is significant uncertainty about the impacts of the filling and operational phases of the proposal on the flow dynamics and water quality within the Hunter Estuary. Despite the Proponent's numerical modelling, significant gaps remain in the impact assessment of the proposal as scenarios that could be significant to the lower estuary have not been assessed by the Proponent.
- Due to the significant uncertainty of the changes to the flow and salinity dynamics that could occur within the vicinity of the Hunter Estuary Wetlands Ramsar Site, there is significant residual uncertainty about the impacts that could occur to the species and communities within the internationally recognised Hunter Estuary Wetlands Ramsar Site.
- The Department considers the water reform process managed by the NOW is a strategic and comprehensive process and that there are significant risks involved if a project of the scale of the proposed dam was approved, which could pre-empt NOW's thorough and strategic water reform process. There is uncertainty about the future impacts of the proposal on other water licence holders throughout the Hunter System and it is not known whether the proposal could lead to a reduction or loss of entitlements for other water licence holders within the Hunter catchment.

present high levels of social and environmental risk. Therefore, on the basis of the precautionary principle, the Department considers that there are threats of serious or irreversible environmental damage that would result from the proposal and that there is significant uncertainty as to whether these threats can be minimised or managed to acceptable levels.

Subsequently, the Department is of the view that the proposal is not in the public interest and should be refused.

It is recommended that the Minister:

- **consider** the Director-General's report;
- **refuse** to approve the project application; and
- **sign** the attached Instrument of Refusal (tagged B)

23/11/10

Daniel Keary
Director Infrastructure Projects

23/11/10

Richard Pearson
Deputy Director General

Sam Haddad
Director General
24/11/2010.

APPENDIX A – INSTRUMENT OF REFUSAL

APPENDIX B – ENVIRONMENTAL ASSESSMENT

APPENDIX C – SUBMISSIONS REPORT

APPENDIX D – SMEC JUSTIFICATION REVIEW

APPENDIX E – THE CIE ECONOMIC EVALUATION REVIEW

APPENDIX F – BEWSHER CONSULTING REVIEW

APPENDIX G – WRL REVIEW

APPENDIX H – CUMBERLAND ECOLOGY REVIEW

APPENDIX I – PROPONENT'S RESPONSE TO DEPARTMENT'S QUESTIONS (OCTOBER 2010)