T4 PROJECT

RESPONSE TO SUBMISSIONS ON PREFERRED PROJECT

Prepared for Port Waratah Coal Services Limited | January 2014

EMM
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PORT WARATAH
COAL SERVICES
Pioneering Through Partnership

T4 Project

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1 Introduction

1.1 Background

Port Waratah Coal Services Limited (PWCS) proposes to construct and operate a new coal export terminal at the Port of Newcastle, New South Wales (NSW). The proposal, known as the Terminal 4 Project, or T4 Project, will provide additional port capacity required to accommodate future growth in coal exports from the Hunter Valley and NSW more broadly. PWCS owns and operates the Kooragang Coal Terminal (KCT) at Kooragang Island and Carrington Coal Terminal (CCT) at Carrington, both in the Port of Newcastle. The T4 Project is essentially an extension to KCT.

Approval for the T4 Project is being sought under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The consent authority under Part 3A is the NSW Minister for Planning and Infrastructure, although in this instance, this responsibility will be delegated to the NSW Planning Assessment Commission (PAC). The Part 3A process under the EP&A Act has also been accredited as the appropriate Commonwealth assessment pathway for the project.

As part of the T4 Project's approval process an environmental assessment (EA) was prepared by EMGA Mitchell McLennan Pty Limited (EMM), with input from various external specialists. It was prepared in accordance with the requirements of the Commonwealth Department of the Environment (DoE), NSW Department of Planning and Infrastructure (DP&I) and other government agencies, as given in the Director-General's Requirements (DGRs) issued on 14 March 2011, letter clarification dated 17 May 2011 and supplementary DGRs issued on 21 September 2011.

The EA was publicly exhibited between 8 March and 7 May 2012. In response, PWCS received 488 submissions, including a large number of form letters and multiple submissions from some respondents. Most of the submissions were from objectors to the project though some supporting submissions and general comments were received. All submissions were reviewed and issues raised were summarised and responded to in a combined response to submissions and preferred project report (RTS/PPR).

Following exhibition of the EA, the T4 Project's design was also modified. Modifications were made in response to submissions and government feedback, to further minimise environmental impacts, to reflect the reduced maximum proposed coal throughput capacity from 120 million tonnes per annum (Mtpa) to a nominal 70 Mtpa, and to incorporate engineering improvements and the biodiversity offset package. Accordingly, the RTS/PPR responded to submissions; described the 'preferred project', inclusive of modifications since the EA was published; assessed the environmental impacts of the modifications; and provided a revised statement of commitments for environmental management, mitigation and monitoring.

The RTS/PPR was publicly exhibited between 16 September and 22 November 2013. In response, approximately 995 submissions were received, including a large number of form letters and multiple submissions from some respondents. Most of the submissions (approximately 619) were in support of the T4 Project. Objecting submissions mostly raised similar matters to those in the submissions on the EA, which it is considered are adequately addressed in the RTS/PPR. However, DP&I identified 29 matters which it requested PWCS provide responses to. These matters and the responses to them are provided in Chapter 3 of this report.

This 'RTS on Preferred Project' will be submitted to the DP&I who will distribute the report to government agencies and the PAC for consideration in the project's assessment and determination.

1.2 Overview of assessment reports prepared

This RTS on Preferred Project forms part of a suite of reports that have been prepared to support the T4 Project's approval process under the EPBC and EP&A Acts, several of which are referenced in this report. As background information, an overview of the assessment reports prepared to date is provided below. The T4 Project's design, including the proposed environment management, mitigation and monitoring measures, has been progressively refined throughout this process, including to incorporate outcomes of the technical assessments. This has included developing a comprehensive biodiversity offset strategy and package.

The main reports prepared to support the T4 Project's approval process are as follows:

- **Preliminary Environmental Assessment Report** prepared by EMM (2010) to accompany PWCS's project application under Part 3A of the EP&A Act, brief relevant stakeholders about the project, provide a preliminary assessment of potential environmental impacts and identify key aspects to focus on in the EA.

- **Referral of proposed action** to the then Commonwealth Department of the Environment, Water, Heritage and the Arts (now DoE), prepared by EMM (2011). It was prepared to inform the Environment Minister's decision on whether approval under the EPBC Act is necessary and if so, the type of assessment required. The referral provided details on the proposed action, existing environment, likely impacts on matters of national environmental significance (MNES), and measures proposed to avoid or reduce impacts. It concluded that the proposed action is likely to have a significant impact on MNES and is therefore a controlled action.

- **Environmental Assessment** prepared by EMM (2012) to provide information about the T4 Project, assess its potential environmental, social and economic impacts, and detail the measures proposed to mitigate, manage and/or monitor potential impacts. The EA was prepared in consultation with government agencies and other stakeholders and in accordance with the relevant guidelines and policies. It addressed the relevant assessment requirements set out in the DGRs. It included detailed contamination, groundwater, flooding, hydrodynamic, surface water, ecology, noise, air quality, greenhouse gas (GHG), traffic, visual, heritage, economic and social assessments by experts in these fields. The technical assessments were prepared over several years and included environmental sampling and monitoring, quantitative modelling by industry experts and development of environmental management, mitigation and monitoring measures in consultation with relevant stakeholders.

- A combined **Response to Submissions/Preferred Project Report** prepared by EMM (2013) to respond to submissions on the EA and assess the project changes made after the EA's publication, which were mentioned in Section 1.1. The following studies prepared after the EA were also appended to the RTS/PPR:

    - a review of air quality-related health effects, prepared by Associate Professor David McKenzie, the Head of the Department of Respiratory and Sleep Medicine at the Prince of Wales Hospital, and Director of the Cardiac and Respiratory Clinical Stream of the South-Eastern Sydney Local Health District;

    - reports relating to contamination management and remediation, prepared by groundwater and contamination specialists at Douglas Partners and project design engineers at Aurecon Hatch, including a landfill closure plan, remediation action plan (pre-detailed design) and containment cell design report;

- an updated impact mitigation and biodiversity offset strategy prepared by ecologists at Umwelt, and including assessments of the strategy's adequacy using the NSW Government's BioBanking Assessment Methodology (BBAM) and the Commonwealth's EPBC Offsets Calculator;

- an Environmental Impact Assessment (EIA) of the proposed habitat restoration and creation works at the biodiversity offset site at Tomago, prepared by Umwelt; and

- an engineering review of alternative project designs that may better protect green and golden bell frog (*Litoria aurea*) habitat, prepared by the design engineers Aurecon Hatch, with input from technical specialists including ecologists.

- This **RTS on Preferred Project** which outlines submissions received on the RTS/PPR and responds to those matters indicated by DP&I as requiring a response.

1.3 Overview of the T4 Project

The T4 Project is unchanged from the description given in the RTS/PPR. A brief outline of the project is provided in this section and the indicative site layout plan is provided in Figures 1.1 and 1.2. The Tomago offset site and a concept design for the restoration project proposed there is shown in Figure 1.3.

The T4 Project application area is described in detail in the EA and RTS/PPR. In summary it comprises the:

- proposed coal terminal site on Kooragang Island and wharves and berth pockets in the Hunter River South Arm in the Port of Newcastle ('T4 project area'); and

- biodiversity offset site at Tomago ('Tomago offset site').

The T4 Project is proposed to be developed progressively in response to demand for increased coal export capacity nominated by coal producers and would provide a nominal coal throughput capacity of up to 70 Mtpa. This is in addition to PWCS's existing approved capacity of 120 Mtpa at KCT and 25 Mtpa at CCT, and would give PWCS a total approved capacity of 215 Mtpa. The project's design allows for future stockyard and rail receival expansion within the T4 project area to achieve a nominal capacity of 120 Mtpa when required by demand. Further expansion to increase throughput capacity beyond 70 Mtpa would be subject to future assessment and approval under the relevant legislation.

All coal will be received by rail, stockpiled and then shipped to market. The T4 Project is subject to detailed design and will be further refined, however generally it includes the following:

- **Site preparation:** ground treatments including preloading will take place to create suitable foundation conditions for development. Sand dredged from the Hunter River South Arm will be pumped to the proposed stockyard area, to provide preload and fill. This will be supplemented by imported fill such as sand, gravel and rock, trucked in from elsewhere. Contamination management and remediation works will be undertaken including capping, barrier walls and pumping out and treating some contamination.

- **Rail infrastructure and coal receival:** rail infrastructure will comprise up to four arrival tracks generally along the same alignment as the existing rail lines servicing Kooragang Island. These tracks will converge into up to two dump stations, where coal will be unloaded from trains. There will be up to four departure sidings, which will combine into a single track around the outside of KCT's rail loop, leading to Kooragang Island's departure track over the Hunter River rail bridge.

- **Coal stockyard and stockpiles:** a relatively level stockyard with benches and berms will be constructed following ground treatments. There will be up to four coal stockpile pads, oriented in an east west direction, and yard machines for stacking and reclaiming coal.

- **Wharf and berth infrastructure:** wharf and berth facilities are proposed on the north side of the Hunter River South Arm, near the Tourle Street Bridge. Up to two shiploaders and berthing for up to three ships is proposed.

- **Conveyors:** coal conveyors, feeders and transfer stations will extend through the stockyard to deliver coal from the dump stations to the stockpiles, and then to the shiploaders at the wharf, via buffer bins.

- **Infrastructure and services:** new infrastructure will be constructed including roads, electricity supply, dust suppression and fire fighting systems, fences, amenities, landscaping, car parks and water management infrastructure. Some existing infrastructure and services will be relocated such as electricity transmission lines, water lines, fibre optic cable and Jemena's gas lines. Existing KCT infrastructure, systems and workforce, including administration, stores and maintenance facilities and environmental management and monitoring systems, will also be used.

- **Environmental management, mitigation and monitoring:** a comprehensive suite of environmental management, mitigation and monitoring measures, equipment and systems will be in place. This will include, but not be limited to, real-time monitoring of particulate matter; green and golden bell frog habitat ponds across the site; biodiversity offsets at Ellalong Lagoon and next to Brundee Swamp Nature Reserve; and habitat restoration and creation works at a biodiversity offset site at Tomago, adjoining the Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site.

- **Workforce:** a construction workforce of up to an estimated 1,500 people is proposed. The T4 Project will be operated by PWCS's existing workforce and approximately 80 additional employees, supported by contractors as required.

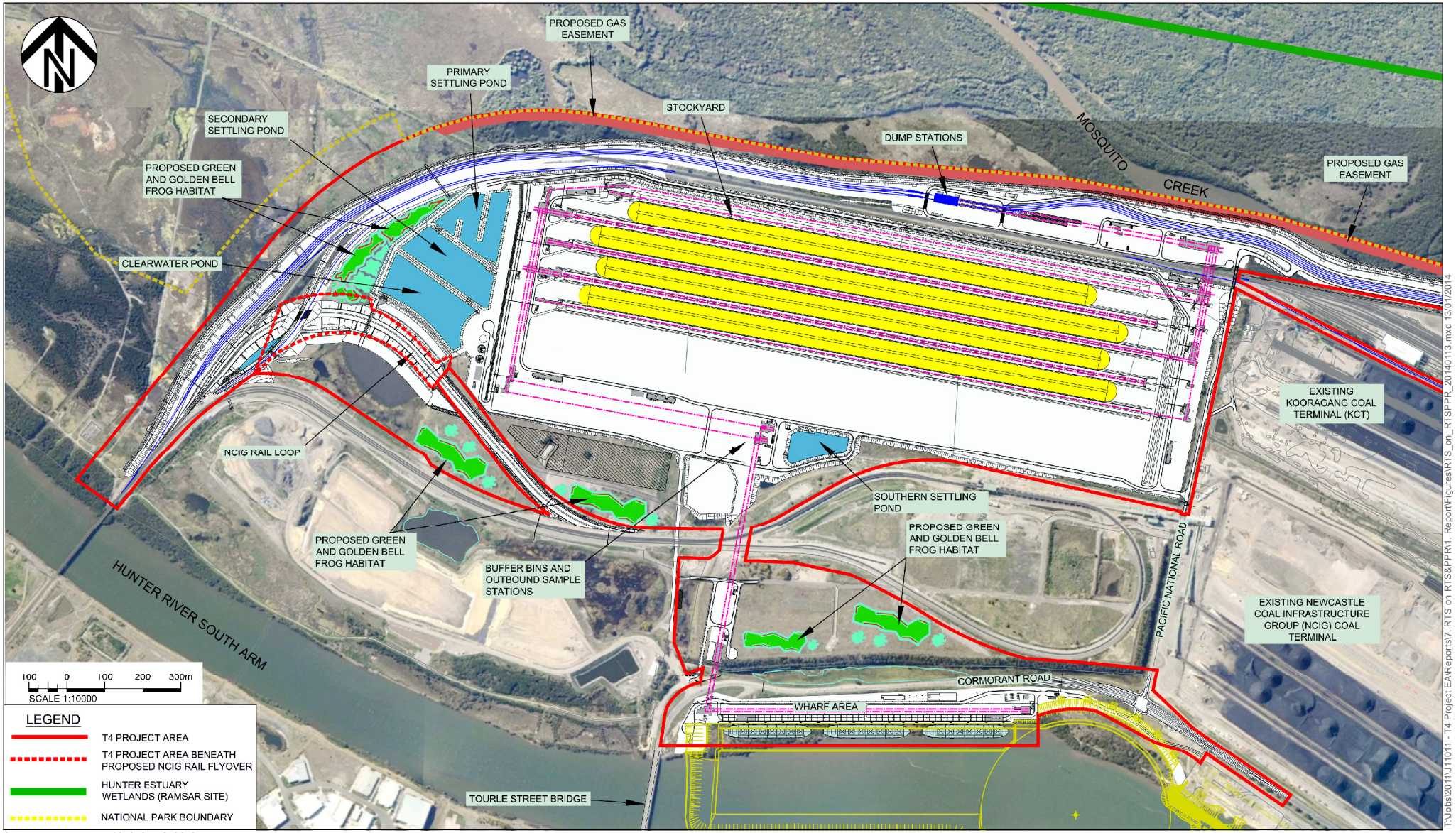
Further details on the proposed T4 Project are provided in the EA and the RTS/PPR.

The issues DP&I identified for address in this report that relate to project components (as opposed to the assessment methodology or other matters) predominately relate to those components that were modified after the EA's publication and described and further assessed in the RTS/PPR. These include the biodiversity offset package and the habitat restoration and creation works proposed at the Tomago offset site.

1.4 Purpose of this report

The DP&I, in a letter dated 9 December 2013, provided clear guidance on those matters raised in submissions that require response from PWCS. It identified 29 matters for address. The main purpose of this report is to respond to these matters. Additionally, it provides a brief overview of the T4 Project, its approval process to date and the submissions received on the RTS/PPR.

This report will be submitted to the DP&I who will distribute it to government agencies and the PAC for consideration in the project's assessment and determination.



Source: Aurecon Hatch, 2013; SMEC, 2013

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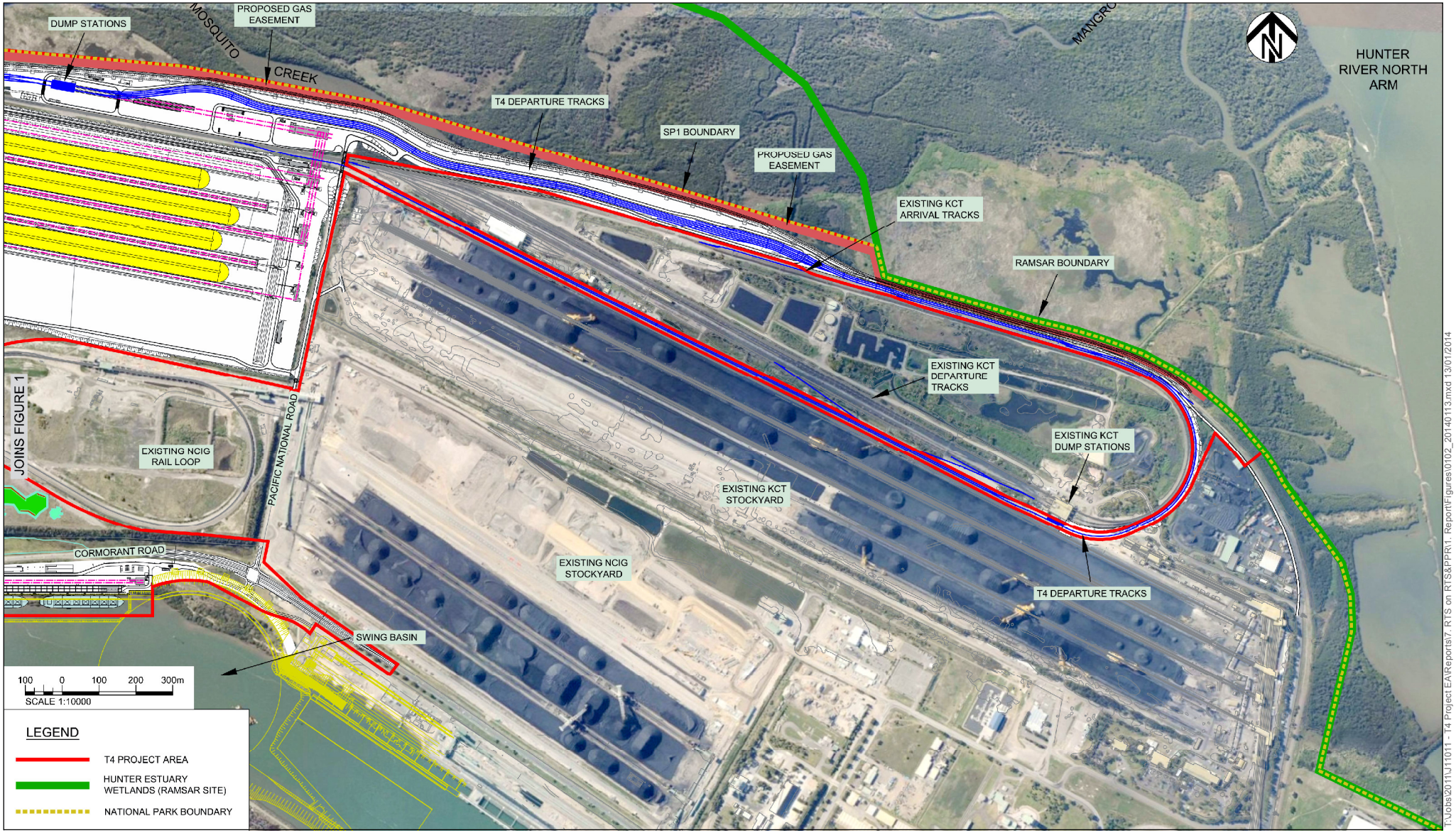
T4 Project (indicative layout) - western view

T4 Project - Response to Submissions on Preferred Project

FIGURE 1.1



Source: Aurecon Hatch, 2012; SMEC, 2013

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T4 Project (indicative layout) - eastern view

T4 Project - Response to Submissions on Preferred Project

FIGURE 1.2

T:\Jobs\2011\J11011 - T4 Project EA\Reports\7. RTS on RTS&PPR\1. Report\Figures\0103.mxd 13/01/2014

Source: IDS, 2012; Umwelt, 2012

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Tomago offset site - restoration project concept design

T4 Project - Response to Submissions on Preferred Project

FIGURE 1.3

2 Summary of submissions and response methodology

2.1 Exhibition details

The RTS/PPR was publicly exhibited for more than two months, from 16 September to 22 November 2013 at the following locations:

- DP&I Information Centre, 23-33 Bridge Street, Sydney;
- Nature Conservation Council of NSW, Level 2, 5 Wilson Street, Newtown;
- Newcastle City Council (NCC), City Administration Centre, 282 King Street, Newcastle;
- Newcastle City Library, Laman Street, Newcastle;
- Mayfield Library, Hanbury Street, Mayfield;
- Stockton Library, King Street, Stockton;
- Raymond Terrace Library, 18A Sturgeon Street, Raymond Terrace;
- Cessnock Library, 65-67 Vincent Street, Cessnock; and
- Nowra Library, 10 Berry Street, Nowra.

These are the same exhibition locations as for the EA, other than the Raymond Terrace, Cessnock and Nowra libraries, which were included due to the biodiversity offset sites being in the Port Stephens, Cessnock and Shoalhaven local government areas (LGAs) respectively.

It was also available for review on DP&I's website and copies were sent to government agencies nominated by DP&I.

Exhibition details were advertised in the Newcastle Herald, Sydney Morning Herald, Daily Telegraph, South Coast Register and on DP&I's website. The original advertised exhibition period was until 28 October 2013 however it was extended at the request of community members.

2.2 Submissions received

Approximately 995 submissions were received in response to exhibition of the RTS/PPR, including a large number of form letters and multiple submissions by some respondents. The submissions were reviewed by DP&I and classified into one of the following three categories:

- **Supports**, comprising submissions that were supportive of the T4 Project proceeding;
- **Objects**, comprising submissions that objected to the T4 Project and/or the coal industry in general; or
- **Comments**, mainly comprising submissions made by government agencies that did not necessarily support or object to the project, but rather made comments on matters such as the assessment scope and methodology and/or included suggested conditions of approval.

The submissions and their classifications are all provided on the DP&I's website at:

http://majorprojects.planning.nsw.gov.au/index.pl?action=view_job&job_id=4399

It is noted that some of the submissions from individuals and organisations classified by DP&I as 'comments' appear to express support for or objection to the T4 Project. However to ensure consistency with information on the Department's website, these same classifications have been applied in this report.

Also, multiple and duplicate responses were submitted by some parties. Due to factors including respondent details being withheld it was not possible to identify all of these and this may have resulted in some double counting of submissions.

Based on DP&I's review and classification of the submissions, and noting the above disclaimers, approximately 619 respondents supported the T4 Project and 355 were opposed to it. The remaining 21 provided general comments on the project. The majority of the submissions (approximately 926) were from individuals and 64 were from organisations and government agencies. A breakdown of submissions by classification (supports, objects or comments) and respondent type is provided in Table 2.1.

2.3 Response methodology

All the submissions on DP&I's website were reviewed. Based on this review it was determined that almost two-thirds of the submissions were in support of the T4 Project. Reasons given for support relate mostly to the project's economic and social benefits including employment; role in accommodating future growth in coal exports from the Hunter Valley; comprehensive environmental mitigation, management and offset measures including noise, dust and water management measures, biodiversity offsets, and private sector funded management, remediation and use of significantly contaminated land; and PWCS's ongoing contribution to the community and proven track record in successfully operating coal terminals in the Port of Newcastle. Matters commonly raised in the supporting submissions are summarised in Section 2.4 though are not discussed further in this report.

Just over a third of the submissions objected to the T4 Project. Consistent with submissions on the EA, common reasons for objection included concerns around the project's potential adverse air quality, health and ecological impacts; broader concerns about the rail corridor and coal industry, including its contribution to GHG emissions and climate change; and the view that there is no project need. Matters commonly raised in the objecting submissions are summarised in Section 2.4. A small number of submissions, mainly from government agencies, provided comments on the project, its assessment and suggested conditions of approval but did not necessarily support or object to it. Matters raised in objecting and commenting submissions are mostly consistent with matters raised in submissions on the EA, which it is considered are adequately addressed in the RTS/PPR, or relate to matters that would typically be addressed in negotiating conditions of approval.

The DP&I, in its letter dated 9 December 2013, provided clear guidance on those matters that require response from PWCS. It identified 29 matters requiring response, each of which is addressed in Chapter 3 of this report. Chapter 3 contains DP&I's summaries of these matters, extracts from the original submissions on which DP&I's comments were based and responses to each matter. The responses were prepared by the same technical specialists that undertook the assessments in the EA and RTS/PPR, with input from PWCS.

Table 2.1 Breakdown of submissions by classification and respondent

Respondent type	Submissions received from:		
	Supports[1]	**Objects**[1]	**Comments**[1]
Community member	• 596 individuals, including form letters	• 330 individuals, including form letters and multiple responses from some	• 4 individuals
Non-government organisation/ community group	• Hunter Business Chamber • HunterNet Co-operative	• Aust.Coal Alliance • Australian Youth Climate Coalition • Birdlife Australia • Bylong Valley Protection Alliance • Clarence Environment Centre • Climate Action Newcastle • Coal Terminal Action Group • Coal Terminal Action Group Dust and Health Committee • Gloucester Residents in Partnership • Hunter Bird Observers Club (HBOC) • Hunter Communities Network • Hunter Community Environment Centre • Hunter Environment Lobby Inc. • Islington Village Community Group Inc. • Lock the Gate Alliance • Lock the Lake • Newcastle Public Health Professionals, The University of Newcastle • North East Forest Alliance - Hunter Region • Parks and Playgrounds Movements Inc. • Stockton Community Action Group • The Australia Institute (TAI) • The Black Hill Environment Protection Group and The Buttai Community Development Group • The Wilderness Society Newcastle	• Construction, Forestry, Mining and Energy Union, Mining and Energy Division, Northern Mining and NSW Energy District • Doctors for the Environment Australia • Nature Conservation Council of NSW

Table 2.1 Breakdown of submissions by classification and respondent

Respondent type	Submissions received from:		
	Supports[1]	**Objects**[1]	**Comments**[1]
Business	• Doito Pty Limited • DYWIDAG – Systems International Pty Limited • Gencom • Hunter Valley Coal Chain Coordinator Limited • KEPCO Bylong Australia Pty Limited • Malabar Coal Limited • Moore Management Pty Limited • Moray & Agnew Lawyers • Newcastle Coal Infrastructure Group • Ohmic Controls Pty Limited • Power Control Engineers Pty Limited • Reliable Conveyor Belt Pty Limited • Rio Tinto Coal Australia • Shenhua Watermark Coal Pty Limited • Spur Hill Management Pty Limited • Star Electrical • The Bloomfield Group • Total Temmco • Whitehaven Coal		• Northbank Enterprise Hub Pty Limited • Hardie Holdings
Government	• Newcastle Port Corporation (NPC)	• Hunter-Central Rivers Catchment Management Authority (CMA)	• Australian Rail Track Corporation Limited (ARTC) • Commonwealth DoE • Hunter New England Local Health District • NCC • NSW Department of Primary Industries – Fisheries NSW and NSW Office of Water • NSW Environment Protection Authority (EPA)

Table 2.1 Breakdown of submissions by classification and respondent

Respondent type	Submissions received from:		
	Supports[1]	**Objects**[1]	**Comments**[1]
			• NSW Office of Environment and Heritage (OEH), including the OEH Parks and Wildlife Group (Central Coast Hunter Range Region) • NSW Trade & Investment - NSW Resources & Energy • Port Stephens Council • Roads and Maritime Services (RMS), both their Roads and Maritime divisions • Transport for NSW
Political	• Lord Mayor of Newcastle	• Greens NSW	

Notes: 1. Based on submissions publicly available on DP&I's website and classifications by DP&I, also publicly available on its website.

2.4 Summary of matters raised in supporting and objecting submissions

This section summarises some of the main reasons for support and objection given in the submissions. The submissions can be viewed in full on DP&I's website.

2.4.1 Project justification and need

i Summary of reasons for support

Numerous respondents were of the view that there was a pressing need for the T4 Project. Reasons given included to:

- overcome port capacity constraints, ensure sufficient capacity to meet the Hunter Valley coal chain's long-term needs and service future mining industry expansion and growth in coal exports;
- remove coal chain bottlenecks and move ships more quickly with associated benefits such as reducing their waste discharges;
- fulfil obligations under the Capacity Framework Arrangements (CFAs), which were developed by the NSW Government and the coal industry and form a critical part of the Hunter's long-term coal export plan;
- deliver a solution the NSW Government sought for certainty of capacity and investment in the coal chain's future requirements;
- underpin more efficient, cost effective coal industry operations;
- provide certainty for industry and the region's future development, employment and increased wealth;
- provide confidence for current and prospective coal producers that additional infrastructure will be available to support further development of the Hunter Valley coal industry;
- invest in and ensure the viability of the Hunter's coal industry and that Australia remains competitive as a coal producing nation, and thereby help realise associated economic, industry and employment benefits for Australia and NSW and continued economic and social stability;
- continue the economic story of a region whose wealth, history and future has and is dependent on successful and responsible coal mining and export of the product; and
- help provide international access to a commodity for which there is considerable world demand.

It was raised that given the cyclical nature of coal demand it is important to obtain the necessary approvals now so that the coal export facilities can be built as quickly as possible when triggered by demand. This would reduce risk to companies. A view was expressed that if there is a long-term reduction in coal demand, it is important to capitalise on demand in the short term to avoid a lost opportunity for the Hunter.

Some submissions acknowledged the need to balance environmental and development considerations stating that:

- the T4 Project provides a fair balance between the environment and development and sets a benchmark for industrial development; and
- we cannot halt development without massive change to our standard of living, so we need to support 'good' developments.

ii Summary of reasons for objection

Several other respondents questioned the need for the project given a coal industry downturn, potential future decrease in coal's commercial viability, move to renewable energy and a perception that it relies on speculative industry needs and mining projects not guaranteed to occur. As in submissions on the EA, it was raised that the existing coal terminals are under-utilised and could be made more efficient to accommodate increased exports.

2.4.2 Project location

i Summary of reasons for support

Some respondents commented on the suitability of the T4 project area for the proposed development on grounds that:

- the project provides appropriate use of a brownfield site zoned for heavy industry, set amongst similar industrial operations and with ready access to an established deep water port;
- developing a coal terminal in the Port of Newcastle, which is an existing industrial port, will avoid developing terminals and associated pressures in new harbours;
- it allows common use of KCT's facilities; and
- it is relatively remote from residences.

ii Summary of reasons for objection

Conversely it was raised that the proposed T4 project area is too close to residential areas and ecologically sensitive areas such as the Hunter Estuary Wetlands Ramsar site.

2.4.3 Groundwater, surface water and contamination

i Summary of reasons for support

Respondents supported the T4 Project on the grounds that it provides a rare opportunity for use and private sector funded management and remediation of significantly contaminated state-owned land (within the T4 project area). This was considered a positive environmental outcome. It was raised that without the T4 Project, responsibility for capping and containing site contamination rests with the NSW Government, and so the project would remove this burden from government. A view was expressed that the T4 Project would positively transform the site from a waste disposal area to remediated and productive land.

ii Summary of reasons for objection

Consistent with the previous submissions, concerns were raised about:

- potential groundwater and contamination impacts, including exacerbation of existing contamination, and increased contaminant transport to estuarine aquifers and surface water bodies, including wetlands and the Hunter River, for example due to squeezing effects;
- risks of intercepting or exposing contaminants during construction;
- 'new' contamination including from dumping contaminated dredge material on the site;
- potential surface water impacts, including to water quality of surrounding wetlands and the Hunter River; and
- an inability to adequately assess impacts due to a lack of detail on proposed surface water management.

2.4.4 Ecology

i Summary of reasons for support

Numerous respondents supported PWCS's proposed biodiversity impact mitigation and offset package, stating that:

- PWCS has delivered a significant biodiversity offset package (approximately 850 ha), as well as investing in green and golden bell frog captive breeding and research programs. Significant investment has been made prior to project approval to secure environmental offsets which demonstrates a responsible and significant commitment to the environment;
- the proposed offsets benefit ecological diversity in the area where preservation for perpetuity is vital; and
- the commitment to higher value conservation areas provides a positive environmental outcome.

Some respondents raised that context must be given to the T4 project area's biodiversity, being that the habitats for threatened species and communities to be impacted are contaminated landfills.

ii Summary of reasons for objection

Conversely, many respondents raised concerns about ecological impacts and the mitigation and offset measures proposed to address them, largely:

- impacts on migratory birds, endangered ecological communities (EECs), mangroves, aquatic ecology, and native and threatened species, particularly the green and golden bell frog and Australasian bittern (*Botaurus poiciloptilus*);
- impacts on Deep Pond, Swan Pond, wetlands, the Hunter estuary, Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site;
- belief that the project will be partly developed on public conservation land owned and managed by the NSW National Parks and Wildlife Service (NPWS);

- concerns about developing that part of the site which has been subject of a successful restoration project (part of the Kooragang Wetlands Rehabilitation Project) and significant hours of volunteer work;

- adequacy of the proposed mitigation and biodiversity offset package to compensate for the project's impacts. For example it was felt that the Ellalong and Brundee offset sites outside of the Hunter estuary would not adequately offset impacts at the T4 project area within the Hunter estuary. Uncertainty on success of created green and golden bell frog habitat was again raised;

- view that habitat restoration projects should be demonstrated to be effective before any impacts on existing habitats be considered; and

- uncertainty on whether the proposed biodiversity offset sites have previously been used as offsets for other projects.

2.4.5 Noise

i Summary of reasons for support

Many supporting submissions stated that the proposed environmental management controls to protect the community and environment are comprehensive and 'state of the art' and include best practice engineering applications to manage noise. It was raised that this was supported by the noise modelling results which indicate that the project's noise levels will be acceptable.

ii Summary of reasons for objection

Some respondents raised concerns about the impacts of existing noise and increased noise due to the T4 Project, including night-time noise, sleep disturbance and associated health impacts.

2.4.6 Air quality

i Summary of reasons for support

Many supporting submissions raised that the proposed environmental management controls to protect the community and environment are comprehensive and 'state of the art' and include best practice engineering applications to manage dust. It was raised that this was supported by the air modelling results which indicate the cumulative dust levels will generally comply with government's guidelines.

ii Summary of reasons for objection

As with submissions on the EA, air quality was commonly raised in the objecting submissions, including concerns around:

- existing poor air quality in the region and increased project-related dust and particulate matter impacts, including from particulate matter less than 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and diesel exhaust emissions;

- amenity, nuisance and health impacts of air pollution, particularly dust, coal dust, particulate matter and diesel exhaust;

- use of baseline monitoring data from 2010 when higher levels were recorded in previous years;

- adequacy of existing air quality standards, including that the guidelines are outdated and health effects occur at levels below those given in the current guidelines;
- adequacy of the air quality modelling and assessment, stated as underestimating impacts. For example predictions for Stockton were considered to be inaccurate as they are based on baseline monitoring at other locations;
- EA's failure to address impacts of increased diesel exhaust impacts, predominately from increased shipping and train movements; and
- existing dust suppression, said to be ineffective, and that the proposed dust mitigation measures are inadequate and not best practice. As in the previous submissions, additional measures were requested, including covering coal stockpiles.

2.4.7 Greenhouse gases

Many of the objections to the T4 Project were based on concerns around its contribution to GHGs, global warming and climate change. It was stated by some that the predicted Scope 3 emissions are significant and warrant rejection of the project.

2.4.8 Transport and access

A small number of objectors raised concerns around existing traffic congestion and impacts of increased traffic from the T4 Project's construction and operation.

2.4.9 Employment and socio-economics

i Summary of reasons for support

Social and economic benefits were commonly given as reasons for supporting the T4 Project. These included that the T4 Project would:

- stimulate the economy and generate local employment, business opportunities and economic benefits to the NSW, Hunter and Newcastle regions during construction and operations, including long-term employment and economic opportunities for hundreds of businesses supplying the mines. Specific mention was made of people whose livelihoods depend on PWCS and the coal chain;
- secure employment for PWCS's hundreds of existing local employees, noting that PWCS is a large employer for trainees and young people and the employment provides security for families;
- keep local companies viable and allow them to maintain employment;
- generate tax and royalty revenue;
- support Newcastle's position as a world leader in bulk goods handling and engineering; and
- comply with NPC's Strategic Development Plan.

In particular many of the coal industry employees and businesses who made submissions on the project did so on the grounds that it would provide ongoing revenue, employment and security for them and/or their businesses.

ii Summary of reasons for objection

Many of the project's objectors also raised socio-economic matters, similar to those raised in submissions on the EA, including:

- the short-term economic benefits to a minority will be outweighed by long-term costs of adverse social, health, economic and environmental impacts, including due to climate change;
- potential adverse social and economic impacts, including to people's amenity, health and wellbeing, communities in the Hunter and Newcastle and other economic activities such as tourism;
- claims of the project's employment generation are dubious and not justified or explained;
- the project would have little or no economic, community or employment benefit;
- profits would mostly go overseas;
- the economic modelling is bias and overstates the project's economic importance. There is a lack of credible data and analysis supporting the reported economic benefits and external coal chain costs, including from the coal industry expansion it will service, have not been included in the benefit cost analysis (BCA);
- concerns about economic reliance on coal mining and export, with preference expressed for a great diversity of industries at the port; and
- view that associated infrastructure upgrades required such as road and rail upgrades are a waste of time and money.

2.4.10 Environmental management, assessment and sustainability

i Summary of reasons for support

Some felt that the T4 Project would provide overall long-term benefits for the natural environment and community and expressed support for PWCS's proposed environmental management, stating that:

- the management controls proposed to protect the community and environment are comprehensive and 'state of the art' and include best practice engineering to manage dust, water and noise;
- the project design has carefully considered environmental impacts and the engineering is built on best practice solutions for managing water, energy, noise and dust; and
- the proposal's overall approach minimises potential impacts on local communities.

ii Summary of reasons for objection

Others raised adverse impacts in general and that the T4 Project is short-sighted and unsustainable and impacts on future generations need to be considered. It was raised that further cumulative assessment is required, considering associated impacts of coal mining and transport to port and other impacts of coal industry expansion. Some respondents were of the view that the measures proposed to prevent or mitigate environmental, social and economic impacts are inadequate.

2.4.11 Dredging and shipping impacts

Concerns were raised about impacts of dredging and increased ship movements.

2.4.12 Coal industry

i Summary of reasons for support

Broad support for Australia and the Hunter's coal industry was expressed for several reasons including its:

- significant contribution historically to the economic development and wealth of Australia, NSW and the Hunter Valley, including its role in providing the region with a strong buffer throughout the recent global financial crisis;
- benefits, including as a major employment, royalty and tax generator and to support other industries such as financial, hospitality and consulting, all of which are relied on and much needed in the community;
- investment in infrastructure in the Hunter Region, considered to be critical at a time when government is reducing its expenditure;
- contribution to providing efficient energy and resources to developing nations, thereby contributing to their future prosperity; and
- belief that it is better environmentally to conduct coal mining in Australia where there are more robust environmental controls, and where product coal is a relatively clean energy source compared to coal from some other countries.

ii Summary of reasons for objection

A common matter raised in objecting submissions was opposition to the coal industry in general, including to coal mining, transport and export. As with submissions on the EA concerns included:

- existing and anticipated future adverse impacts of the coal industry, including to health, the environment, communities and other industries such as agriculture, tourism, horse breeding and viticulture. It was felt that the T4 Project would increase these impacts by facilitating more coal mining;
- adverse health, economic and environmental impacts of coal and fossil fuel use, including climate change impacts; and
- preference to transition away from fossil fuels and invest in renewable or sustainable energy instead.

2.4.13 Rail

Several respondents raised concerns relating to coal trains along the rail corridor, particularly:

- rail dust, diesel exhaust and associated health impacts, with calls to cover rail wagons;
- adverse health and amenity impacts of train noise and vibration, particularly night-time and sleep disturbance impacts;

- rail corridor impacts have not been adequately assessed and need to be considered. For example there was a view that the assessment focussed on air quality impacts within 20 m of the rail corridor and that the return journey of coal trains needed to be assessed; and

- other potential impacts of increased coal train movements including traffic congestion.

2.4.14 Human health

As with submissions on the EA, the need for a health risk assessment or health impact assessment was raised. As mentioned in the preceding sections health concerns were mainly air quality-related and included impacts from mining, transporting and burning coal. Noise and contamination-related health risks were also raised.

2.4.15 PWCS contribution and track record

i Summary of reasons for support

Several of the supporting submissions raised PWCS's contribution to the community and proven track record in successfully operating coal terminals in the Port of Newcastle. Matters raised included:

- confidence and trust in PWCS as they have proven to be a responsible developer, operator and active member of the Newcastle community, operating and expanding their business in Newcastle for over 30 years and contributing greatly to the local economy;

- PWCS's proven environmental performance and commitment to socially and environmentally responsible development, including through significant investment to secure environmental offsets prior to project approval;

- PWCS's willingness to share and openly discuss safety, health and environmental information with industries and the community, including environmental results and events at its terminals;

- PWCS has demonstrated how a major project can work in an environmentally sensitive area and has the capacity to look after land and the endangered species on it better than a land owner with limited knowledge and resources;

- PWCS's responsive consultation process and response to community concerns, including its noise and dust reduction programs and willingness to act on feedback on matters such as traffic solutions; and

- PWCS's commitment to community organisations and charities through training opportunities for apprentices, trainees and uni students, and donations and funding, for example distributing more than $3.5 million (M) in local sponsorships and donations since 2003.

ii Summary of reasons for objection

Some objecting submissions cited existing adverse impacts from PWCS's operations, including noise and dust impacts and belief that the existing dust controls are ineffective.

3 Response to submissions

3.1 Traffic and transport

3.1.1 Issue 1

i DP&I issue summary

"The response from RMS is quite prescriptive and effectively written in the form of conditions. Whilst the Department is not suggesting at this stage that these would be adopted in this form should approval be recommended, it would be helpful if PWCS could advise if there are any issues raised that would be difficult to meet or considered outside of the scope of the project and justification for that position."

ii Extracts from RMS submission and responses

Traffic impact assessment

Issue: A revised traffic impact assessment (TIA) is to be completed prior to concept and detailed design, to the satisfaction of RMS. This must include ten year traffic growth projections, allowing appropriate background growth on the classified road network that considers any approved developments and those in the later stages of planning approval. The traffic analysis of the proposed signalised intersection shall be calibrated to reflect actual traffic signal operation and peak queue lengths.

Response: PWCS agrees to providing a revised TIA during the T4 Project's detailed design. It will be done in consultation with RMS and consider new 10 year traffic growth projections at that time. The results of the revised TIA will be taken into account in designing the proposed Cormorant Road and Pacific National Access Road intersection and signal operation.

Car parking requirements

Issue: A concept plan showing parking areas for both construction and operational employees, including the number of parking spaces at each car park shall be provided. Car parking areas should be positioned/ designed to permit expansion, if necessary, to cater for fluctuations in parking numbers across the site during the construction phase.

On-site and off-site parking areas are to be designed and constructed in accordance with AS 2890.1-2004 and AS 2890.2-2002, including aisle widths, parking bay dimensions and loading/unloading bays for service vehicles.

All car parking areas, inclusive of parking for construction workers, should be a sealed pavement surface permitting all weather access and thereby minimising dust and erosion.

Details of the off-site parking area(s) shall be provided, including location options and shuttle bus service routes/arrangements to ensure that the site chosen is feasible and employees will use the service. This is to include how employees will be restricted from driving to site should the construction workforce exceed 1,200 people.

Advice on how the staggering of construction traffic will be implemented shall be provided. It is stated that only "where possible" construction traffic will be staggered. Consideration needs to be given to a situation where it is not possible.

Response: PWCS agrees to provide a concept plan showing parking areas for both construction and operational employees during the T4 Project's detailed design. Consistent with comments in the EA, more car parking spaces will be provided during the peak of construction than at less intensive construction stages. The concept plan will be prepared and documented in the traffic management plan which will form part of the construction environmental management plan (CEMP). It will be prepared in consultation with RMS and NCC. Parking areas will be designed in accordance with the relevant Australian standards (currently AS 2890.1-2004 and AS 2890.2-2002).

The on-site operational car parking areas will be sealed. On-site construction car parking areas will not be sealed. As stated in Section 10.2.2(vii) of the RTS/PPR main report, these areas will be provided with an all-weather gravel surface which will be watered during dry periods if required.

Details of the proposed off-site parking area(s) and shuttle bus arrangements will also be provided by PWCS during the T4 Project's detailed design. As per the statement of commitments in Chapter 15 of the RTS/PPR main report, these details will be documented in the traffic management plan which will be prepared in consultation with RMS and NCC and form part of the CEMP. Details of other proposed traffic mitigation measures for construction, including how the staggering of construction traffic will be implemented, will also be documented in the traffic management plan.

Intersection works - Terminal 4/State Road access

Issue: Prior to issuing of a construction certificate for the proposed development, the developer shall upgrade the existing Cormorant Road/Pacific National Access Road intersection. The intersection shall be designed and constructed in accordance with the Austroads (2010) *Guide to Road Design* (with RMS supplements) and the RTA (2008) *Traffic Signal Design* to the satisfaction of RMS including, but not limited to, the following works:

- upgrading the intersection to a four leg traffic signal controlled intersection, which incorporates vehicular access to/from the Newcastle Coal Infrastructure Group Pty Limited (NCIG)/wind turbine sites;
- the required lane configuration, types and lengths shall be determined by RMS, subject to a review of the requested revised TIA, to be prepared to the satisfaction of RMS in accordance with the RTA's *Guide to Traffic Generating Developments*;
- signalised pedestrian crossings shall be provided on all legs of the intersection;
- street lighting shall be provided at the intersection to Australian standards, or as determined by RMS; and
- the intersection shall be designed and constructed to accommodate on-road cyclists. If cyclists cannot be accommodated on-road due to site constraints, and subject to the agreement of RMS, adequate provision shall be made off-road.

All vehicular access to the relevant site areas shall be via this intersection. No other direct vehicular accesses will be permitted to/from the site.

All traffic lanes shall be 3.5 m wide on Cormorant Road, including at the proposed upgraded intersection, or as determined by RMS.

Appropriate pedestrian and cyclist facilities, foot/cycle paths and ramps, connecting to the traffic signal controlled intersection shall be provided to the satisfaction of RMS and Council. Pedestrian fencing may be required in certain areas. This will be identified as part of the design review process.

Response: PWCS has committed to constructing a traffic signal controlled intersection to replace the existing Pacific National Access Road and NCIG Wharf Access Road T-intersections on Cormorant Road. As per PWCS's commitment in Section 15.9 of the RTS/PPR main report, the intersection's detailed design will be finalised in consultation with RMS and NCC during the detailed design of the T4 Project. The design of the T4 Project will ensure safe and adequate provision is made for pedestrians and cyclists on all public roads. Timing for upgrading the intersection will be agreed with RMS during the detailed design phase.

To date, PWCS has spent considerable time and effort liaising with RMS on the design of the traffic signal controlled intersection. The concept design presented in the RTS/PPR was prepared in consultation with RMS. Its detailed design will be undertaken in accordance with the guidelines stipulated by RMS and will consider the proposed revised TIA mentioned previously.

Notwithstanding the above, RMS in its submission stated that "all vehicular access to the relevant site areas shall be via this intersection. No other direct vehicular accesses will be permitted to/from the site". This would remove the ability for vehicles to enter and exit the site via the existing access point off Cormorant Road at Delta EMD Access Road. PWCS cannot commit to this restriction and it is not considered necessary given that:

- the Kooragang Island road network operates well with considerable spare capacity at most times of the day (ie outside of the peak-hourly periods identified in the RTS/PPR);
- predicted delays at peak times are mainly due to background commuter traffic along Cormorant Road (not the T4 Project) and generally only affect left-turn egress traffic leaving the T4 project area; and
- there is minimal potential for further restricting use of this intersection to benefit traffic flows on Cormorant Road.

The majority of construction traffic will use the new signalised intersection for site access and egress rather than the Delta EMD Access Road access point. For example, based on experience with KCT's expansion construction workforce, it is estimated in the RTS/PPR that approximately 87% of the construction workforce traffic will be travelling to and from Newcastle. The majority of egress traffic would therefore use the Pacific National Access Road intersection, where the proposed traffic signals will permit right turns towards Newcastle. However, some vehicles will need to use the Delta EMD Access Road when travelling to and from work areas at this western end of the site, for example when accessing the principal contractor's construction area.

As the Delta EMD Access Road intersection is already limited to left turn in and left turn out traffic movement only, there would be only limited potential for benefits for Cormorant Road traffic flows by further restricting use of this access. In particular, the left turn ingress movement into the Delta EMD Access Road already has a left turn deceleration lane and there would be no potential traffic flow benefits to the Cormorant Road traffic from further restricting this access.

SIDRA modelling in the RTS/PPR predicted a poor level of service (level of service F) for three of the peak-hourly periods (7.15-8.15 am, 4.00-5.00 pm and 5.00-6.00 pm). However, the predicted delays are for the left turn egress traffic (ie vehicles leaving the T4 project area) and will not generally affect other traffic flows on Cormorant Road. Delays will be an issue for T4 Project traffic trying to leave the site rather than other traffic on Cormorant Road and so are more related to site construction management than public

road traffic conditions. For this reason, it is our view that there will not be any major benefits to traffic flow on Cormorant Road from restricting the left turn ingress or egress movement into the Delta EMD Access Road, especially as the delays will be primarily due to continuing background traffic growth along Cormorant Road and not T4 Project-related traffic.

Notwithstanding this, PWCS will review traffic movements as part of the T4 Project's traffic management plan to minimise delays experienced by the T4 Project's construction traffic when leaving the site, paying particular attention to the weekday afternoon peak periods (which are between 4.00 and 6.00 pm typically). The traffic management plan, which will form part of the CEMP, will be prepared in consultation with RMS and NCC. The effect of the T4 Project-related traffic at these intersections is also proposed to be minimised by, where possible, staggering construction traffic departures so that less vehicles leave during the 4.00 to 5.00 pm peak.

In addition to the above, it is noted that Delta EMD Access Road is, and will continue to be, used by other companies other than PWCS such as BHP Billiton, NCIG and NPC.

Conveyor bridge over the State Road

Issue: Land required by PWCS for the conveyor structure may need to be retained as road reserve with a Deed Containing Agreement, *Roads Act 1993* Section 138 agreement or similar between RMS and PWCS. RMS will provide further advice when PWCS's final land requirements are determined.

The bridge structures over Cormorant Road shall be designed and constructed to RMS requirements, including (but not limited to):

- allowance for future road widening/duplication of Cormorant Road. An 8 m distance is required between the edge of the Cormorant Road shoulder (existing and proposed) and PWCS structures;
- any barriers/protection required to prevent errant vehicles from striking the bridge structures;
- a minimum 6.5 m vertical height clearance from the top of the Cormorant Road pavement to the underside of the bridge structures;
- the bridge structures and approaches shall be designed to minimise impacts on road and public utility maintenance/construction activities required within the road reserve;
- maintenance activities required for the bridge structures shall be carried out from within/on the bridge structures; and
- urban design principles in accordance with the RMS *Beyond the Pavement* publication shall be applied to the bridge and associated structures design and construction to the satisfaction of RMS.

The developer shall enter into an agreement with RMS for the ongoing maintenance and ultimate demolition of the bridge structures, to the satisfaction of RMS.

Response: PWCS notes these requirements and will work with RMS to achieve them. Detailed design of the conveyor bridge over Cormorant Road will be undertaken in accordance with the guidelines stipulated by RMS. As stated in the RTS/PPR, the design of the T4 Project will ensure safe and adequate provision is made for future duplication of Cormorant Road. PWCS also commits to entering into an agreement with RMS for ongoing maintenance of the bridge, as well as its removal when no longer required for the T4 Project. Future land ownership details for the land where conveyers pass over road reserves will be negotiated with public authorities. It is envisaged that the land owner will remain a public authority.

Stormwater drainage

Issue: The proposed wharf side development south of Cormorant Road will have a significant impact on the stormwater drainage regime between Cormorant Road/Tourle Street and the Hunter River. The proponent will be required to maintain stormwater drainage conditions and structures such that Cormorant Road/Tourle Street remains trafficable during a 1 in 100 year storm event.

Prior to issuing of a construction certificate for the site, the developer shall upgrade the existing drainage structures and/or install new drainage structures as required, to the satisfaction of RMS and Council. This should incorporate the hydraulic requirements of the Cormorant Road/Tourle Street carriageway and Long Pond (to maintain appropriate sustainable water levels).

Hydrologic and hydraulic investigations and assessments are to be completed to the satisfaction of RMS and Council. These investigations/assessments must encompass the interaction of the proposed T4 site and Cormorant Road/Tourle Street carriageway drainage requirements and Long Pond.

On-site stormwater drainage, sedimentation basins and chemical containment facilities shall be designed and constructed clear of the Cormorant Road/Tourle Street road reserve to the satisfaction of RMS and Council.

Appropriate easements and drainage structures shall be provided over the site as required to enable Cormorant Road/Tourle Street and any catchments north of Cormorant Road to be drained to the satisfaction of RMS and Council.

Response: As with the traffic signal controlled intersection at the Cormorant Road/Pacific National Access Road intersection, PWCS has spent considerable time liaising with RMS on the proposed design of stormwater drainage on Cormorant Road. Currently, there is minimal, or no, stormwater drainage system.

PWCS has designed a stormwater drainage system that will ensure that a 100 year average recurrence interval (ARI) flood event can discharge into the Hunter River South Arm via two appropriately sized culverts at the eastern end of Long Pond (at the swing basin). This has tentatively been agreed to by RMS at meetings, with a commitment to further define during the detailed design phase. The detailed design of the stormwater drainage system on Cormorant Road will be undertaken in accordance with the requirements stipulated by RMS, and in consultation with RMS.

As stated in the RTS/PPR, no chemical containment facilities are proposed in the Cormorant Road/Tourle Street road reserve. The only stormwater drainage facilities proposed in the road reserve are for road drainage.

Tourle Street Bridge stability

Issue: An independent assessment is to be undertaken on the proposed T4 river bed batter design during the detailed design phase, to provide RMS with assurance that the Tourle Street Bridge will not be structurally impacted by a coal carrier ship (either by direct impact or possible energy transfer through the river bed). The assessment is to be conducted at the detailed design stage by a person(s) with the required technical capabilities, to the satisfaction of RMS, and is required to:

- validate design assumptions and friction parameters to determine the sensitivity on stopping distances; and

- quantify the forces transmitted into the river bed stratum using numerical modelling on the revetment.

Response: The requirement to undertake an independent assessment of the proposed river bed batter design was raised by RMS some time ago. In response, PWCS engaged independent experts (Aecom) to prepare an assessment. A copy of the assessment is appended to RMS's submission. It concludes:

> In principle, the concept design presented in the Aurecon Hatch Report provides a design that will not impact the structural adequacy of Tourle St Bridge or its proposed duplication. The supporting piles for the future bridge are not expected to be required to be of a greater size than those of the existing bridge for the effects of the proposed development.
>
> It is recommended that further assessment should be undertaken at the detailed design stage:
>
> - to validate the design assumptions and friction parameters to determine the sensitivity on stopping distances and,
>
> - to quantify the forces transmitted into the river bed stratum using numerical modelling of the revetment.

PWCS agrees that further assessment of the river bed batter design is required at the detailed design stage but notes that it should be limited only to the two matters recommended by Aecom. As per Aecom's conclusion, the design presented, albeit conceptually, will not impact the structural integrity of the Tourle Street Bridge or its proposed duplication.

<u>General</u>

Issue: A Construction Traffic Management Plan shall be prepared and include a Vehicle Movement Plan and Traffic Control Plan. It shall be prepared with the intention of having minimal impact to the operation of the road network during construction. It shall be submitted to RMS and Council for review and approval prior to any construction activities occurring on-site.

As road works are required on State roads, and traffic control signals, RMS will require the developer to enter into a Works Authorisation Deed (WAD) with RMS. RMS will exercise its powers under Section 87 of the *Roads Act 1993* and the functions of the roads authority, to undertake road works in accordance with Sections 64, 71, 72 and 73 of the Act, as applicable, for all works under the WAD.

Prior to issuing a construction certificate for the proposed development, the developer shall enter into a WAD with RMS and complete all road works associated with the Cormorant Road/Pacific National Access Road/[NCIG Wharf] Access Road intersection.

Prior to issuing an occupation certificate (interim or final) for the proposed development the developer shall complete all works under the WAD to practical completion, as determined by RMS.

All works associated with the proposed development shall be at full cost to the developer and at no cost to RMS or Council, to the satisfaction of RMS.

Response: The general comments made by RMS are virtually identical to general comments made in response to exhibition of the EA, particularly in relation to the requirement to enter in a WAD and that all works associated with the T4 Project shall be at full cost to PWCS. As per the RTS/PPR, PWCS note the requirements around entering into a WAD and will work with RMS to achieve them. The cost of all works associated with the T4 Project will be met by PWCS. As stated in Section 15.9 of the RTS/PPR main report, PWCS has committed to preparing a traffic management plan in consultation with RMS and NCC prior to construction. This would include a vehicle movement plan and traffic control plan.

3.2 Flooding and hydraulics

3.2.1 Issue 2

i. DP&I issue summary

Based on NCC's submission, the "issue of development in the floodway, considering the flood zone classification of the site needs to be addressed".

ii. Extract from NCC submission

The proponent should consider the flood zone classification of the site and the effects that the development will have on the floodway.

Council mapped the Hunter River floodways considering cumulative development impacts in the *Newcastle City-wide Floodplain Risk Management Study and Plan*, June 2012 (see Map 4-L, 1% annual exceedance probability (AEP) flood impact categories). It is a requirement of the Newcastle Development Control Plan 2012 to minimise development in identified floodways. This issue has not been properly addressed in the report.

iii. Response

As noted by NCC (refer - Map 4-L of the BMT WBM (2012) *Newcastle Floodplain Risk Management Study*), some T4 Project components are partially located within a mapped floodway. However, detailed two-dimensional hydrodynamic modelling and a flood impact assessment by WorleyParsons, reported in Appendices H and I of the EA demonstrated that the T4 Project is unlikely to be significantly impacted by flooding. Furthermore, as stated in Section 9.2.4(iii) of the EA:

> The flood modelling for the existing and post-development scenarios (incorporating climate change) indicates that changes to site elevations as a result of filling during development of the T4 Project will reduce inundation of floodwaters (compared to existing conditions) during extreme flood events (1% AEP) on most parts of the T4 project area.

As stated in Section 5.1.2(iv) of the RTS/PPR main report:

> Applying predicted 2100 climate conditions, with increased upstream discharge and tailwater level, found that a 100 year ARI event would marginally overtop the rail embankment (by 0.1 m) and inundate a localised area around the water management ponds. However, this would not significantly impact project infrastructure and other areas of the site would not be affected...Modelling also showed that the project is not likely to significantly impact flooding or the effects of sea level rise at any downstream areas.

The modelling and assessment in the EA demonstrated that dredging associated with the T4 Project will in fact have a positive impact on flood levels in the vicinity of the T4 project area. In principle, any increase in the available floodway area is likely to cause locally reduced water levels and velocities in the vicinity of the development. In the case of the T4 Project, there is proposed to be an increase in waterway area (ie due to the proposed dredging activities in the Hunter River South Arm), and therefore there is a corresponding reduction in the upstream flood levels and velocities.

The *Floodplain Development Manual* (Department of Infrastructure, Planning and Natural Resources 2005) guideline on development in floodways generally does not recommend development in floodways that cause elevated water levels and velocities affecting neighbouring (upstream, downstream or

adjacent) properties. In addition, for any development in a floodway it is typically required to be demonstrated that the development proposal can withstand the velocities and forces imposed upon the proposed structures.

As previously stated, the proposed T4 Project's impact on flood levels for various scenarios was assessed through detailed two-dimensional hydrodynamic modelling and flood impact assessments. The maximum predicted difference in water level resulting from the T4 Project (under a present day climate scenario) was a reduction in the 100 year ARI flood level of approximately 320 mm (refer EA Appendix H). Similar reductions are also reported for assessed climate change scenarios. The estimated water level reductions occurred for approximately 1.6 km upstream of the Tourle Street Bridge, and for fluvial flooding scenarios for an area immediately downstream of the Tourle Street Bridge. The hydrodynamic modelling and flood impact assessments also showed no significant impacts on flood levels north of the T4 project area, including within the Hunter River North Arm.

Similar results were derived when two-dimensional hydrodynamic modelling was undertaken for the NPC's South Arm Dredging Project. The results are published in Patterson Britton & Partners (2003) *Potential Impacts of Proposed Dredging of South Arm on Tidal Hydrodynamics, Flooding and Water Quality, Issue No. 3*, contained as Appendix F to the GHD (2003) environmental impact statement (EIS) for the proposed extension of shipping channels in the Port of Newcastle.

As noted in the RTS/PPR, the T4 Project has changed since the hydrodynamic modelling and flood impact assessments were undertaken by WorleyParsons as part of the EA in 2012. No wharves, berths, conveyors or other infrastructure are currently proposed to be developed south of the Hunter River South Arm, with the terminal to be restricted to the Kooragang Island side of the river. Infrastructure previously proposed to service the south bank wharf area, including the conveyors crossing the river, no longer forms part of the T4 Project.

Therefore the hydraulic modelling and flood impact assessment results would differ slightly from those previously prepared by WorleyParsons. The proposed increase in waterway area affecting floodway flow would now likely be slightly less than that previously modelled by WorleyParsons due to the change in the required dredging area. This would be offset by the removal of wharves and other infrastructure from the southern bank of the Hunter River South Arm. It can still be said with confidence that there would not be any detrimental flood impact on adjoining, upstream or downstream properties as a result of the T4 Project; the main influence on flood level changes in the river would be the remaining dredging proposed for extension of shipping channels in the Hunter River South Arm (subject of NSW Maritime's Development Consent No. DA-134-3-2003-i).

In terms of the NCC requirement for no development within a floodway, since it has been demonstrated that there is no significant impact of the proposed development within the floodway areas, in terms of impacts on upstream, downstream or adjacent properties, and that all proposed structures (embankments and wharf structures) within the floodway areas will be designed to withstand all forces imposed by floodwaters and debris, there should be no reason why the development should not be allowed to proceed.

Furthermore, it is not clear how a maritime project within a busy working port is proposed to proceed, if the entire Hunter River channel (ie both the North and South arms) is designated as a floodway precluding any development. Port development inherently would always be within a floodway of any river system, as shipping is required to utilise the deeper section of the channel, where the majority of flood conveyance occurs and flood depths and velocities are highest.

3.2.2 Issue 3

i. DP&I issue summary

Based on NCC's submission, "hydraulic behaviour and risk to life of the probable maximum flood (PMF) need to be addressed".

ii. Extract from NCC submission

The hydraulic behaviour and the risk to life for the PMF event should be considered by the proponent. This is a requirement of the Newcastle Development Control Plan 2012 and has not been properly addressed.

iii. Response

The PMF by definition is an extreme flood event. It will have a high ARI, meaning statistically it is likely to occur very infrequently, but when it does occur, will have the potential, through high water levels, velocities and large flood extents, to cause significant risk to life.

Key factors to consider with respect to a Hunter River PMF for the T4 Project is that the T4 project area is at the downstream end of the Hunter River, which has a large catchment area and therefore long flood propagation times. The *Newcastle City-wide Floodplain Risk Management Study and Plan* prepared by BMT WBM (2012) for NCC assessed flood warning times for all forms of flooding affecting Newcastle, including from the Hunter River. It states:

> flooding from the Hunter River is expected to have a significant and good warning time (in the order of days). It is expected that extensive emergency services and combat agencies could be deployed to assist with evacuation and flood management prior to the onset of river flooding.

An example of flood warning lead times associated with the Hunter River can be derived from the June 2007 event, which over Newcastle's city centre was approximately a 0.5% AEP event and for the whole Hunter catchment, a 5% AEP event. Intense storms associated with an east coast low pressure system occurred in the afternoon and evening of 8 June 2007, causing widespread flooding throughout Newcastle and surrounds. Water levels in the Hunter River at Maitland (over 40 km upstream of the proposed T4 project area) peaked on the morning of 11 June 2007, some 2.5 days after the actual rainfall event. The flood wave was tracked continuously by the Bureau of Meteorology (BoM), local councils and the State Emergency Services. Ample warning was given for more than 3,000 Maitland residents who were evacuated, based on a possible threat that the levees at Maitland would overtop (although they did not do so in this instance).

The flood warning lead times associated with a PMF event are considered sufficiently long to warn and evacuate people working on Kooragang Island, including the additional workforce proposed for the T4 Project. Importantly Map Series 3 of the *Newcastle City-wide Floodplain Risk Management Study and Plan* shows that the area south of the Tourle Street Bridge, over which workers on Kooragang Island would likely be evacuated, is not considered a floodplain and therefore is considered a safe evacuation location. Map Series 11 highlights a number of potential locations for elevated refuge within Newcastle's city centre, within 5 km of the T4 project area, in the event of a PMF.

In summary, the PMF risk to life for workers on Kooragang Island is considered low and manageable due to flood warning times that would enable orderly evacuation.

3.2.3 Issue 4

i. DP&I issue summary

Based on the submission by the Hunter-Central Rivers Catchment Management Authority (CMA) "what would the implications be for the project if Government decided to decommission the Hunter Valley Flood Mitigation Scheme".

ii. Extract from Hunter-Central Rivers CMA submission

The CMA does not deem it appropriate that PWCS rely on the bund wall that is associated with Area 3 of the Hunter Valley Flood Mitigation Scheme to protect the Tomago offset site against climate change related impacts for the next 50 years. The Hunter Valley Flood Mitigation Scheme is legislated under Part 2, Chapter 5 of the *Water Management Act 2000* and is currently valued at $5,690 million. The CMA contributes 25% of costs associated with the maintenance of this scheme. A policy decision has not been made on whether the scheme will be used to mitigate the impacts of climate change and it is likely that some scheme assets could be decommissioned if cost benefit ratios become unsustainable under differing climatic conditions. It is highly presumptuous to forecast that Government would commit to maintaining this structure at potentially such a high cost.

iii. Response

Based on the current concept design for the Tomago offset site, PWCS proposes to construct a perimeter bund around the proposed restoration area to a height of 1.7 m above the Australian Height Datum (AHD). Where present along the southern and eastern boundary, PWCS proposes to use and extend the height of the existing levee system which forms part of the Hunter Valley Flood Mitigation Scheme. The cost of constructing this perimeter bund, including extending the existing levee system, will be borne by PWCS.

PWCS has committed to providing a suitable offset that relies in part on maintenance of the perimeter bund. Therefore the cost of maintaining the proposed perimeter bund and extending the existing levee system will also be borne by PWCS until such time as an agreement for the transfer of the ownership of the site, including its ongoing management, is reached with an appropriate land manager such as the NPWS.

Government's decision to continue to maintain the Hunter Valley Flood Mitigation Scheme is independent of PWCS's commitment to construct and maintain the habitat restoration and creation project at the Tomago offset site (referred to herein as the 'Tomago Restoration Project'). Should a decision be made by Government in future to not maintain the scheme, PWCS or the relevant land owner/manager would need to decide on an appropriate level of maintenance, as would be the case for all other potentially affected properties.

3.3 Ecological impacts and biodiversity offsets

3.3.1 Issue 5

i. DP&I issue summary

PWCS is to address comments by the Department of Primary Industries (DPI) "on the design of the Tomago offset site".

ii. Extracts from DPI submission and responses

Consideration of more natural rehabilitation options

Issue: While the DPI is aware of the need to meet particular offset habitat requirements at the Tomago site, the current proposal is overly focused on intensive earth works to achieve those outcomes. The Department encourages a less invasive option be considered, such as reinstating tidal flows over the existing landscape and allowing a natural regeneration of saltmarsh vegetation. This is more consistent with best practices for reinstating estuarine wetlands and restoring fish access to these wetlands. While some earthworks may still be required, probably only a fraction of the scale, cost and disturbance of the proposed project would be needed.

There is an established and proven method of saltmarsh rehabilitation that has been employed in the Hunter Wetlands National Park and other locations which has been over-looked in favour of the intensive pond construction works proposed. These more natural hydrological methods have been very effective in increasing saltmarsh areas in the national park and provide habitat frequented by migratory shorebirds that are the primary target of the Tomago offset site. Fisheries NSW encourages consideration of more natural rehabilitation options through detailed hydrological modelling investigations.

Modelling of other hydrological connectivity options may indicate that adequate habitat compensation would be achievable in a more natural, cheaper and less destructive manner that would allow the fauna and flora of the site to gradually revert back to the desired ecological community types. Timeframes for natural site ecosystem transformation are likely to be similar or better than that expected by the intensive pond construction design, as evidenced by monitoring of the Hunter Wetlands National Park area at Tomago versus the Port Botany constructed saltmarsh site at Penrhyn estuary (Port Botany Post Construction Monitoring Annual Report 2013 prepared for Sydney Ports Corporation, September 2013 EL1112046). Natural rehabilitation would also omit the disruptive construction period, shown to impact on shorebird numbers at the Penrhyn estuary site for at least five years for many species.

Monitoring of the Penrhyn Estuary site also indicated better saltmarsh rehabilitation results are obtained from retaining and improving existing areas of saltmarsh, rather than creating new areas artificially. Zelder & Callaway (1999) have also shown that adequate soil characteristics for saltmarsh do not develop in constructed estuarine wetlands for a number of years.

The proposal to add organic matter to the upper layers of pond sediment to assist with the re-establishment of saltmarsh and benthic invertebrates seems overly complicated. Will this organic matter be sourced from on-site (with subsequent seed bank issues) or from off-site, ie seagrass wrack as used in other locations, requiring significant operational commitments?

There is a potentially large risk of ongoing acid sulphate soil (ASS) problems from removed soil, especially if this fill is to be used to create bunds/levees. Remediation of this acidity will require very large quantities of lime. This cost would be significantly reduced with alternative rehabilitation options.

None of the boreholes monitored as part of the Coffey geotechnical assessment are located in the areas of deepest excavation (the bottom of permanent ponds). Considering the issues regarding the tide levels, culvert and pond inverts and ASS risks discussed in the submission, as well as construction methods, questions about the likelihood of exposing potential ASS and the quality and management of groundwater during construction remain under the current design proposal for the site. Designs that reduce excavation requirements at the site may decrease this risk.

Response: The above issues raised by the DPI were discussed in detail at a meeting with DPI - Fisheries, OEH, NPWS, Phil Straw from Avifauna Research and Services and Dr William Glamore from the University of NSW Water Research Laboratory (involved in the existing rehabilitation project in the Hunter Wetlands National Park mentioned in the submission). As discussed at this meeting, the outcomes being sought for the Hunter Wetlands National Park rehabilitation project and the Tomago offset site are different and therefore the same restoration techniques cannot be successfully applied to both sites. The topography, size, existing vegetation and potential tidal inundation patterns on the Tomago offset site mean that in order to restore the land to estuarine saltmarsh complexes, active excavation and engineering works would be required. Previous successful construction of wetland habitats in the Hunter have involved large-scale excavation. For example the Shortland portion of the Hunter Estuary Wetlands Ramsar site (now known as the Hunter Wetlands Centre Australia) required substantial landscape modification using heavy machinery to achieve the desired outcome.

As also discussed at this meeting, PWCS is committed to the restoration of the Tomago offset site in close liaison with the Hunter Wetlands National Park rehabilitation project so that opportunities to provide beneficial outcomes for both sites and regional biodiversity can be provided. As outlined in the EIA for the Tomago Restoration Project (contained in the RTS/PPR Appendix K), PWCS will, in consultation with OEH and NPWS, investigate options for integrating the site with the adjacent Hunter Wetlands National Park, via connection to the North/South drain and variations to the ratio of mudflat to saltmarsh habitat. This potential option was excluded from the concept design to demonstrate that the Tomago Restoration Project could occur without an adverse impact on the Hunter Wetlands National Park. However, should consultation with OEH and NPWS identify that connection to the North/South drain may have beneficial outcomes for the Hunter Wetlands National Park and the Tomago Restoration Project, this will be considered in the detailed design phase.

The concept design, as pointed out at the meeting, was to establish shorebird habitat to offset that lost within the T4 project area in as short a timeframe as possible. The timing of the habitat creation aims to provide compensatory habitat for displaced birds to move to over the short term, not over a five to ten year period. This can only be achieved within the required timeframe with a heavily engineered option. The concept design for the Tomago offset site is based on many decades of experience of successfully constructed and remediated shorebird habitat projects worldwide. Some artificially constructed wetlands, created for other purposes, but used by shorebirds, have had a higher productivity than similar scale 'natural habitats' for many species of shorebirds. These include the Dampier Saltworks in north-west Australia, Cheetham Saltworks in South Australia, as well as sewage treatment works ponds managed specifically for shorebirds (eg Melbourne Water in Victoria). All of these are heavily engineered but attract internationally important numbers of shorebirds, and provide some of the most extensive saltmarsh communities in Australia. In addition to offsetting the T4 Project, the Tomago Restoration Project will also go a long way to replace shorebird habitat lost in the Hunter estuary over the past 60 years or more.

Regarding the addition of organic matter to pond sediment, this practice was undertaken at a similar restoration project at Penrhyn Estuary but was not primarily for the establishment of saltmarsh communities. The organic matter was added to speed-up the colonisation of benthic invertebrates in open tidal flats, as foraging habitat for migratory shorebirds. This was necessary because of the sterile nature of the sand used to create the tidal flats. The existing soils at the Tomago offset site are part of a

well established floodplain and should not require significant modification for saltmarsh or shorebird habitat. It is not proposed to import organic matter to the Tomago offset site.

In regard to the DPI's comments on ASS, a detailed ASS assessment was undertaken as part of the EIA for the proposed habitat restoration and creation works at the Tomago offset site (refer RTS/PPR Appendix K). As outlined in the EIA, there is a high likelihood of encountering ASS within areas of the site and active management will be required to minimise the risk associated with its exposure. The assessment found, however, that with the implementation of management controls, ASS risk associated with the Tomago Restoration Project can be appropriately managed. Only soils not capped or kept wet present a problem if they are acidic. For the Tomago Restoration Project, soils used to create bunds and levees will be capped to exclude air and would therefore not create ASS problems.

PWCS has committed that, to further define the extent of ASS to be disturbed by the Tomago Restoration Project and refine the approach to ASS management, a comprehensive ASS investigation will be carried out in accordance with the ASSMAC (1998) ASS Manual. PWCS has also committed to preparing an ASS management plan as part of the CEMP for the Tomago Restoration Project. The commitment to a CEMP, including an ASS management plan, is documented in the updated statement of commitments for the T4 Project, in Section 15.5.2 of the RTS/PPR main report.

Connectivity with the Hunter Wetlands National Park

Issue: Revision of the Tomago offset site design criteria to seek connectivity to the existing Hunter Wetlands National Park rehabilitation area, rather than isolation from it, is encouraged where it can be determined that no adverse impacts will occur to the national park area. This will provide better integration of the site with the Hunter Wetlands National Park if and when it is transferred to NPWS ownership in the future and allow more direct connectivity and biological dispersal from previously rehabilitated areas within the national park to the Tomago offset site.

Response: The eastern boundary of the Tomago offset site is adjacent to the Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site boundaries. As previously discussed with DPI, OEH and NPWS, the concept design of the Tomago offset site was specifically developed to operate independently and separately from the adjacent Hunter Wetlands National Park to avoid any potential alteration or impacts to the existing environment within the national park and Ramsar site.

As mentioned in the preceding section and as previously discussed with DPI, OEH and NPWS, PWCS is committed to liaising with the Hunter Wetlands National Park rehabilitation project so that opportunities to provide beneficial outcomes for both sites and regional biodiversity can be provided. As outlined in the Tomago Restoration Project EIA (RTS/PPR Appendix K), the detailed design phase will, in consultation with NPWS, investigate options for integration of the site with the adjacent Hunter Wetlands National Park, via connection to the North/South drain and variations to the ratio of mudflat to saltmarsh habitat. This potential option was excluded from the concept design to demonstrate that the Tomago Restoration Project can meet the offset objectives and operate independently without adversely impacting the surrounding land. However, should consultation with NPWS identify that variations are desirable, for example that integration with the adjacent national park may have beneficial outcomes for the national park and the restoration project, this will be considered in the detailed design phase. This is reflected in PWCS's statement of commitments for the T4 Project (in Chapter 15 of the RTS/PPR main report) which state that the "detailed design phase for the Tomago Offset Site Restoration Project will…investigate options to integrate the site with the Hunter Wetlands National Park".

Any integration with the Hunter Wetlands National Park rehabilitation project should not be to the detriment of the Tomago Restoration Project. The Tomago offset site must be able to operate independently and separately from the Hunter Wetlands National Park but in harmony with the objectives of both sites. This will also allow for the success of the Tomago Restoration Project to be determined independent of the Hunter Wetlands National Park rehabilitation project.

It is the intention of PWCS to hand over ownership and management of the site to an appropriate land manager such as NPWS who manage the adjacent Hunter Wetlands National Park. Once the Tomago offset site is established, a suitable mechanism for long-term conservation will be established in consultation with relevant agencies.

Influence of past disturbance

Issue: Some of the Swamp Oak Forest on the site is in good condition and the forest has poor connectivity mostly due to the industrial land surrounding it. With the exception of levee areas the claim that the site elevations have been broadly raised from historical levels thereby allowing the Swamp Oak Forest to colonise the area is questionable, with many such drained areas actually decreasing in elevation due to prolonged drainage.

Swamp Oak Forest occurred on the site in 1946, prior to the levee being constructed. The extent and density of the forest has no doubt varied over time due to changes in land use and the ability of the species to quickly colonise suitable habitat.

The 'Rice Paddy' is not a natural depression, but rather a constructed, bunded site. Questions remain as to whether the 'freshwater wetland' would occur in the 'Rice Paddy' area to the current extent if it was not for the historical infrastructure there, ie a similar situation to that claimed by the proponent about the Swamp Oak forest that has grown behind the levee since its construction and apparently decreased its value as significant habitat. Other information indicates that the environmental conditions within the 'Rice Paddy' are quite saline, with numerous saltmarsh species found in the area.

Response: Vegetation of the Tomago offset site is highly modified and unlikely to currently represent the pre-European environment. Despite this, three EECs occur on the site being Coastal Saltmarsh EEC, Freshwater Wetlands EEC and Swamp Oak Floodplain Forest EEC. The Swamp Oak Floodplain Forest EEC occurring in the Tomago offset site is not considered to have high conservation significance, as per the OEH's *Threatened Species Assessment Guidelines* (DECC 2007) and the NSW Final Determination for Swamp Oak Floodplain Forest EEC (NSW Scientific Committee 2004). This is because the community is not part of a wildlife corridor that has connective importance, does not provide important winter feed trees for arboreal mammals and birds and does not provide a 'stepping stone' for fauna in an otherwise cleared landscape. It is also considered unlikely that the community maintains a healthy native seed bank due to the highly disturbed surrounding landscape.

Conversely, the Freshwater Wetland EEC is known to provide habitat for the endangered Australasian bittern.

Freshwater wetlands occur throughout the Tomago offset site north of the access road that runs east-west across the site. They are generally restricted to closed depressions and swales that hold standing water for lengthy periods, and have little to no tidal inundation. It has been noted that where tidal inundation occurs, freshwater wetlands are gradually populated by halophylic species typical of saltmarsh. A transition zone occurs between the freshwater and halophylic plant species in the east of the Tomago offset site where floodgates allow tidal flows into the area. In this transition zone, species typical of both freshwater wetlands and saltmarsh occur together. This is the case for some small areas of the 'Rice Paddy' area.

It should be noted that OEH has expressed overall support for the T4 Project's proposed offset strategy (described in the RTS/PPR as the Updated Impact Mitigation and Biodiversity Offset Strategy) and the restoration of the Tomago offset site despite the proposed disturbance of Swamp Oak Floodplain Forest EEC. The offset strategy for the T4 Project provides in-perpetuity offsets for Swamp Oak Floodplain Forest EEC at the Ellalong and Brundee offset sites. The restoration of the Tomago offset site will result in a loss of approximately 74 ha Swamp Oak Floodplain Forest EEC, which represents approximately 0.02% of the remaining Swamp Oak Floodplain Forest EEC in the Hunter. However, the restoration project will result in a gain of up to 140 ha of suitable migratory shorebird habitat, which has been historically and extensively cleared and degraded in the Hunter estuary.

Effects of sea level rise

Issue: Questions remain about the ability of the constructed site to operate independently of sea level rise until 2050 due to increasing volumes through the submerged culverts and overland flow between ponds that may bypass fitted control structures. The constructed ponds proposal is limited in its provision of areas for landward migration of saltmarsh ecosystems, whereas the mosaic of wetland ecosystems likely to occur with natural rehabilitation is likely to be more accommodating of water level changes over the long term. The geotechnical assessment also recommends further investigations about the settlement rates and magnitudes which may affect design levels for levees, leading to prolonged maintenance requirements to maintain the constructed design.

Response: The ability for landward migration of saltmarsh ecosystems from the site is significantly limited by surrounding constraints, including the Hunter River North Arm to the west, the Southern Channel to the south, the main North South channel to the east and the proposed Northbank Enterprise Hub development to the north. PWCS has therefore designed the Tomago Restoration Project so that sea level rise impacts are managed through the main channel system and within the ponds as opposed to via overtopping of the existing levee system for at least the next 50 years. Final design levels for the perimeter bund, control mechanisms and ponds will be determined as part of the detailed design process and will take into consideration geotechnical constraints and long-term management of the site.

Mangrove propagule exclusion

Issue: It is difficult to comment on any proposed mangrove propagule exclusion mechanisms at this stage due to the lack of proposed mechanism or how it is incorporated into the culvert design. Reno mattresses will provide very poor benthic habitat if required over a large area. The use of gabions in any water flow control situations, such as around the culvert structure is not recommended.

Response: The concept of an undershot weir is that surface water, and anything floating on it (including mangrove propagules), does not flow through the structure into a channel feeding water to a wetland. Water must pass under culverts that are always submerged irrespective of tide height. Experience has shown that this design excludes the vast majority of flotsam, including mangrove propagules. The small numbers of propagules that flow through the system during the short period when they are neutrally buoyant are collected annually. However, additional structures that prevent the passage of the few mangroves propagules, but do not significantly resist water flow or fish passage, will be investigated during detailed design. This degree of control is necessary to minimise the need for intensive weeding at the site in the long term.

The use of reno mattresses will only be to prevent erosion from the high velocity movement of water in the vicinity of the undershot weir, to stabilise the channel outlet. Previously constructed undershot weirs, using reno mattresses (such as those used for the artificial wetlands at the Towra Point Ramsar site at Woolooware Bay, Kurnell NSW), have provided highly productive habitat for fish and consequently herons and egrets in this high energy area.

Culvert invert depth and flow velocities

Issue: There are some discrepancies between the main culvert invert depth, the depth of the central channel and recorded tides that indicate they will not be submerged during low tides. Chart 4.1 Recorded and Estimated Tidal Cycle suggests low tides regularly are below -0.6 m AHD in the vicinity of the proposed culverts, whereas the culvert inverts are -0.2 AHD and the lagoon base elevations between 0 and 0.2 m AHD. This indicates that the channel would drain completely on every tidal cycle. Velocities through main entrance of 1.2 to 2 metres per second (m/s) are acceptable for 'fish friendly' flows through the box culverts as long as there is no waterfall effect beyond the culvert or the culverts are not dry. Velocity at the swing gates in western Tomago Hunter Wetlands National Park is slower at 0.3 m/s.

Response: The hydraulic design criteria for the undershot weir connecting the restoration area to the Hunter River states that the invert level of the main inlet from the Hunter River will be designed below the minimum low perigean tide elevation. As such, the undershot weir will be constructed as a submerged opening to prevent the ingress of mangrove seeds to the restoration area and minimise the potential for a waterfall effect beyond the outlet. The invert level of the undershot weir will be determined at detailed design stage. The EIA for the Tomago Restoration Project notes that construction of the undershot weir will require excavation below -0.2 m AHD.

Vegetation management area

Issue: The plan to scrape the majority of the topsoil off the site and pile it on 11 ha of 'vegetation management area' to a height of about 8 m (initially) has a number of concerning issues:

- Will this elevated area affect the drainage of or into neighbouring properties, particularly the Hunter Wetlands National Park?
- What is the fire and/or self combustion risk of such a large mass of vegetation and organic material, especially initially?
- Where does rainfall water drain to from this fully bunded site?
- What will be the impacts of runoff and seepage on the amount and quality of freshwater draining from the site?
- What is the impact of the weight of the 'vegetation management area' placed onto the soil profile on soil heave?

Response: The proposed vegetation management area currently drains east to the main North/South drain. As part of the detailed design phase, consideration will be given to ensuring existing local catchment boundaries do not change significantly as a result of the vegetation management area's construction.

The volume of drainage from the vegetation management area will not change as a result of increasing the height/surface area of the site, as the land area and runoff coefficient for the land will remain similar. The Hunter Wetlands National Park is located within a separate catchment area, however is connected to the main North/South drain. The vegetation management area will not change the drainage regime to the main North/South drain and therefore is not expected to adversely impact on the Hunter Wetlands National Park.

The CEMP to be prepared for the Tomago Restoration Project will address the potential for fire and spontaneous combustion associated with the vegetation management area. The CEMP will also address management of water quality associated with the vegetation management area, including ASS, erosion and sediment control and soil and water management.

The geotechnical impacts of the vegetation management area will be considered as part of the detailed design process, including consideration of foundation materials, stability and localised effects.

Casuarina management

Issue: It is likely that casuarina regrowth in the vegetation management area will occur due to the transported soil seed bank and the elevation of the subsequent mound, even after it has settled. Therefore long-term plans to grow pasture grasses in that location seem unlikely.

Depending on the depth excavated, the remaining soil is likely to retain a substantial seed bank and casuarinas are likely to be an ongoing issue on the site where conditions are suitable for their growth, such as the proposed islands (affecting bird line-of-site in these critical places). Natural casuarina dieback in low lying areas has and is occurring in naturally regenerating estuarine wetlands in the adjacent national park, with little risk of further recruitment in those areas.

Response: It is not practically possible to exclude all seeds from the site during the earthworks and some will be retained in the soil. However areas inundated by tides, including channels and ponds, are not likely to be colonised by *Casuarina* sp. seedlings or regrowth due to high salinity and frequent inundation. This can be seen at the adjacent 'Samphire Flats' where *Casuarina* sp. stands are dying rapidly as a result of flooding by saltwater. Islands that are designed primarily as shorebird roost sites and coincidentally saltmarsh habitat will be largely covered by spring high tides that are likely to inhibit germination of seeds. Areas above spring high tides will be weeded during the initial period of management and maintenance activities post-construction as the site establishes and stabilises.

The total exclusion of *Casuarina* sp. from the site will not be possible largely due to seed dispersal from the adjacent Hunter Wetlands National Park, where extensive areas of *Casuarina* sp. will remain during the remediation works.

3.3.2 Issue 6

i. DP&I issue summary

Based on OEH's submission, provide "further information on the credit variation criteria adopted under Tier 3 and how the offset strategy achieves this to enable verification of the application of the credit variation rules".

ii. Extract from OEH submission

Appendix J of the RTS/PPR states that the T4 Project Biodiversity Offset Strategy has been undertaken in accordance with Tier 3 of the OEH's *Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development and State Significant Infrastructure* (OEH 2011). OEH concurs that the policy can be applied and that it appears to have been appropriately applied, however, a number of minor operational issues described require justification and/or rerunning of the credit tool. BBAM operational issues that need to be addressed before OEH supports the proposal include clarification on what credit variation criteria have been used under Tier 3 and how the biodiversity offset strategy achieves this. OEH requires this justification to assess whether the application of the credit variation rules are in accordance with the policy and the BBAM.

iii. Response

The following response applies to all of the BioBanking assessment scenarios and offset sites.

In order to justify a Tier 3 outcome, as detailed in the OEH (2011) *Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development and State Significant Infrastructure* for ecosystem credits, variation criteria A in Attachment B allows an assessor to "convert ecosystem credits for one vegetation type to any vegetation type within the same vegetation formation in the same IBRA bioregion" (OEH 2011). This being the case, the shortfall of 378 credits for HU563 Mangrove Forest in Estuaries of the Sydney Basin and South East Corner can be satisfied by the surplus of 1,377 credits for HU606 Saltmarsh in Estuaries of the Sydney Basin and South East Corner, which are both in the Saline Wetlands vegetation formation and the Sydney Basin IBRA bioregion.

In order to justify a Tier 3 outcome, as detailed in the OEH (2011) interim policy for species credits, Table 7.2 from the RTS/PPR Appendix J, Appendix 1 has been revised with threatened species' conservation status. The revised table is presented below as Table 3.1. It is noted that three threatened species requiring species credits have credit shortfalls, being the little tern (*Sternula albifrons*), red-backed button-quail (*Turnix maculosa*) and pondweed (*Zannichellia palustris*). Under a Tier 3 offsetting outcome variation criteria B in Attachment B allows an assessor to "convert one type of species credit to another type of species credit with the same or more endangered conservation status" (OEH 2011). This being the case, the following conversion of species credits is possible to make up for the credit shortfalls:

- The little tern (*Sternula albifrons*), listed as endangered under the NSW Threatened Species Conservation Act 1995 (TSC Act), has a shortfall of 293 credits which can be covered by the four fauna species, Australasian bittern (*Botaurus poiciloptilus*), black-necked stork (*Ephippiorhynchus asiaticus australis*), Australian pied oystercatcher (*Haematopus longirostris*) and green and golden bell frog (*Litoria aurea*), which are all listed as endangered under the TSC Act and have a surplus of credits totalling 3,336.

- The red-backed button-quail (*Turnix maculosa*), listed as vulnerable under the TSC Act, has a credit shortfall of 838 which can be covered by the ten fauna species, sanderling (*Calidris alba*), great knot (*Calidris tenuirostris*), large-eared pied bat (*Chalinolobus dwyeri*), lesser sand-plover (*Charadrius mongolus*), spotted harrier (*Circus assimilis*), black bittern (*Ixobrychus flavicollis*), broad-billed sandpiper (*Limicola falcinellus*), black-tailed godwit (*Limosa limosa*), southern myotis (*Myotis macropus*) and Terek sandpiper (*Xenus strenua syn. Xenus cinereus*), which are all listed as vulnerable under the TSC Act and have surplus credits totalling 8,011.

- Pondweed (*Zannichellia palustris*), listed as endangered under the TSC Act, has a credit shortfall of 65 which can be covered by the flora species Bynoes wattle (*Acacia bynoeana*), which is also listed as endangered under the TSC Act and has a surplus of 1,200 credits.

Table 3.1 Revised table 7.2 from RTS/PPR Appendix J, Appendix 1: Comparison of species credits required and credits created, including species conservation status

Common name	Scientific name	Status		Credits required	Credits received			Residual credits
		TSC Act	EPBC Act	Species credits required for the T4 project area	T4 frog habitat corridor	Tomago offset site	Ellalong offset site	Brundee offset site	(negative values indicate credit shortfalls)
Bynoes wattle	*Acacia bynoeana*	E	V				1200		1200
Australasian bittern	*Botaurus poiciloptilus*	E	E	360	24	84		957	705
Sanderling	*Calidris alba*	V	-			966			966
Great knot	*Calidris tenuirostris*	V	-	660		966			306
Large-eared pied bat	*Chalinolobus dwyeri*	V	V					1224	1224
Lesser sand-plover	*Charadrius mongolus*	V	-			1247			1247
Spotted harrier	*Circus assimilis*	V	-				653		653
Black-necked stork	*Ephippiorhynchus asiaticus australis*	E	-	360		1247		957	1844
Small-flower grevillea	*Grevillea parviflora subsp. parviflora*	V	V				1200		1200
Australian pied oystercatcher	*Haematopus longirostris*	E	-	352		966			614
Black bittern	*Ixobrychus flavicollis*	V	-	737		84	207	957	511
Broad-billed sandpiper	*Limicola falcinellus*	V	-	660		1,247			587
Black-tailed godwit	*Limosa limosa*	V	-	660		966			306
Green and golden bell frog	*Litoria aurea*	E	V	1,292	60		207	1,198	173
Southern myotis (syn. large-footed myotis) (breeding)	*Myotis macropus*	V	-			281	1,624		1,905
Little tern	*Sternula albifrons*	E	-	293					-293
Red-backed button-quail	*Turnix maculosa*	V	-	1,308			470		-838
Terek sandpiper	*Xenus strenua syn. Xenus cinereus*	V	-	660		966			306
Pondweed	*Zannichellia palustris*	E	-	85	8		12		-65
Total				**7,427**	**92**	**9,020**	**5,573**	**5,293**	**-**

3.3.3 Issue 7

i. DP&I summary

Based on OEH's submission, "justify application of Tier 3 outcomes with particular reference to mitigated net loss".

ii. Extract from OEH submission

Appendix J of the RTS/PPR states that the T4 Project biodiversity offset strategy has been undertaken in accordance with Tier 3 of the OEH's *Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development and State Significant Infrastructure* (OEH 2011). OEH concurs that the policy can be applied and that it appears to have been appropriately applied, however, a number of minor operational issues described require justification and/or rerunning of the credit tool. BBAM operational issues that need to be addressed before OEH supports the proposal include justification as to why it is appropriate to apply the Tier 3 outcomes under OEH's interim policy for offsetting on major projects.

In considering whether the mitigated net loss standard is appropriate, consideration should be given to:

- whether the credits required by the calculator are available on the market;
- whether alternative offset sites (other than credits) are available on the market; and
- the overall cost of the offsets and whether these costs are reasonable given the circumstances.

OEH concurs that the proponents and their consultants have discussed this during the consultation phase, but it must be included in the report.

iii. Response

The following response applies to all of the BioBanking assessment scenarios and offset sites.

As per a Tier 3 outcome (OEH 2011), the following justifications are provided:

- The online BioBanking credits register (http://www.environment.nsw.gov.au/bimsprapp/SearchBiodiversityCredit.aspx?Start=1) was accessed on 20 December 2013 to determine the availability of the ecosystem and species credits required for the T4 Project. Insufficient credits are available for all vegetation types and threatened species impacted by the T4 Project. It is noted that some credits for HU563 Mangrove Forest in Estuaries of the Sydney Basin and South East Corner and HU606 Saltmarsh in Estuaries of the Sydney Basin and South East Corner are currently available within 30 km of the T4 project area (in the adjacent Karuah Manning CMA sub-region). A very small number of credits are also available for HU673 *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands of the Sydney Basin, in the adjacent Wyong CMA sub-region, approximately 11 km south of the T4 project area. However given that the T4 Project is not seeking a BioBanking approval the overall surplus of credits created by the proposed offset sites, and further justifications below, it is not considered that purchasing BioBanking credits would be required.

- Alternative and/or more appropriate offset sites are not known to be available on the market. An investigation of potential offset opportunities for the T4 Project that focused on habitat quality and the presence of relevant threatened species was undertaken as part of the ecological assessment in the EA and the Updated Impact Mitigation and Biodiversity Offset Strategy in the RTS/PPR, both

of which were publicly exhibited. Extensive investigations were undertaken as part of the process of selecting suitable offsets, including desktop reviews, site inspections and workshops with relevant stakeholders. Many offset locations in the Hunter were investigated including land at Hexham, Lenaghan, Shortland, Fullerton Cove, Fern Bay, Heatherbrae and Gillieston Heights. The combination of the Ellalong, Tomago and Brundee offset sites and the on-site green and golden bell frog habitat corridor provides a wide range of offsetting opportunities to conserve the threatened species and communities of the T4 project area on a local, regional and state-wide scale. The strategy includes in-perpetuity conservation of existing habitat for threatened species and communities and the creation of additional wetland habitat which will provide a net gain in habitat in the Hunter estuary.

- The overall cost of the offsets is significant, and is considered to be reasonable.

3.3.4 Issue 8

i. DP&I summary

Based on OEH's submission, "provide the currently used credit calculator files for the current development footprint for confirmation of credit profiles".

ii. Extract from OEH submission

The credit calculator files (Proposal ID: 00201201210019D) submitted February 2012 do not correspond completely to the data presented in the RTS/PPR (Section 2.0 of Appendix 1 of Appendix J), for example credit profiles are slightly different. OEH expects that the assessment presented in the updated biodiversity offset strategy relates to the amended development footprint while that submitted in 2012 is the former footprint. Although the impacts and areas of vegetation are almost identical (albeit for lower conditioned vegetation), the most up-to-date credit calculator files should be submitted on the current proposed development footprint.

iii. Response

Table 2.7 of the RTS/PPR Appendix J, Appendix 1 includes the number of ecosystem credits required for the T4 Project. The total number of ecosystem credits listed in this table is 1,584, which is equal to the number of ecosystem credits detailed in the credit calculator files (Proposal ID: 0020/2012/0019D) sent to OEH on 18 October 2013.

Table 2.8 of the RTS/PPR Appendix J, Appendix 1 includes the number of species credits required for the T4 Project. There are two minor differences in the number of species credits in this table and the credit calculator files (Proposal ID: 0020/2012/0019D). The first difference, due to number rounding, is explained on page 2.12 of Appendix 1 (of the RTS/PPR Appendix J):

> One of the difficulties experienced during field surveys was the requirement for a population estimate of the threatened aquatic flora species *Zannichellia palustris*. This small, inconspicuous aquatic plant spreads by rhizomes, making the identification of individual plants not possible. In addition, *Zannichellia palustris* often grows with other similar submerged aquatic plants, making the differentiation of individuals difficult. An expert report has been prepared by Mary Greenwood (Greenwood 2012), an ecologist specialising in this species, detailing the areas of suitable habitat on the T4 project area, which was utilised by Umwelt (2012a) to estimate of the area of suitable habitat on the T4 project area. The area of habitat for this species was used as an alternative to population estimates given the difficulties discussed and was recommended by John Seidel, a BioBanking expert from OEH.

When entering the area of suitable habitat into the Credit Calculator, only whole numbers can be inputted since flora species usually require the number of individuals to be entered for calculation of species credits. For this assessment the nearest whole hectare of suitable habitat for *Zannichellia palustris* was entered into the Credit Calculator. The species credits were then multiplied by the actual suitable habitat and then divided by the rounded up area of habitat for this species. Species credits were then also rounded to the nearest whole number. As a result of this, the species credits for *Zannichellia palustris* are slightly higher in the attached credit report.

As a result of this, a total of 85 species credits for *Zannichellia palustris* are noted in Table 2.8 of the RTS/PPR Appendix J, Appendix 1, compared to a total of 100 credits for this species in the credit calculator files (Proposal ID: 0020/2012/0019D).

The second difference is due to a reporting error for southern myotis (*Myotis macropus*). Originally this species was assessed for foraging habitat based on the erroneous assumption that this species was a species credit species. However it was later determined that foraging habitat for this species was covered by ecosystem credits. As a result this species was omitted from the credit calculator files (Proposal ID: 0020/2012/0019D), however the associated report in the RTS/PPR was not updated to reflect this. Only breeding habitat for this species is covered under species credits, however as detailed on page 40 of Appendix 7 of the ecological assessment in the EA Appendix K, breeding habitat for this species is not considered present within the T4 project area.

Table 2.8 from the RTS/PPR Appendix J, Appendix 1 has been revised to match the credit calculator files (Proposal ID: 0020/2012/0019D) and is provided below as Table 3.2.

Table 3.2 Revised table 2.8 from RTS/PPR Appendix J, Appendix 1: Species credits required

Common name	Scientific name	Species credits required
Australasian bittern	*Botaurus poiciloptilus*	360
Great knot	*Calidris tenuirostris*	660
Black-necked stork	*Ephippiorhynchus asiaticus australis*	360
Australian pied oystercatcher	*Haematopus longirostris*	352
Black bittern	*Ixobrychus flavicollis*	737
Broad-billed sandpiper	*Limicola falcinellus*	660
Black-tailed godwit	*Limosa limosa*	660
Green and golden bell frog	*Litoria aurea*	1,292
Little tern	*Sternula albifrons*	293
Red-backed button-quail	*Turnix maculosa*	1,308
Terek sandpiper	*Xenus strenua syn. Xenus cinereus*	660
Pondweed	*Zannichellia palustris*	85*
	TOTAL	**7,427**

Notes: **listed in the credit calculator files as 100 species credits required. This number was revised to take into consideration number rounding, as explained above.*

The credit calculations in the credit calculator files (Proposal ID: 0020/2012/0019D) submitted to OEH on 18 October 2013 are based on the latest disturbance footprint. Based on the above explanations of the minor differences in reported credit numbers, it is not considered necessary to modify or re-submit the credit calculator files.

3.3.5 Issue 9

i. DP&I summary

"BBAM operational issues as outlined by OEH".

ii. Extracts from OEH submission and responses

OEH has reviewed the submitted credit calculator files and the underlying assumptions provided in Appendix J of the RTS/PPR. OEH is satisfied that the credits generated have been generally calculated correctly under BBAM, albeit a number of minor operational issues described that requires justification and/or rerunning of the credit tool. OEH expects that in addressing these issues, the BBAM tool will need to be re-run and as such it is likely that this will result in a change to the number of biodiversity credits that will be either required (development site) or generated (Biobank sites). Although OEH acknowledges that these issues are likely of a minor operational manner, except for the Tomago offset site which will require some adjustments to be made, these need to be addressed before OEH lends its full support to the proposal. BBAM operational issues that need to be addressed before OEH supports the proposal are set out in the following.

T4 project area

Issue: Appropriate justification needs to be provided with respect to the increase in 'native vegetation cover class after management' from 1-10% to 11-20%. OEH acknowledges that the assumption is that green and golden frog habitat corridors will be re-created and improve vegetation cover however requests adequate justification of how this will be achieved. Notably, how revegetation will occur and how it will achieve an increase in percent cover, including appropriate explanation of why the 11-20% class was used.

Response: The native vegetation cover class for the landscape value assessment was determined to increase by one threshold, from 1-10% to 11-20%, based on future creation of aquatic vegetation. As explained in the RTS/PPR (Section 3.1.1.1 of Appendix 1 of Appendix J), and in accordance with the BBAM, the 100 ha assessment circle was positioned over an area of the site where the greatest change or greatest amount of habitat creation would occur.

This increase in percent native vegetation cover class will be achieved by converting areas of disturbed land into freshwater wetlands. These areas will be excavated to create suitable water holding reservoirs and then planted with appropriate aquatic plant species. The green and golden bell frog habitat corridor will require emergent and fringing wetland plants around the ponds to provide protective and basking habitat for juvenile and adult bell frogs. This will be achieved by planting or transplanting tube stock of rushes and sedges such as *Bolboshoenus* sp.*, Gahnia* sp. and *Schoenoplectus* sp. At least 50% of the surface of the pond will be open water and not dominated by emergent plants which will be achieved by varying the depths across the pond.

Issue: Justification needs to be provided as to why groundcover (grassland vegetation –'non-woody vegetation types') condition was chosen over overstorey condition (woody vegetation). OEH understands that the surrounding vegetation in the 1,000 ha circles is a mosaic of non-woody types (ie *Sporobolus* sp. and/or *Juncus* sp. dominated coastal saltmarsh and *Typha* sp./*Phragmites* sp. dominated freshwater wetlands) verses woody vegetation types (ie mangroves), though it appears the cover of these two types are similar and difficult to separate. OEH requests explanation of how cover was measured and how the non-woody vegetation type was chosen over the woody.

Response: As discussed in Section 3.1.2 of the RTS/PPR Appendix J, Appendix 1, for the connectivity assessment the condition of the connecting link was assessed as non-woody vegetation. This is because the native vegetation to be retained and created as part of the T4 Project's green and golden bell frog habitat corridor comprises non-woody native vegetation and the adjacent vegetation to the north-west also mainly comprises non-woody vegetation in the form of saltmarsh and freshwater wetlands.

The condition of this link was assessed as being at benchmark based on knowledge of the area and also from aerial photography interpretation using an aerial photograph from April 2011.

Issue: Justification needs to be provided why 'Hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian land' was not selected under the geographic and habitat features component of the credit tool, as per the report (OEH notes that in submitted credit calculator files this option is not available). This was selected for the development site assessment scenario and the proposed green and golden bell frog habitat corridor occurs within the same footprint.

Response: The geographic/habitat feature 'Hollow-bearing trees, bridges, caves or artificial structures within 200 m of riparian land' did not appear as an option to select for the green and golden bell frog habitat corridor in the credit calculator. There is also no way of adding additional geographic/habitat features in the current version of the credit calculator. The inclusion of this geographic/habitat feature in Table 3.3 of the RTS/PPR Appendix J, Appendix 1 was erroneous. In any case, breeding habitat for the southern myotis (*Myotis macropus*) is not considered to be present in the T4 project area, as discussed in the response to Issue 8.

<u>Tomago offset site</u>

Issue: With respect to the '% native vegetation cover' entered at the before and after BioBanking, the values added are different for both the 100 and 1,000 ha assessment circles. It appears that this scenario is assuming that prior to the BioBanking the 140 ha of the site that is being restored to coastal saltmarsh is cleared (ie devoid of native vegetation cover) and that after BioBanking has been applied (ie saltmarsh restoration) there will be an approximate 20 (1,000 ha assessment circle) to 60% (100 ha assessment circle) increase in cover (ie 2-5 cover classes depending on assessment circle). OEH does not agree with this assumption, given that for the site value and description of the site it was assumed that the 140 ha 'restoration area' was mapped as low condition Coastal Saltmarsh, not as cleared land prior to BioBanking being applied. Under this scenario OEH believes that an inflated 'landscape' score has been applied. As such there is still native vegetation cover on the site before BioBanking and OEH is of the opinion that this cover does not substantially change after BioBanking has been applied. Hence OEH believes there is no justification for adding different values in the 'before' and 'after' BioBanking scenarios. The site value gain will account for the improvement of the site (via improved vegetation condition) which is applied when adjusting the 'management scores'. OEH is of the opinion that the credit calculator will need to be amended and re-run, if it was assumed part of the site was cleared prior to BioBanking.

Response: The approach taken by Umwelt for the Tomago offset site 'Restoration Scenario' is the approach that was recommended to Umwelt by OEH at a meeting on 3 July 2012, which was attended by OEH staff John Seidel and Steve Lewer. This approach assumed that the site had already been cleared of vegetation at the 'Before BioBank' step and that restoration of native vegetation occurred at the 'After BioBank' step. In order to take into consideration the impact to the existing native vegetation, a separate assessment was undertaken for the Tomago offset site, identified as the 'Development Scenario', as described in Section 4.2 of the RTS/PPR Appendix J, Appendix 1.

Umwelt understands that application of the BioBanking tool to the Tomago offset site is not standard, hence seeking OEH's guidance on its use. Umwelt applied the tool in strict accordance with OEH guidance.

Issue: Justification needs to be provided why 'swamps or shallow freshwater on clay' was not selected under the geographic and habitat features component of the credit tool. This habitat feature assumes that suitable habitat for *Maundia triglochinoides* may be present. Soil landscape mapping for the Newcastle area (Matthei 1995) maps the Tomago offset site as estuarine landscapes dominated by Holocene sediments of estuarine mud, silt and clay. As such, OEH is of the opinion this feature should have been selected as the site contains swamps on clay soil types. Furthermore, *Maundia triglochinoides* has been recorded on similar landscapes less than 5 km west of the Tomago offset site.

Response: Umwelt acknowledges that it would have been appropriate to select the geographic/habitat feature 'swamps or shallow freshwater on clay' at the Tomago offset site. However this geographic/habitat feature does not affect credits generated. By selecting this geographic/habitat feature the credit calculator stipulates that targeted surveys are required for *Maundia triglochinoides*. Targeted surveys were completed during September 2011 and July 2012, which is outside of the required survey period for this species. According to the credit calculator targeted surveys for this species should be undertaken between November and March. This coincides with the flowering period of this species, given that flowers are required to separate this species from other similar species in the *Triglochin* genus.

However, given that *Maundia triglochinoides* has vegetative parts present all year, it can be recorded as possibly present at all times of the year. Given that no similar *Triglochin* species were at the Tomago offset site and that only *Triglochin striatum* was recorded in saltmarsh, which is easily separated from *Maundia triglochinoides* based on leaf characteristics, it is considered that adequate surveys for this species were undertaken. Consequently, this species was not further considered in the assessment.

Ellalong offset site

Issue: Appropriate justification needs to be provided with respect to the increase in 'native vegetation cover class after management' from 51-60% to 61-70% in the 100 ha assessment circle No. 1. OEH acknowledges that the assumption is that part of the site will be regenerated/restored but requests adequate justification of how this will be achieved. Notably how revegetation (if applicable) will occur and how it will achieve an increase in percent cover.

Response: The native vegetation cover class for the landscape value assessment was determined to conservatively increase by one threshold, from 51-60% to 61-70%, based on future recruitment and revegetation of the Ellalong offset site. The site contains approximately 300 ha of woodland and forest vegetation and approximately 43 ha of cleared/exotic grassland communities. It is envisaged that natural recruitment and regeneration of the surrounding forested and woodland areas would gradually revegetate areas of exotic grassland which would, in turn, increase the native vegetation cover of the site.

3.3.6 Issue 10

i. DP&I issue summary

Based on OEH's submission, provide "response to issue of staged development to maintain existing habitat while construction of [green and golden bell frog] habitat corridor occurs and opportunities for a co-ordinated approach with other land holders/operators".

ii. Extracts from OEH submission

In previous correspondence (dated 9 May 2012), OEH requested that the proponent demonstrate that consideration had been given to the feasibility of staging the T4 project so that areas of important and significant habitat are retained whilst green and golden bell frog habitat re-creation is ongoing and breeding success in newly constructed ponds is shown to be successful, preferably over multiple seasons

(ie two generations). OEH indicated that this would ensure that some breeding habitat was retained as a safety measure if habitat re-creation works are unsuccessful, and as such would likely ensure the continuing viability of the local population.

OEH acknowledges that PWCS has provided justification that indicates their design of the T4 Project has considered appropriate avoidance strategies and investigated the possibilities of a staged approach, including reasons as to why this is not feasible due to infrastructure requirements. However, OEH is still of the opinion that a staging proposal and/or an over-arching management agreement between all land-users that impact green and golden bell frog habitat would ensure that critical habitats are managed appropriately, retained and/or not indirectly impacted upon, such as Pond K22 on NPC land that occurs on the northern boundary of the T4 Project. For example, retention and long-term management of this area is considered critical for the maintenance of the Kooragang Island population of green and golden bell frog, as it is recognised as significant breeding habitat.

If the project is approved, OEH considers that staging should still be investigated to ensure appropriate green and golden bell frog habitat is maintained in situ during construction of the habitat corridor. Furthermore, OEH recommends that the proponent consider discussions with other land owners/users of Kooragang Island which impact on green and golden bell frog to ensure the long-term survival of the species, rather than managing in isolation on specific areas in separate ownership. This would help facilitate a more coordinated approach to the species management at Kooragang. OEH would support a development condition that established a green and golden bell frog management framework and advisory committee for Kooragang and Ash Islands with representatives of industry, landowners, government and community.

iii. Response

As discussed in the RTS/PPR, PWCS commissioned Aurecon Hatch to undertake a detailed design review to consider whether the T4 Project could be redesigned to protect green and golden bell frog habitat at the northern extent of the proposed stockyard area during the initial stages of the development and potentially reduce the short-term impacts on the green and golden bell frog, particularly during construction and establishment of the green and golden bell frog habitat corridor. Aurecon Hatch's report is provided in Appendix T of the RTS/PPR. The alternative construction design included the retention of important green and golden bell frog habitat ponds including Ponds 9, 10, 11 and 12 and Railway Pond (refer to RTS/PPR Figure 4.1 for locations of ponds) during the initial stages of the T4 Project's construction and operation. PWCS considered the outcome of the design review and determined that the proposed redesign and staging alternative was not a feasible option for the T4 Project. The potential alternative option is a cost-prohibitive solution, with a materially longer engineering and construction period, that provides no further certainty that the green and golden bell frog will be protected and successfully breed.

Trial ponds for the green and golden bell frog habitat corridor were constructed in the northern and southern areas of the T4 project area in 2012. These ponds were installed adjacent to existing ponds in the north of the T4 project area and adjacent to Long Pond in the south. Advantages of the ponds constructed include that they are free of the introduced plague minnow (*Gambusia holbrooki*), vegetation can be managed, and water quality and level can be easily manipulated.

Monitoring of the trial ponds is already showing signs that the created habitat will be successful, with both areas of created ponds found to be occupied through natural colonisation of green and golden bell frogs by early 2013. The southern cluster of ponds contained two adult green and golden bell frogs in March 2013. The northern cluster had one green and golden bell frog in February and March 2013, three (two adults and one juvenile) in October 2013 and three females in December 2013. Additionally, a monitoring event in January 2014 identified four adult green and golden bell frogs in the northern cluster

and seven green and golden bell frog tadpoles (S. Clulow pers. comm.), which confirms breeding has occurred in this cluster. These frogs and tadpoles were not introduced to the ponds, but rather moved to and occupied the created habitat themselves.

It is considered that the early construction of ponds within the T4 project area (in areas that can be developed without risk of disturbance during construction of the T4 Project and subject to capping requirements and timing) will build on the success of the trial ponds in creating additional habitat so that the species can be maintained in situ within the T4 project area during the T4 Project's construction. The population of the green and golden bell frog in the proposed habitat corridor can be supplemented by PWCS-funded captive-bred individuals, if required.

Collaboration between adjacent landholders, both public and private landholders, is considered desirable moving forward with the management of the green and golden bell frog population across the industrialised Kooragang Island.

3.3.7 Issue 11

i. DP&I issue summary

Based on OEH's submission, provide "response to concerns regarding loss of habitat provided by Deep Pond as raised in OEH correspondence dated May 2013".

ii. Extract from OEH submission

OEH expressed concerns in previous correspondence that the EA did not provide adequate justification of the loss of significant foraging and roosting habitat that Deep Pond provides for a variety of shorebirds and waders (including threatened species, such as the deep-diving blue-billed and freckled ducks). Umwelt's response to ecology matters appears not to address these concerns. OEH requests the proponent address the concerns on this matter as outlined in correspondence dated 9 May 2013.

iii. Response

The EA and RTS/PPR acknowledge the importance of Deep Pond and Swan Pond as habitat for a wide range of shorebirds, water birds and other species of water fowl. The loss of these important habitats was considered in the ecological impact assessment, particularly in relation to the impact of habitat loss associated with the T4 Project on threatened and migratory species. The report notes that the T4 Project is likely to have a significant impact on migratory shorebird species listed under international conventions (under the EPBC Act).

Deep Pond occurs on Kooragang Island as a result of industrial reclamation by infilling of the original estuarine wetlands with industrial waste (Lindsey 2008). The existence of a freshwater wetland of this size on Kooragang Island is not representative of the natural habitats that once occurred in the area. Additionally, all impacts on wetland habitats are contained within the SP1 zone which permits port developments (with consent) under the SEPP (Major Projects) Amendment (Three Ports) 2009. The construction and operation of the T4 Project is dependent upon the utilisation of the land currently occupied by Deep Pond. The southern part of Deep Pond will be retained however there are no feasible options for avoiding impacts to the remainder of Deep Pond. Accordingly, a substantial impact mitigation and offset package has been developed to minimise impacts and compensate for those not able to be avoided or mitigated.

The habitats provided by Deep Pond in the T4 project area are proposed to be offset through habitat restoration and creation works at the Tomago offset site, for use by migratory shorebirds, and by in-

perpetuity conservation of the Ellalong offset site, that is known to provide drought refuge habitat for waterfowl.

3.3.8 Issue 12

i. DP&I issue summary

Based on OEH's submission, provide "consideration of not removing levee on Mosquito Creek".

ii. Extract from OEH submission

Discussions have been held with PWCS subsequent to the EA exhibition and the proposed removal of the levee will be dealt with through a review of environmental factors process as the existing levee is on-park and is outside of the T4 footprint. Although removal of the levee is proposed by PWCS, not removing the levee should also be considered to reduce the chance of mangrove recruitment into the existing saltmarsh. The OEH Parks and Wildlife Group is satisfied that the matter has been dealt with through the additional studies and documentation.

iii. Response

The following response refers to the proposed levee removal near the Eastern Watercourse, east of Mosquito Creek and north of the KCT rail loop. There are no levees on Mosquito Creek proposed to be removed as part of the T4 Project.

As discussed in Sections 5.1.2(i) and 6.1.2(ii) of the RTS/PPR main report, without mitigation, the proposed rail embankment near the KCT rail loop is likely to block a tidal flow path and so indirectly impact the tidal regime of a wetland area (and associated vegetation communities) around the southern end of the Eastern Watercourse (including within the Hunter Wetlands National Park). PWCS is committed to avoiding direct and indirect impacts to the Hunter Wetlands National Park. Accordingly, it is proposed to modify or remove the levee at the Eastern Watercourse channel to reinstate the estuarine channel and maintain tidal flows to these vegetation communities. These mitigation works will be undertaken within the Hunter Wetlands National Park. And require approval from NPWS. NPWS has stated in consultation with PWCS that they support this approach in principle subject to an appropriate level of assessment provided to them. NPWS expressed the view that it would "assist in the protection and ongoing management of the conservation values present in this part of the national park". Therefore, indirect impacts within the Hunter Wetlands National Park are currently proposed to be mitigated by modifying or removing the levee at the Eastern Watercourse channel, subject to NPWS approval.

The option of not removing the levee was assessed and outlined in correspondence with the NPWS. Modelling indicated that construction of the proposed rail embankment is likely to block the existing overland flow path that facilitates tidal exchange from the west. This overland tidal flow sustains estuarine wetland communities south of the existing levee. If unmitigated, this will likely alter the existing tidal regime in the disturbed wetland complexes between the levee and the rail embankment.

The vegetation communities within this wetland include a stand of grey mangroves (*Avicennia marina* subsp*. australasica*) and saltmarsh communities which rely on tidal exchange. However, the saltmarsh contains a large amount of the introduced sharp rush (*Juncus acutus*) which has the potential to take over the native saltmarsh community regardless of any impacts associated with the rail embankment. If the estuarine wetland was to become tidally isolated it is likely the habitat would be altered over time. Mangroves may in time die off if tidal influence is completely blocked. Freshwater influences from adjacent areas are likely to eventually transform this area into land dominated by freshwater species such

as common reed (*Phragmites australis*) and broad-leaved cumbungi (*Typha orientalis*), which form the dominant vegetation within the area east of the wetland pocket.

Umwelt determined that reinstating an estuarine channel through the levee would mitigate the project's potential impacts and result in a likely ecological improvement (refer Section 6.1.2(ii) of the RTS/PPR main report). The proposed modification or removal of the existing levee is likely to restore the area of disturbed wetland complex to a native estuarine mangrove complex, characteristic of the area's natural condition, and maintain tidal flows to this area. Therefore, it is considered that modification or removal of the levee will be more beneficial to the local native estuarine communities and habitats of the Hunter Wetlands National Park than retaining the levee in this area.

Notwithstanding, alternative mitigations may be available and in discussions with PWCS, NPWS has indicated that extensive mitigation works may not be required. Further discussions between PWCS and NPWS regarding this mitigation will be undertaken post-approval. The commitment in Section 15.4 of the RTS/PPR main report is:

> Works will be undertaken to avoid impacting the tidal regime of the wetland complex near the Eastern Watercourse. The mitigation design will be finalised prior to construction. Subject to approval from NPWS, this could involve modifying or removing the existing levee at the Eastern Watercourse channel, to maintain tidal flows to the wetland complex by this route.

3.3.9 Issue 13

i. DP&I issue summary

Based on the Hunter-Central Rivers CMA submission, provide response to issues "with regard to the Tomago offset site, in particular reference to 'less engineered' solutions to estuarine wetland provision and reliance on the bund associated with area 3 in relation to climate change".

ii. Extract from Hunter-Central Rivers CMA submission

The CMA does not consider the proposed construction of 100 ha of estuarine wetlands at the Tomago offset site to be an appropriate mitigation method for the loss of shorebird habitat at the T4 development site.

The CMA does not believe that the proposed habitat restoration program for the Tomago offset site will achieve the goals listed in Section 1.3 of the Updated Impact Mitigation and Offset Strategy to:

- mitigate potential impacts within T4 project area;
- maintain or improve biodiversity values of the surrounding region in the medium to long term;
- maintain or improve the viability of threatened species that could be significantly affected by the T4 Project through securing and/or restoring habitat for the lower Hunter Valley or elsewhere in their range; and
- ensure there are no residual impacts on key threatened species or ecological communities in the long term as a result of construction or operation of the T4 Project.

The CMA is concerned that the construction of the lagoon complex at the Tomago offset site will clear 74 ha of Swamp Oak EEC; destroy 84 ha of local eastern grass owl habitat and an identified white-bellied sea eagle nesting site; create ASS management issues and cost a disproportionate amount in relation to

the benefits gained. The CMA is not aware of any research which suggests that the construction methods proposed will create habitat any faster than more natural regeneration approaches and believes the proposal will create a raft of significant ecological problems that could otherwise be avoided.

The CMA suggests that PWCS purchases additional offset land in the lower Hunter estuary and develops a less engineered estuarine habitat restoration program such as the CMA's Kooragang Wetland and Hexham Swamp rehabilitation projects and the NPWS project at the Hunter Wetlands National Park, Tomago. These projects clearly demonstrate that once tidal flows are restored, natural regeneration of estuarine communities (including saltmarsh and mudflat habitat) occurs quite quickly and without significant detrimental impact to the local ecology. Applying the construction and monitoring budget currently allocated to the Tomago…Restoration Project to a 'softer' engineering solution could secure a greater area of shorebird habitat and a more ecologically sustainable solution in the long term.

The CMA does not deem it appropriate that PWCS rely on the bund wall that is associated with Area 3 of the Hunter Valley Flood Mitigation Scheme to protect the Tomago offset site against climate change related impacts for the next 50 years. The Hunter Valley Flood Mitigation Scheme is legislated under Part 2, Chapter 5 of the *Water Management Act 2000* and is currently valued at $5,690 million. The CMA contributes 25% of costs associated with the maintenance of this scheme. A policy decision has not been made on whether the scheme will be used to mitigate the impacts of climate change and it is likely that some scheme assets could be decommissioned if cost benefit ratios become unsustainable under differing climatic conditions. It is highly presumptuous to forecast that Government would commit to maintaining this structure at potentially such a high cost.

iii. Response

Swamp Oak EEC and eastern grass owl

As discussed in the Updated Impact Mitigation and Biodiversity Offset Strategy contained in Appendix J of the RTS/PPR, although the proposed Tomago Restoration Project will result in the net gain of up to 140 ha of migratory shorebird habitat in the Hunter estuary, it will also involve the removal of existing habitats, in particular Swamp Oak Floodplain Forest, listed as an EEC under the TSC Act, and habitat for the eastern grass owl (*Tyto longimembris*), listed as vulnerable under the TSC Act. The Tomago Restoration Project EIA (RTS/PPR Appendix K) assesses the impact of the project on these ecological values.

Swamp Oak Floodplain Forest EEC was identified in the Tomago offset site on reclaimed estuarine land. Approximately 74 ha of this community will be removed by the proposed restoration activities. The EIA concluded that the local significance of the Swamp Oak Floodplain Forest EEC is considered to be low, as per the OEH's *Threatened Species Assessment Guidelines* (DECC 2007) and the NSW Final Determination for Swamp Oak Floodplain Forest EEC (NSW Scientific Committee 2004). This is due to it not forming part of a wildlife corridor that has connective importance, not providing an important winter feed tree source for arboreal mammals and bird species and not providing a 'stepping stone' for fauna in an otherwise cleared landscape. Additionally, the other two offset sites for the T4 Project, Ellalong and Brundee, contain Swamp Oak Floodplain Forest EEC that will be preserved in perpetuity as part of the biodiversity offset strategy.

The eastern grass owl (*Tyto longimembris*) has been recorded within the Tomago offset site on 10 occasions by Umwelt in 2011 and 2012. Additionally, surveys by Ecobiological (2011) recorded eastern grass owls in the Tomago area and nest sites in lands adjacent to the site. The Tomago Restoration Project will require the removal and disturbance of approximately 84 ha of known and potential foraging habitat for the eastern grass owl across the site. The re-introduction of tidal inundation to the site will reduce the area of grassland foraging habitat for the species in the area. However, the species has been recorded utilising the freshwater wetland and saltmarsh habitat for foraging. The proposed restoration work is

expected to create nominally up to 100 ha of saltmarsh including extensive areas of preferred upper saltmarsh habitats. Furthermore, 11 ha of freshwater wetland habitat will be retained within the site that provides known foraging habitat for the species.

PWCS has committed (refer Section 15.5.2 of the RTS/PPR main report) to "investigate the feasibility and practicality of relocating the white-bellied sea eagle nest to a suitable location within, or in close proximity to, the Tomago offset site, outside the proposed area of inundation".

Further response to the matters raised by the CMA is provided earlier in the response to Issue 5.

Engineered design of Tomago

A more passive engineering approach was the preferred option for PWCS in developing suitable local offsets for migratory shorebirds. As part of the EA's ecological assessment, potentially suitable land in the Hunter was investigated and its suitability for restoration and offsetting in terms of locality to the T4 Project, position in the Hunter estuary, proximity to existing conservation areas and purchase availability was assessed. The Tomago offset site was considered the most suitable available land as it occurred within 2 km of the T4 project area, was located on the north arm of the Hunter River (which migratory shorebirds are known to use for navigation) and adjacent to the Hunter Wetlands National Park and the Hunter Estuary Wetlands Ramsar site. The topography, size, existing vegetation and potential tidal inundation patterns on the Tomago offset site mean that in order to restore the land to estuarine saltmarsh complexes, active excavation and engineering works would be required. Previous successful construction of wetland habitats in the Hunter have involved large-scale excavation. For example the Shortland portion of the Hunter Estuary Wetlands Ramsar site (now known as the Hunter Wetlands Centre Australia) required substantial landscape modification using heavy machinery to achieve the desired outcome.

Additionally, the success of passive saltmarsh creation depends on the proximity of other healthy saltmarsh communities to naturally recruit and regenerate into the new tidally inundated areas. This can be seen in the projects involving the creation of saltmarsh communities on Ash Island. Although the Tomago offset site has areas of saltmarsh in the southern section of the site, they are separated from the proposed restoration area by an existing highly-bunded access track. In the case of the Tomago offset site, excavating landscape levels and active planting of saltmarsh species are likely to be required. Recent success of this method on a smaller scale have been achieved in the restoration of saltmarsh on the edges of Tuggerah Lakes, NSW (Laegdsgaard and McGaharan 2013).

A more passive approach to restoration of saltmarsh and tidally influenced wetlands could be achieved through a less robust engineering approach in a similar fashion to the rehabilitation project at the Hunter Wetlands National Park, however this would not provide habitat for all species displaced from Deep Pond or Swan Pond due to the different nature of the wetland habitat. Species such as sharp-tailed sandpiper (*Calidris acuminate*), common greenshank (*Tringa nebularia*) and marsh sandpiper (*Tringa stagnatilis*), as well as Lathams snipe (*Gallinago hardwickii*) are beginning to use the adjacent Hunter Wetlands National Park in small numbers after a period of five years. Other species would be expected to use the Hunter Wetlands National Park as a roost site in time. However key species such as curlew sandpiper and red-necked stint are not likely to be able to find suitable foraging habitat in this type of wetland. Both these species have declined in the Hunter estuary. While the curlew sandpiper is declining by up to 3% per year in south-eastern Australia, the red-necked stint which has declined in the Hunter estuary and Botany Bay has not declined in other parts of Australia and has seen a slight increase in other parts of NSW and south-east Australia as a whole.

A passive approach will not replace the required area of habitat to offset the loss of Deep Pond and the area of Swan Pond to be disturbed as a result of the T4 Project.

The proposed offset habitat at Tomago will adequately offset losses to both Deep Pond and Swan Pond with habitat that will provide suitable feeding and roosting habitat for all 19 species listed that would be collectively subject to a significant impact by the T4 Project.

3.3.10 Issue 14

i. DP&I issue summary

Based on DoE's submission, provide "additional information with regard to the efficacy of [green and golden bell frog] mitigation measures and migratory shorebirds".

ii. Extract from DoE submission

The proposed green and golden bell frog habitat corridor appears to have the potential to partly mitigate the loss of green and golden bell frog habitat from other parts of the T4 site and provide connectivity between known green and golden bell frog habitat which would otherwise be fragmented by the project. The design of the corridor should be further refined using the best available information in green and golden bell frog habitat creation to ensure that it provides the maximum possible benefit to a residual green and golden bell frog population.

The green and golden bell frog, Australasian Bittern and migratory shorebirds are all critical ecosystem components of the Hunter Estuary Wetlands Ramsar site, as described in the ecological character description (ECD) for the wetland. The ECD of the Ramsar site identifies limits of acceptable change (LAC) which, if exceeded, indicate unacceptable change to the ecological character of the wetland. The proposal has the potential to exceed or contribute to an existing breach of the LAC for the green and golden bell frog and migratory shorebirds. Impacts to a Ramsar wetland can only be offset by measures which provide compensatory benefits directly to the Ramsar wetland.

The proposed Tomago offset for migratory species could be an acceptable offset for impacts on the ecological character of the Ramsar wetland due to its location in the Hunter estuary, if it was shown to compensate for the loss of migratory shorebird habitat prior to the impact occurring.

The proposed green and golden bell frog offset at Brundee would not be an acceptable offset for any breach of the LAC for this species. The retention of a viable green and golden bell frog population on Kooragang Island, with connectivity to the breeding habitat in the Ramsar site, would be needed to ensure the LAC for this species was not permanently exceeded.

iii. Response

<u>Green and golden bell frog</u>

The green and golden bell frog habitat corridor will be designed using the best available information on habitat features to support breeding and movement of the species on Kooragang Island. The strategy is based on the strong evidence that suitable wetland habitats created adjacent to known breeding locations is known to be the most effective means of enhancing green and golden bell frog habitat. The strategy will be informed by knowledge from other projects restoring habitat for the species, particularly from ongoing habitat creation works undertaken by BHP Billiton and NCIG on Kooragang and Ash Islands and previous successes at Sydney Olympic Park. It will also draw on the results of the current trial ponds constructed on the T4 project area which have not only recorded ongoing occupation by the green and golden bell frog but also evidence of breeding (refer response to Issue 10 for further details).

As land-based offsetting opportunities are no longer available for the green and golden bell frog population on the adjacent Ash Island (as advised by OEH and NPWS), a state-wide approach to conserving the species is considered an appropriate way to provide the best opportunity for the ongoing protection of the species as a whole. This is in combination with the proposed on-site green and golden bell frog habitat corridor.

While not situated in the Hunter Region, the Brundee offset site conserves habitat for a substantial, breeding population of the green and golden bell frog. The Brundee offset site is currently privately owned by four separate landholders, can potentially be used for different land uses (other than the current), and is not being consistently managed for the preservation of the green and golden bell frog. The continued use of the site for grazing, which has prevented swamp oak from invading wetlands on the site and impacting the quality of the habitat for green and golden bell frogs, cannot be guaranteed. As such, the claim that the risk of loss at this site is low, is not supported.

In addition, the Ellalong offset site was secured as part of the biodiversity offset package, resulting in the in-perpetuity conservation of an area that has an historical record of green and golden bell frog in the Hunter region.

As discussed in detail in the response to Issue 16 below, the green and golden bell frog is not known to occur in the Hunter Estuary Wetlands Ramsar site and therefore cannot be a critical ecosystem component of the Ramsar site. It follows that any impact on the species cannot result in exceeding any LAC for the species in the Ramsar site. This issue has been discussed with DoE on several occasions, and DoE has previously verbally indicated that it is no longer of any concern. The Brundee offset site has not been selected to offset or mitigate any impacts on the Ramsar site as the green and golden bell frog does not occur in these areas and the T4 Project is not considered to impact the Ramsar site as a result of the impacts to the local population of green and golden bell frog. This is further discussed in the response to Issue 16 below.

Regarding compensatory benefits for the Ramsar site, construction of the green and golden bell frog habitat corridor will supplement existing and retained green and golden bell frog breeding habitat (for example in OEH Wetland 1) with a terrestrial habitat corridor that links known habitat for this species across Kooragang Island to Ash Island and aims to increase suitable habitat for the species on Kooragang Island. The proposed habitat corridor will link known green and golden bell frog breeding sites (some of which are already partially isolated ie within the NCIG rail loop), including habitat under construction or retained on public and private lands adjacent to the T4 project area. Equally importantly, it will enhance breeding opportunities by incorporating wetland clusters that are designed specifically to provide habitat for the green and golden bell frog.

Migratory shorebirds

The T4 Project will have a significant impact on some of the threatened and migratory species known to occur in the T4 project area. All of the migratory shorebird species recorded in the T4 project area are known to occur in the Hunter Estuary Wetlands Ramsar site, and the site is considered to provide a considerable area of high quality habitat. While the T4 Project could result in a significant impact on individual migratory species, this is not expected to result in the loss of these species from appropriate habitats in the Ramsar site, or a significant change to their habitats or lifecycles.

The Tomago offset site has the potential to provide up to 140 ha of shorebird habitat in the lower Hunter estuary. Taking into account the impacts of the T4 Project, this would result in a net gain of up to approximately 100 ha of shorebird habitat in the lower Hunter estuary adjacent to the Ramsar site. The Tomago offset site is considered to provide an appropriate offset for migratory shorebirds in the lower Hunter estuary. Many of the shorebird habitats within the Hunter estuary are man-made or created as a

result of previous disturbance, such as Deep Pond and the Kooragang Dykes. Additionally, there are many examples of deliberate restoration works within the Hunter estuary that have proven success as bird habitats such as the Hunter Wetlands Centre Australia, Stockton Sandspit and the Ash Island restoration by the Kooragang Wetlands Rehabilitation Project. These sites are regularly utilised by substantial numbers of migratory shorebird and waterfowl species, and in the case of the Hunter Wetlands Centre Australia it is listed as a Ramsar wetland of international significance. The concept design for the Tomago offset site has considered the key learnings of habitat restoration projects in the Hunter estuary in order to improve its likelihood of success.

The LACs are broadly defined in the ECD framework as the upper and lower bounds of variability for a measure of a particular ecosystem component, process or service (Department of the Environment, Water, Heritage and the Arts 2008). If the particular measure exceeds these bounds (moves outside the limits of acceptable change) this may indicate unacceptable change in ecological character. Ramsar Convention (2005) refers to unacceptable change as 'human induced change' that is generally negative.

In relation to the LAC for migratory shorebirds in the Hunter estuary, the ECD states that the LAC would be exceeded if:

- *It is not understood what amount of migratory species loss would constitute a change in ecological character and whilst there is some baseline data a LAC was not set.*

The baseline for shorebird diversity was set at 18 species, based on available records of shorebird counts for the Hunter estuary (Herbert pers. comm. 2011). The baseline range for 1970 to 1989 was 17 to 18 species and the median maximum count was 18 species (Herbert, unpublished data 2011). What would constitute a significant decline in species richness resulting in a change in ecological character is not well understood. However, the data for 2003 to 2007 show that the maximum species richness has been declining and was 16, 17, 16, 16 and 13 species in respective years).

- *For any five year period the annual maximum summer count of migratory shorebirds is less than 5,000 birds in five consecutive years.*

Between 1984 and 2007 there has been an overall declining trend in the number of migratory shorebirds (from 6,800 recorded at the time of listing to 3,200 in 2007). Since 1999 the maximum counts of migratory shorebirds have been around 3,500 birds, ranging from a low of 3,095 in 2006 to a high of 3,451 in 2003, with six out the eight counts recording more than 3,330 birds (Herbert 2007). The LAC for the abundance of migratory shorebirds was set at 5,000 and it has already been exceeded.

- *For any five year period the annual maximum summer count of eastern curlew is less than 600 birds in any year.*

Between 1999 and 2007, 400 to 600 eastern curlews have been regularly counted in monthly surveys in the Hunter estuary (Herbert 2007). Eastern curlews are only moderately recorded at Deep Pond and Swan Pond (up to around 20 birds at any one time). The species is more commonly recorded in more suitable habitat at Stockton Sandspit and Kooragang Dykes where they occur in the hundreds. The T4 Project is unlikely to significantly lessen the population size or distribution of the eastern curlew in the Hunter estuary.

- *The area extent of saltmarsh falls below 466 hectares.*

The current area extent of saltmarsh within the Hunter Estuary Wetland is around 339 ha (note that it is assumed that the Hunter Estuary Wetland means the area within the Ramsar site). The T4 Project will not result in the loss of saltmarsh in the Hunter Estuary Wetlands Ramsar site.

While the impacts of the T4 Project were considered likely to result in a significant impact on migratory shorebirds, Australasian bittern and the green and golden bell frog, it is not considered that this will lead to flow on adverse impacts to the Hunter Estuary Wetlands Ramsar site and in particular the ecological character of the Ramsar site. The T4 Project includes a comprehensive wetland restoration project at Tomago, adjacent to the Ramsar site, that will compensate for the loss of Deep Pond and provide an alternative area of shorebird habitat, resulting in a net gain of approximately 100 ha, which will contribute to the maintenance of the ecological character of the lower Hunter estuary in the long term.

3.3.11 Issue 15

i. DP&I issue summary

Based on DoE's submission there is a "need to consider any further measures available to reduce impacts on the [green and golden bell frog]".

ii. Extract from DoE submission

The Department has consistently requested that PWCS seek to further reduce the impacts of the proposal on the green and golden bell frog.

iii. Response

As discussed and documented in the RTS/PPR, PWCS commissioned Aurecon Hatch to undertake a detailed design review to consider whether the T4 Project could be redesigned to protect green and golden bell frog habitat at the northern extent of the proposed stockyard area during the initial stages of the development and potentially reduce the short-term impacts on the green and golden bell frog, particularly during construction and establishment of the green and golden bell frog habitat corridor. Aurecon Hatch's report is provided in Appendix T of the RTS/PPR. The alternative construction design included retaining important green and golden bell frog habitat ponds including Ponds 9, 10, 11 and 12 and Railway Pond during the initial stages of the T4 Project's construction and operation. PWCS considered the outcome of the design review and determined that the proposed redesign and staging alternative was not a feasible option for the T4 Project. The potential alternative option was determined to be a cost-prohibitive solution with a materially longer engineering and construction period and with no further certainty that the green and golden bell frog will be protected and successfully breed.

Despite this, the T4 Project has continually sought to reduce the impacts on the local population of green and golden bell frog by the measures described below.

<u>Avoidance of known habitat</u>

PWCS has modified the T4 Project to avoid impacts on the green and golden bell frog. Notably a significant modification was made to the rail alignment, at significant cost to the project, to avoid important habitat occupied by the green and golden bell frog. Of particular importance is the avoidance of OEH Wetland 1 (and other commitments that minimise the potential for indirect impacts to it), which is a known and important breeding pond on Kooragang Island and a key dispersal point between Kooragang and Ash islands. PWCS has also committed to avoiding other known habitat for the species in OEH Wetland 2, Railway Road Pond and Easement Pond South. Additionally, modification to the proposed Cormorant Road and Pacific National Access Road intersection design has avoided impacts to Long Pond, which provides known green and golden bell frog breeding habitat. This modification will allow these areas that are currently being utilised by the species to remain, minimising the impact of the T4 Project on breeding, foraging and dispersal habitat of the species thus reducing the impact and maintaining a future link for the proposed green and golden bell frog habitat corridor.

Mitigation measures

PWCS has committed to the design and implementation of a comprehensive mitigation strategy to mitigate the unavoidable impacts of the T4 Project on the green and golden bell frog. These include:

- Creation of the green and golden bell frog habitat corridor that includes a series of habitat features across the T4 project area that provide habitat for the species and link known green and golden bell frog habitat across Kooragang Island to Ash Island, including habitat under construction or retained on public and private lands adjacent to the T4 project area. The green and golden bell frog habitat corridor will:

  - incorporate clusters of vegetated wetlands, including large and small permanent and ephemeral ponds, designed to provide habitat for the green and golden bell frog;

  - link known green and golden bell frog habitat across Kooragang Island to Ash Island;

  - be subject to an independently reviewed monitoring, evaluation and reporting process that will include field monitoring and population viability analysis. Population monitoring protocols and performance criteria will be developed in consultation with leading green and golden bell frog researchers during development of the ecological management plan;

  - be supported by appropriate off-site actions such as funding for captive breeding. Captive-bred individuals will be released into the corridor if monitoring demonstrates that such a contingency measure is necessary; and

  - where possible, integrate with and supplement the works and research being undertaken on lands outside of the T4 project area, for example other projects on Kooragang Island.

  A culvert will be constructed to assist frog movement between the constructed habitat west of the proposed water management ponds and the existing habitat in OEH Wetland 1.

  The green and golden bell frog habitat corridor's detailed design will be subject to peer review and approval of relevant authorities. A habitat corridor management plan will be developed for the green and golden bell frog habitat corridor, as part of the ecological management plan, and will be peer reviewed. The habitat corridor management plan will include a population monitoring plan, disease and hygiene management plan (if required), genetic management plan and habitat management plan. It will outline trigger-action-response-plans.

- Pre-clearance surveys and green and golden bell frog relocation procedures in all known green and golden bell frog habitat in the T4 project area.

- Training in relation to the green and golden bell frog incorporated into the site induction process.

- Assessment (with relevant involvement by the University of Newcastle) of the need for a hygiene protocol similar to the DECC (2008) *Hygiene Protocol for the Control of Disease in Frogs*. If required, it will be incorporated into the ecological management plan and site induction procedure.

- Feral animal and noxious weed control, including for the plague minnow (*Gambusia holbrookii*).

- Funding a green and golden bell frog captive breeding program at the University of Newcastle.

- Funding green and golden bell frog research/monitoring programs on Kooragang Island.

In addition to these avoidance and mitigation measures, PWCS has committed to the Brundee offset site to conserve an area containing part of one of the largest green and golden bell frog populations in NSW. The combination of the wide range of avoidance, mitigation and offset measures is considered to be substantial and appropriate in reducing and offsetting the impacts of the T4 Project on the local population of the green and golden bell frog and the wider context of the overall species conservation in NSW.

3.3.12 Issue 16

i. DP&I issue summary

Based on DoE's submission the "basis of claim that [green and golden bell frog] does not occur within Ramsar wetland should be provided".

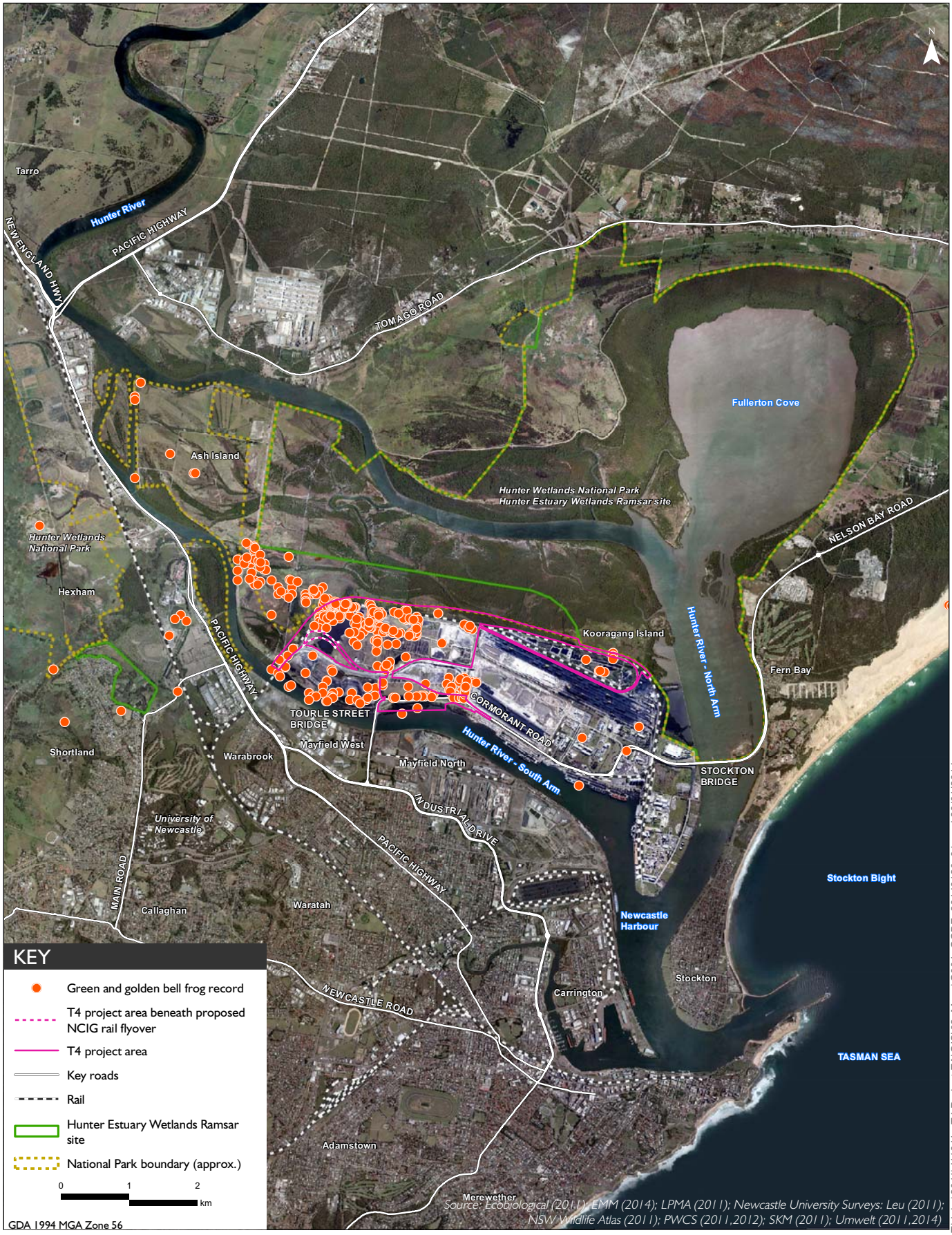
ii. Extract from DoE submission

The green and golden bell frog is a critical ecosystem component of the Hunter Estuary Wetlands Ramsar site. The likely reduction in the size, extent, connectivity and breeding and dispersal capability of the green and golden bell frog population could threaten its continued occurrence in the Ramsar site, which could result in a breach of the limits of acceptable change for the wetland. The proponent has argued that the green and golden bell frog does not occur in the Ramsar site however has not provided any evidence to support this.

iii. Response

As discussed in Section 2.2.6 of the RTS/PPR Appendix B, the assertion that the green and golden bell frog is a critical component of the Hunter Estuary Wetlands Ramsar site appears to be unfounded or based on historical information. The Hunter Estuary Wetlands Ramsar site comprises two locations, approximately 2 km apart, within the former Kooragang Nature Reserve and at the Hunter Wetlands Centre Australia. The Hunter Estuary Wetlands Ramsar site was listed as a wetland of international importance in 1984. The Kooragang component of the Ramsar site (comprising the portion listed in 1984) is located generally to the north of the T4 project area, covering an area of approximately 2,926 ha. It includes the estuarine habitats of the northern area of Kooragang Island, Fullerton Cove and the Tomago Wetlands. The green and golden bell frog is not currently or historically known from the Ramsar site and suitable habitat for the species is very limited. Figure 3.1 shows the known and historic distribution of green and golden bell frog records in the lower Hunter estuary, based on OEH Atlas of NSW database records, records from detailed site surveys and a thorough review of available literature. The estuarine wetland habitats of the Ramsar site are too saline for green and golden bell frog habitation (M. Stockwell pers. comm.).

Despite the ECD (Brereton and Taylor-Wood 2010) for the Kooragang portion of the Ramsar site describing the species as one of the critical ecosystem components of the Ramsar site it also notes that there is a knowledge gap with the species, "no available data on the abundance of green and golden bell frogs within the Ramsar site at the time of listing or since the time of listing", "there is no recent information on the green and golden bell frog breeding events within the Rasmar site" and that there is "limited suitable habitat" for frog species in the Ramsar site. The ECD suggests that the species has been previously recorded in habitats just within the south-western boundary of the Ramsar site on Ash Island and near the eastern portion of the KCT rail loop (Hamer et al. 2002), however mapping suggests that the species was actually recorded outside the Ramsar boundary. Due to the contraction (over the last decade) of the local population to Kooragang Island, it is unlikely that the green and golden bell frog currently occurs in substantial numbers anywhere in the Ramsar site. As a result, it is very unlikely that, in reality, the species is a critical component of the character of the Hunter Estuary Wetlands Ramsar site.



Green and golden bell frog records in the Hunter estuary

T4 Project – Response to Submissions on Preferred Project

Figure 3.1

No records of the green and golden bell frog are known from the saltmarsh and mangrove communities that make up the majority of the Ramsar site. It follows that there can be no breaking of connectivity among or between populations of the green and golden bell frog when none are known to occur. Similarly, there is no evidence of dispersal of the green and golden bell frog to these habitats. This is supported by several field investigations that have been conducted over the past 15 years in the Fullerton Cove and Tomago areas of the Ramsar site (M. Mahony pers comm.). Additionally, in the many field surveys conducted on Kooragang and Ash Islands there have been no reports of green and golden bell frogs in the adjacent Ramsar site. The species has very distinctive mating calls which can be heard up to 100 m away and if they were in the habitats of the Ramsar site it would have been reported (M. Mahony pers. comm.).

The inclusion of the green and golden bell frog as occurring within the boundaries of the Hunter Estuary Wetlands Ramsar site is potentially based on the former range of the species, prior to the severe declines noted during the 1980s that resulted in the species becoming listed as threatened under state and Commonwealth threatened species legislation. As the green and golden bell frog was formerly a common species, it is possible that it occurred prior to inclusion of the sites under the Ramsar Convention, however the estuarine and marine habitat occurring with the Ramsar site is expected to have limited the value of potential habitat for the species.

Furthermore, the LAC for the species as described in the ECD for the Ramsar site states that "there are [to be] no more than two years between successful breeding events (defined as a new first year adult cohort) in at least one of the three known populations". As there is no recent evidence to suggest that the green and golden bell frog occurs within the Ramsar site, despite ongoing targeted surveys around Kooragang and Ash islands, it is unlikely that any breeding events have occurred in the Ramsar site and therefore it is not possible to determine if the specified LAC for green and golden bell frog has been exceeded.

As previously stated, this issue has been discussed with DoE on several occasions, and DoE has previously verbally indicated that it is no longer of any concern.

3.3.13 Issue 17

i. DP&I issue summary

Based on DoE's submission, PWCS needs to provide information on "what options are available for the [green and golden bell frog] habitat corridor to provide breeding habitat as well as functioning as a dispersal corridor".

ii. Extract from DoE submission

The green and golden bell frog habitat corridor is proposed as a dispersal corridor only and not to provide breeding habitat.

iii. Response

The assertion that the green and golden bell frog habitat corridor is only proposed as a dispersal corridor is unfounded. Appendix 9 of the ecological assessment in the EA Appendix K and Section 2.4 of the Updated Impact Mitigation and Biodiversity Offset Strategy contained in the RTS/PPR Appendix J clearly outline the proposed habitat corridor as providing a range of habitat features to support all stages of the species' life cycle, including breeding.

The proposed green and golden bell frog habitat corridor includes several wetland mosaics for breeding, foraging, shelter and dispersal of the green and golden bell frog. The size, shape and location of the wetlands were specifically designed to provide for breeding habitat and connectivity among habitats for the species. The conceptual plan for the breeding habitat and connectivity among wetlands was prepared by amphibian ecologists from the University of Newcastle who have considerable expertise on the habitat requirements of the species and an understanding of the movement and habitat associations on Kooragang Island.

The objective of the proposal is to create green and golden bell frog habitat within a habitat corridor that links known green and golden bell frog habitat. The proposal is to create wetlands in a mosaic, with some large and small permanent ponds and ephemeral ponds. The ponds will be vegetated and placed in appropriate terrestrial areas to increase the probability of the habitat being suitable for the green and golden bell frog. Success is defined as providing habitat for the bell frog to complete its life cycle and to support the wider distributed viable local population (Mahony et al. 2011). This definition means that:

- the constructed wetlands are demonstrated to have habitat that supports all stages of the life cycle (eggs, tadpoles, juveniles and adult);

- individuals move to and from the wetlands (disperse) and become part of the wider distributed viable local population within the corridor and in adjacent habitat; and

- the population abundance is similar to that observed in typical green and golden bell frog habitats (this will be benchmarked against measured densities in a range of wetlands on Kooragang Island) however, the general accepted position is persistence of the population over several seasons). Detailed investigations into green and golden bell frogs on Kooragang Island (Hamer et al. 2010) and at other sites (eg Sydney Olympic Park, Stockwell et al. 2010) show that breeding does not occur in all ponds in consecutive years and the measure of breeding success is for the overall habitat and not individual ponds. Following this approach the measure of success is the persistence of the population in the mosaic of wetland habitats (clusters of permanent and ephemeral ponds within the habitat corridor) and the observation of breeding in these habitats at least twice over a period of five years. Persistence of the population requires survival for each stage of the life cycle (egg, tadpoles, juvenile and adults).

The species is known to currently breed in highly disturbed, man-made ponds within the T4 project area. The establishment of the green and golden bell frog habitat corridor will build on the knowledge gained from previous habitat creation and research projects on Kooragang and Ash islands to design suitable habitat variability to include potential breeding habitat, including PWCS's on-site trial ponds which have now have continuous records of occupancy by the green and golden bell frog and evidence of breeding by the species in one cluster of trial ponds (refer response to Issue 10 for further details).

It is expected that the created habitat in the green and golden bell frog habitat corridor will amply replace the area of known freshwater wetland habitat to be removed as a result of the T4 Project. Opportunities to create temporary habitat for the species adjacent to known habitat prior to disturbance will be investigated to allow for alternative habitat for the green and golden bell frog during the project's construction. Additionally, ponds can be constructed post-construction in areas not otherwise required for surface infrastructure and utilities.

3.3.14 Issue 18

i. DP&I issue summary

Based on DoE's submission, PWCS needs to provide "response to expected timing of offsets with particular reference to Tomago offset site for migratory shorebirds".

ii. Extract from DoE submission

The proposed wetland habitat creation at Tomago appears to have potential to adequately compensate for the loss of shorebird habitat from the impact site. However, the habitat will need to be created and demonstrated to adequately offset the impacts of the proposal prior to the impact occurring to be acceptable as an offset.

The proposed Tomago offset for migratory species could be an acceptable offset for impacts on the ecological character of the Ramsar wetland due to its location in the Hunter estuary, if it was shown to compensate for the loss of migratory shorebird habitat prior to the impact occurring.

iii. Response

PWCS has determined that, subject to appropriate approval, habitat restoration and creation works at the Tomago offset site would commence early. As per the statement of commitments in Section 15.5.2 of the RTS/PPR main report "Construction of the Tomago Offset Site Restoration Project will start during the T4 Project's detailed design phase".

3.3.15 Issue 19

i. DP&I issue summary

Based on DoE's submission, issues around "Australasian Bittern impacts and mitigation/offset".

ii. Extract from DoE submission

The proposed offsets do not adequately compensate for the loss of habitat for the Australasian Bittern when assessed using the Department's Offsets Assessment Guide. A reduction in impacts or additional offsets will be required to adequately offset the stated impacts of the proposal on this species.

Given that the population being impacted is geographically distinct, it would be most appropriate if any additional offsets were located within the area occupied by the population.

In addition, the Australasian Bittern is a critical ecosystem component of the Hunter Estuary Wetlands Ramsar site and is integral to the values of the wetland, since its nationally endangered status assisted the estuary in meeting the criteria for Ramsar listing.

iii. Response

PWCS has committed to the design and implementation of a comprehensive mitigation strategy to mitigate the unavoidable impacts of the T4 Project on native flora and fauna. These include:

- feral animal and noxious weed control;
- lighting management in accordance with the Australian Standard for minimising fugitive lighting emissions; and
- funding of ongoing monitoring programs on Kooragang Island.

It is also considered that the creation of the green and golden bell frog habitat corridor will be beneficial for the Australasian bittern. Although the habitat corridor will not be designed specifically for this species, the habitats occupied by the green and golden bell frog are known to be suitable for the Australasian bittern across Kooragang Island. The species has been recorded in Pond 11, Pond 12, Railway Pond and Easement Pond in the T4 project area, where the green and golden bell frog is also known to occur. The habitat corridor will create an extensive and complex series of freshwater wetland ponds that include the establishment of emergent fringing vegetation using species such as *Phragmites australis* that are known to support the species currently within the T4 project area. The creation of this habitat demonstrates the ongoing availability of habitat for the species on Kooragang Island within the population areas to be impacted by the T4 Project.

In addition, the T4 Project proposes the in-perpetuity protection of known reedy freshwater wetland habitat for the Australasian bittern on two of the offset sites, the Tomago and Brundee offset sites.

In relation to the Tomago offset site, which is located within 3 km of the T4 project area, the Australasian bittern has been recorded utilising the habitat at the site (the Rice Paddy area). All known freshwater habitat for the species will be retained during the establishment and operation of the restored estuarine Tomago offset site. Local monitoring surveys by HBOC have continually recorded the species using the freshwater habitats around the Tomago offset site, particularly in Samphire Flats, adjacent to the Tomago offset site and within the Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site. The conservation of this habitat demonstrates the ongoing availability of habitat for the species in the Tomago area within the population areas to be impacted by the T4 Project.

Although the location of the Brundee offset site is outside the Hunter estuary population of the Australasian bittern, the conservation of 160 ha of reedy freshwater wetland habitat for this state and nationally-listed threatened species is considered appropriate in conserving the species at a wider scale.

The EPBC Offset Calculator Report has been provided to the DoE and review comments have been received. DoE contends that the Brundee offset site provides an inadequate offset for the impacts on the Australasian bittern at the T4 project area due to the department considering the T4 project area as comparable high habitat quality for Australasian bittern to that of the Brundee offset site and that the establishment of Brundee as an offset would not result in an improvement of the habitat features at the site. We disagree that the habitat quality for the species at the T4 project area (a highly disturbed, industrialised and fragmented site) is of equal value to the vast and connected freshwater wetland habitat at the Brundee offset site. Umwelt recognises that the T4 project area supports wetlands that are in reasonable condition for the Australasian bittern, but argues that due to the surrounding land use these wetlands are not in comparably good condition, particularly in the long term.

In terms of site context, Umwelt agrees that the T4 project area is likely to be important for the species in the Hunter estuary. However the assessment should not over-emphasise the records of the species at the site as these result from repeated and persistent survey and monitoring, particularly through very targeted surveys at dusk. This species is highly cryptic and very difficult to detect, and although there has been substantial habitat loss of this species, there are still numerous areas where the species is known or very highly likely to occur, in the lower Hunter estuary, for which targeted survey has been little to none. In comparison, very little survey effort has been undertaken at the Brundee offset site to adequately compare record data. Habitats at the Brundee offset site are of very high quality for the Australasian bittern and include continuous and diverse reed and open water habitats, and should not be considered of equal value to the fragmented disturbed habitats of the T4 project area.

The Brundee offset site, in combination with the protection and management of known habitat at the Tomago offset site and the created habitat within the proposed green and golden bell frog habitat corridor, is considered to provide an appropriately located offset that will protect high quality known habitat in perpetuity across its wider range for this nationally endangered species.

It is not considered that the significant impact to the Australasian bittern in the T4 project area would impact the Hunter Estuary Wetlands Ramsar site. Further, the LAC as described in the ECD for the Ramsar site are not relevant to the Australasian bittern. Therefore, it is not possible to determine if the LAC for the species in the Ramsar site has been exceeded.

3.3.16 Issue 20

i. DP&I issue summary

Based on the submission by Port Stephens Council, PWCS is to provide "further information regarding the extent of change to the 'Rice Paddy' and vegetation management areas as they relate to the eastern grass owl and Australasian bittern".

ii. Extract from Port Stephens Council submission

Council is concerned about the loss of the current foraging and breeding habitat (grasslands) for the grass owl (*Tyto capensis*) and Australasian bittern (*Botaurus poiciloptilus*). Council would like clarification as to the extent of change to both the 'Rice Paddy' and vegetation management areas with regards to grass owl and Australasian bittern.

iii. Response

The vegetation management area, which has been designed to contain removed biomass from the site, will likely result in the loss of approximately 11 ha of potential habitat for the eastern grass owl (*Tyto longimembris*) from the Tomago offset site. The eastern grass owl has been recorded within the Tomago offset site on 10 occasions by Umwelt in 2011 and 2012. Additionally, surveys by Ecobiological (2011) recorded eastern grass owls in the Tomago area and nest sites in land adjacent to the site. A population of the species is known to occur in the lower Hunter estuary.

The Tomago Restoration Project will remove and disturb approximately 84 ha of known and potential foraging habitat for the eastern grass owl across the site. Re-introduction of tidal inundation to the site will reduce the area of grassland foraging habitat for the species in the area. However, the species has been recorded utilising the freshwater wetland and saltmarsh habitat for foraging. The proposed restoration work is expected to create nominally up to 100 ha of saltmarsh including extensive areas of preferred upper saltmarsh habitats Furthermore, 11 ha of freshwater wetland habitat that provides known foraging habitat for the species will be retained. As the species has been recorded actively utilising

the freshwater wetland and saltmarsh habitats for foraging, it is considered that only a short-term loss of habitat will result, as the site is being restored to estuarine habitats. Once the site is restored, a large area of suitable foraging habitat will be available for the species.

As discussed previously in the response to Issue 19, the T4 Project proposes in-perpetuity conservation and management of all known reedy freshwater wetland habitat for the Australasian bittern at the Tomago offset site. This known habitat occurs within the 'Rice Paddy' area, which will be retained. The Australasian bittern has been recorded utilising this freshwater wetland habitat at the Tomago offset site. Local surveys by HBOC have continually recorded the species using the freshwater habitats around the Tomago offset site, particularly within the adjacent Samphire Flats, Hunter Wetlands National Park and Hunter Estuary Wetlands Ramsar site. The Tomago offset site is proposed to be restored to mainly estuarine saltmarsh complexes for migratory shorebirds however it is also proposed to retain the 'Rice Paddy' in its current state, which will effectively conserve all known Australasian bittern habitat on the site. Based on flood and water modelling, the elevated 'Rice Paddy' freshwater habitats will not be altered as a result of the introduced tidal inundation across the Tomago offset site.

3.4 Contamination, water, air quality and noise

3.4.1 Issue 21

i DP&I issue summary

The EPA provided recommended conditions of approval with its submission. "The EPA has not suggested any further investigations are required. As per RMS submission, response to suggested conditions, including justification for any objections, should be provided."

ii. Response

Subject to approval of the T4 Project, PWCS will review any proposed conditions of approval, for example project approval and environment protection licence (EPL) conditions, for consistency with the project assessment outcomes and compatibility with the existing approvals for KCT. This will include liaising directly with DP&I and the EPA. Based on recommended conditions included with the EPA's submission, clarification will be required on some matters including:

- **A1 Works to be undertaken in accordance with information supplied to the EPA**
    - The EPA's recommended condition A1.2 is that "The licensee must not exceed a throughput capacity of 70 Mtpa coal in any 12 month period". PWCS clarifies that a throughput capacity of 70 Mtpa will not be exceeded in PWCS's 12 month reporting period, which is from 1 January until 31 December, as opposed to "any" 12 month period.
- **P1 Location of monitoring/discharge points and areas**
    - Air monitoring locations will be finalised in consultation with the EPA. In particular the EPA's recommended real-time continuous particulate matter monitoring locations include locations where the EPA proposes to establish monitors for its Newcastle Ambient Air Quality Monitoring Network. The EPA's recommended conditions for PWCS and the T4 Project note that "some or all of these locations, and their monitoring, will not be required when this Network is established". To ensure efficient use of resources and avoid double-up, PWCS will liaise with the EPA to ensure its monitors are not installed in the same areas as the EPA's monitors and avoid instances where recently installed monitors at

considerable cost are quickly made redundant due to the Newcastle Ambient Air Quality Monitoring Network installed in comparable locations.

- The recommended conditions note a dredge dewatering discharge monitoring location at the discharge point to the Hunter River South Arm. PWCS has committed to monitoring surface water quality during construction in site settlement basins and upstream and downstream of the dredge return water release point in the Hunter River South Arm. Monitoring at the discharge point to the river is impractical and is not proposed. This is as per discussions with the EPA on this matter. It is also consistent with recent dredge water quality monitoring experience for NCIG's similar Hunter River South Arm dredging project, which was subject of the same development consent to that which will apply to the proposed dredging for the T4 Project, ie DA-134-3-2003-i. Monitoring locations will be included in the CEMP, which will be prepared in consultation with the EPA.

- **L6 Noise**

  - The EPA's submission includes recommended noise limits which generally reflect the highest predicted combined operating noise levels from the proposed T4 Project and KCT. Firstly, it should be made clear that these are operating noise limits and do not apply to construction. Secondly, KCT is an existing, approved project that is subject to separate noise limits and conditions under its project approval. KCT also has an existing EPL. PWCS questions whether it is appropriate to include conditions relating to KCT's operations in the approval conditions for the T4 Project, which is a separate project that if approved, would be subject of a separate project approval and EPL. Thirdly, the specified limits require clarification. For example it is unclear why a $L_{Aeq(1\ minute)}$ night-time limit of 35 dB(A) is recommended at Carrington, when the criteria for assessment locations at Carrington was 52 dB(A) and the maximum predicted $L_{Aeq(1\ minute)}$ level at Carrington was 45 dB(A). Accordingly, PWCS would welcome further discussion with the EPA and DP&I on noise limits for the T4 Project.

- **M4 Weather monitoring**

  - The recommended conditions specify a 1-hour averaging period for rainfall and a 10-minute averaging period for other parameters. The averaging period to be applied warrants discussion to ensure data is output in a best-for-purpose format. For example a 15-minute averaging period is more relevant and practical for noise.

- **M7 Requirement to monitor noise**

  - The EPA recommends that attended noise monitoring be undertaken to assess compliance with noise limits. PWCS supports this but recommends that provision be included for an alternative noise compliance approach in the event direct measurements are prohibitive due to extraneous noise.

- **R4 Noise monitoring report**

  - The EPA recommends that a noise assessment report be submitted to the EPA within 30 days of the completion of yearly monitoring. This timeframe warrants discussion given that 30 days may not be sufficient to prepare the report and have it peer reviewed.

3.5 Air quality

3.5.1 Issue 22

i. DP&I issue summary

"Please clarify incremental increase in PM_{10} despite total particulates and throughput will decrease".

ii. Extract from EPA submission

The PPR does not provide a detailed explanation of why incremental PM_{10} impacts from the project are predicted to increase, despite total project particle emissions and material throughput decreasing under the PPR operating scenarios.

iii. Response

Several factors contributed to increased incremental predictions at some assessment locations for scenarios assessed in the RTS/PPR, compared to those in the EA. These mainly relate to modelling assumption refinements made to reflect additional available information since the EA, including to account for engineering refinements as the design progressed.

A key difference is associated with rail locomotive emissions. Since completing the air quality modelling and assessment in the EA, Environ undertook work for OEH that found diesel-fuelled rail locomotives in NSW to have a higher emission potential than previously assumed. The emissions inventory was therefore updated to reflect this. As a result, emissions increased by an approximate factor of two despite the reduction in anticipated rail traffic (associated with the reduction in proposed maximum throughput capacity). This is explained in Appendix A of the air quality assessment in the RTS/PPR. It is noted that these emission sources are situated closest to the receptor locations with the highest increase in predicted incremental concentrations.

The T4 Project's engineering design progressed post-preparation of the EA including some refinements and additional information which allowed Environ to firm up some of the dispersion modelling assumptions. Accordingly, a degree of spatial redistribution of both emission source locations and the intensity of emissions for construction and operational sources occurred between the EA and the RTS/PPR, which is considered to have contributed to the noted differences in predictions at some assessment locations.

Notwithstanding the above, there were no changes to the overall assessment outcomes in the EA. That is, concentrations of all assessed air pollutants will remain below the applicable criteria and standards during the T4 Project's construction and operation, except for 24-hour average PM_{10}. Baseline 24-hour average PM_{10} concentrations in the local area infrequently exceed the criterion without any contribution from the T4 Project, mainly due to regional events such as bushfires and dust storms. Modelling demonstrated that the T4 Project will not cause exceedances on any additional days of the year. PWCS has committed to implementing a range of air quality and dust management and monitoring measures. Provided these measures are implemented, the T4 Project is not expected to significantly affect surrounding air quality.

3.6 Water

3.6.1 Issue 23

i. DP&I issue summary

Based on the EPA's submission, "further information responding to concerns about particle size in discharge to the river (application of 20 µm particle size in modelling) should be provided".

ii. Extract from EPA submission

The sediment settling capacity of two primary ponds and one secondary pond has been calculated, however, it appears that in a period prior to discharge from the site that all three ponds effectively becomes one pond which may lead to mixing, suspension/re-suspension and bypassing of settlement efficiency compared to settling efficiency of three ponds in series (see Plate 3-2, Appendix L).

Fine sediments and coal fines bypassing treatment may lead to greater sediment and attached contaminant losses than the goal for the system. In average rainfall to wet years when discharge volumes are significant combined with lower than predicted settling of the sediment/coal fines and attached contaminants may create an unacceptable water quality impact.

The difference between setting efficiency during overflows compared to settling efficiency when three ponds are working in series is a key issue. It is recommended that the proponent demonstrate that settling efficiency that was modelled takes into account the settling conditions that occur in the lead up to and during an overflow event, that is, once the level in Clearwater Pond overtops and flows back into the primary and secondary ponds. Water quality and settling in Clearwater pond during reuse periods (prior to any flowback into the primary and secondary ponds) may not be representative of the water quality of an overflow event.

The PPR also states that an average particle size of 20 µm represents a conservative lower bound, considering that it is an average of a mass distribution. This does not confirm whether the average particle size will be an average of 20 µm or whether this is the most appropriate measure to determine settling efficiency considering the nature of the material being settled. The EPA is concerned that 20 µm average particle size is not reflective of sediment laden runoff generated at a site that includes coal fines with attached contaminants. Coal fine discharges may still be significant particularly if settlement efficiency is not as predicted and if contaminants are attached to fines. EPA seeks clarification on the application of the 20 µm particle size in the modelling presented in the PPR.

iii. Response

<u>Settling pond baffles</u>

As outlined in SMEC's surface water assessment for the T4 Project (RTS/PPR Appendix L), there are two main criteria that the settling ponds (also referred to as water management ponds) have been designed to achieve. These are:

1. Provide water quality treatment, by settling, to improve the quality of water available for re-use or overflow off-site.

2. Provide flood storage to:

    - reduce the frequency and volume of overflow; and

- maximise the re-use of captured runoff on-site to reduce the volumes of potable water import required by the T4 Project.

The EPA refer to Plate 3-2 of the RTS/PPR surface water assessment (reproduced as Figure 3.2 below), which conceptually illustrates the functionality of the proposed T4 Project water management ponds.

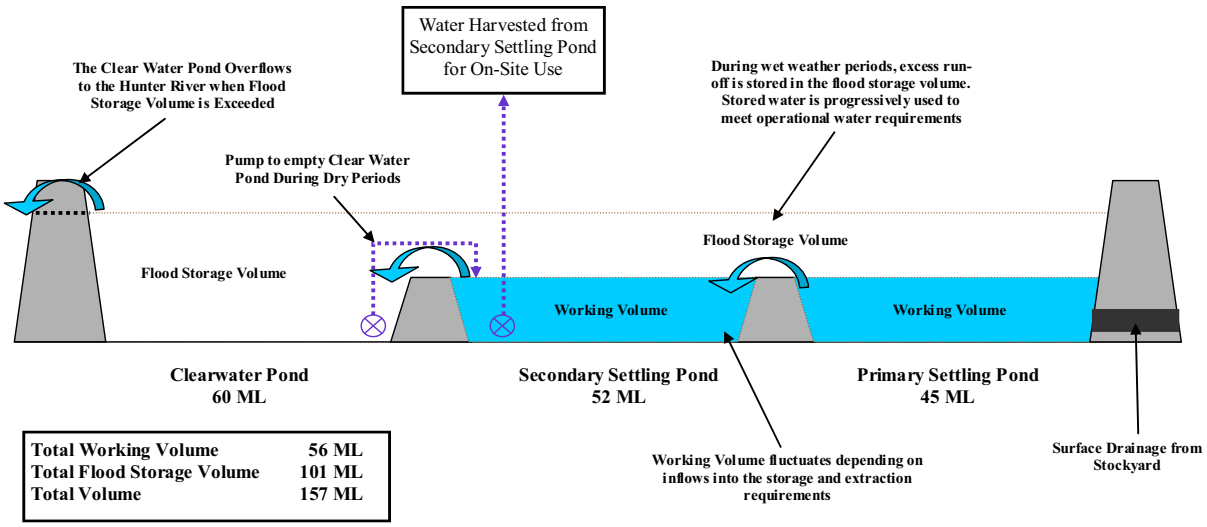


Figure 3.2 **Reproduction of Plate 3-2: Conceptual diagram illustrating the functionality of the T4 Project water management ponds**

Plate 3-2 was a conceptual diagram prepared by SMEC, to help explain the proposed functionality of the water management ponds outlined in the preliminary civil design prepared by the project design engineers Aurecon Hatch. The preliminary civil design of the ponds shows a full height embankment between the different storages, with the ponds joined by culverts which are offset to prevent short-circuiting of flows and limit the possibility of re-suspension of captured sediment. This is illustrated in the preliminary civil design of the ponds, provided as Figure 3.3.

The design was prepared by Aurecon Hatch utilising site water balance modelling in order to balance the two above-mentioned criteria. The concept is for the lower portions of the combined settling ponds to provide a collective working volume of 56 megalitres (ML), while the upper portion of the ponds would provide flood storage during wet weather, with an additional volume of some 101 ML. The total available volume is therefore some 157 ML. Refer to Section 3.3.2 of the RTS/PPR Appendix L for definitions of flood storage and working volumes.

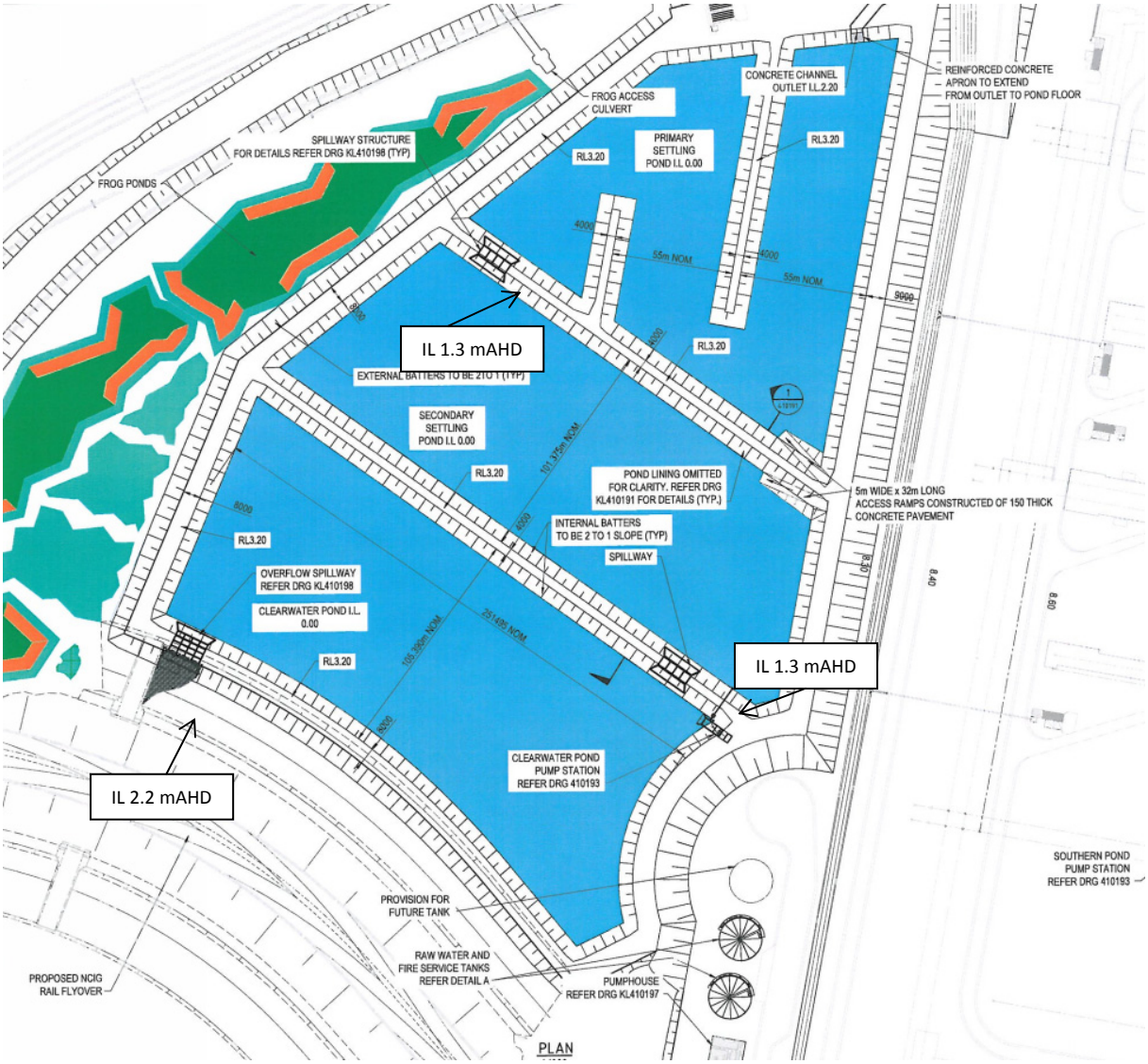


Figure 3.3 Preliminary water management pond design (subject to detailed design)

Based on the preliminary design provided in Figure 3.3, the water management ponds would operate as follows:

1. Under normal operating conditions, the ponds would fluctuate around their normal working volume with primary sedimentation occurring in the Primary Settling Pond and secondary sedimentation in the Secondary Settling Pond. Water will then be extracted from the Secondary Settling Pond and re-used on-site.

2. When wet weather occurs, the collective pond volume will increase beyond the capacity of the working storage volume, and flow will occur through the culvert between the Secondary Settling Pond and the Clearwater Pond.

3. If runoff continues, then water will continue to build up in the Clearwater Pond until such time as the water level reaches the culverts between the Clearwater Pond and Secondary Settling Pond. At

this time Clearwater Pond will form a tailwater to new flow entering the primary and secondary settling ponds and new flow entering these ponds will start to back-water and fill the primary settling, secondary settling and clearwater ponds. This backwater flooding would be a much lower velocity than the primary inflow velocity before the tailwater level in Clearwater Pond becomes elevated. For this reason there is not expected to be significant mixing or re-suspension of sediments in the ponds during pond flood conditions. As all inflow to the ponds enters the Primary Settling Pond, all water that overflows from the Clearwater Pond will have received some sedimentation treatment (by settling).

4. Once the ponds are all full (up to a level of RL 2.2 m AHD based on the preliminary design), overtopping flow will pass through the spillway culvert of the Clearwater Pond, into the receiving channel and ultimately to the Hunter River South Arm. As outlined above, during flood conditions, there is not expected to be any significant threat of mixing or re-suspension of fine particles, due to the ponded water filling in a low velocity backwater state.

Sensitivity to short-circuiting settlement calculations

The target sediment capture efficiency of the water management ponds was established in the EA as 90% removal for a 90th percentile peak daily flow event. As the overall hydraulic performance of the water management ponds did not change significantly when the T4 Project was modified, these settlement calculations were not reproduced in the RTS/PPR for the modified project.

The results of the previous settlement calculations by SMEC, undertaken during the EA using the method described by Fair & Geyer (1954), have been reproduced below in Table 3.3. These were for the original (superseded) project design with a throughput of 120 Mtpa. The original assessment in Appendix J of the EA assumed a total pond surface area of approximately 80,000 m^2, and used a hydraulic efficiency factor (λ) of 0.38 (or λ = 0.38), which accounts for a single large pond with the inflow not being directly opposite to the outflow location (ie not an ideal pond design, but certainly not one that assumes short-circuiting). This was a conservative assumption made at the time of the EA, as the final pond configuration was not known at that time. A more likely hydraulic efficiency value for the water management ponds would be a hydraulic efficiency factor of λ = 0.76, which represents a typical baffled pond configuration, as per the preliminary pond design shown in Figure 3.3. Updated results for the modified T4 Project (throughput of 70 Mtpa), are also provided in Table 3.3, derived using the same methodology as for the original calculations in the EA.

For the purpose of a theoretical sensitivity analysis, if (as suggested by the EPA), hydraulic short-circuiting was to occur when the ponds are close to filling (ie inflows are able to pass more directly to the outlet without the full residence time afforded by the pond volume and surface area), then a reduced hydraulic efficiency value could be adopted. A suggested hydraulic efficiency factor of λ= 0.11 would represent a typical low efficiency pond where short-circuiting occurs. The results using this hydraulic efficiency factor are presented in Table 3.3 and indicate that for the currently proposed pond configuration, even with a low pond hydraulic efficiency assumed, the target capture efficiency of 90% would still be met.

Table 3.3 Sensitivity analysis for 'short-circuiting' or reduced hydraulic efficiency of water management ponds

Pond settlement calculations - sensitivity analysis for hydraulic efficiency (after Fair & Geyer 1954)		
Overflow event (percentile)	**Peak daily flow (m^3/s)**	**Capture efficiency (%)**
Previous calculations for original T4 (120 Mtpa), with λ= 0.38 (previously assumed conservative pond efficiency)		
90th	0.97	98.7%
95th	1.40	97.8%
99th	2.10	96.0%
New calculations with assumed reduced hydraulic efficiency (short - circuiting), with λ= 0.11		
90th	0.97	96.7%
95th	1.40	95.1%
99th	2.10	92.6%
Pond performance, using 70 Mtpa flows, and assumed pond efficiency, ie λ= 0.76		
90th	0.96	99.9%
95th	1.27	99.8%
99th	2.65	98.5%
Pond performance, using 70 Mtpa flows and theoretical reduced pond efficiency, ie λ= 0.11		
90th	0.96	96.3%
95th	1.27	95.1%
99th	2.65	89.6%

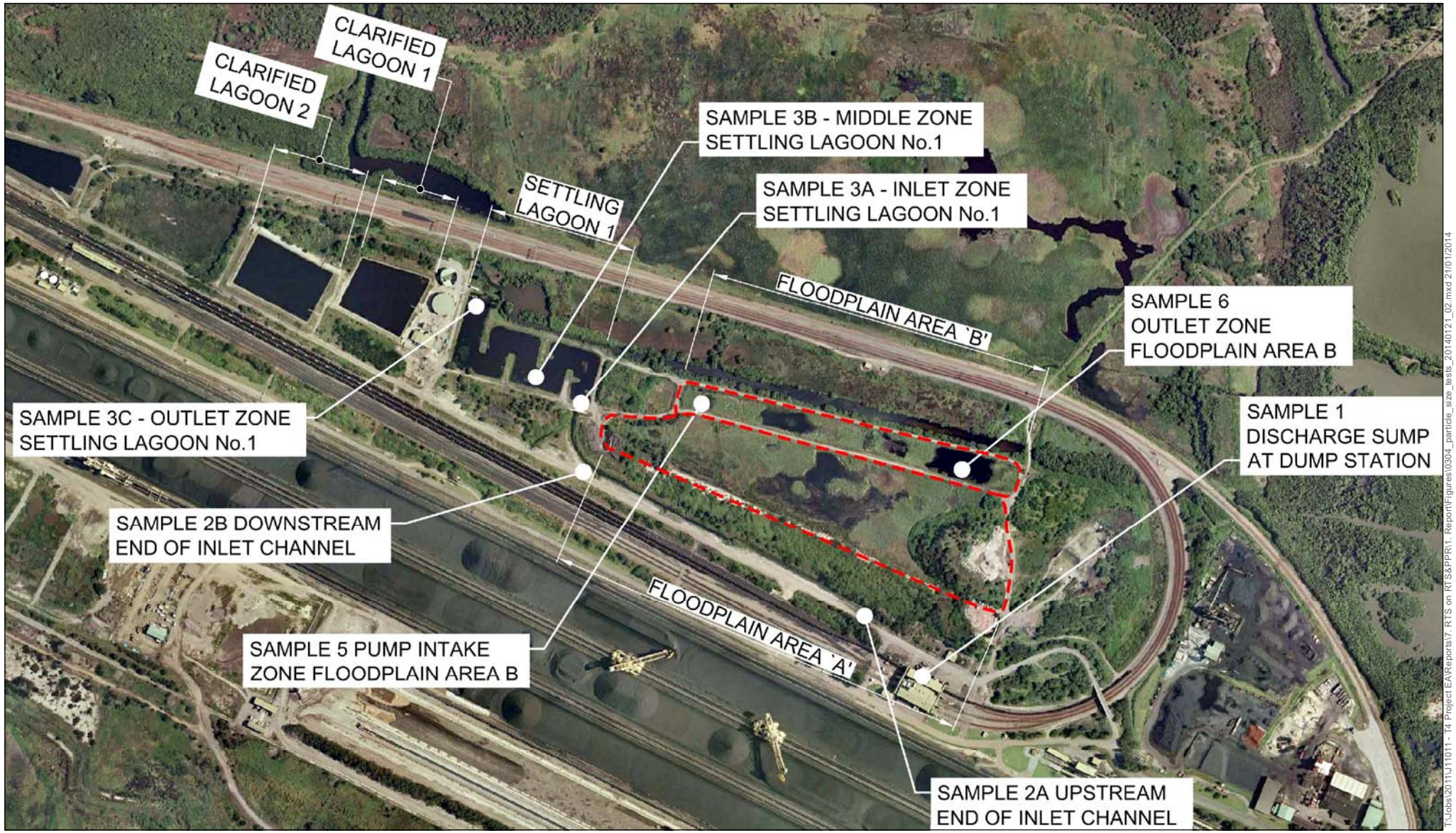
Overall, the results in Table 3.3 indicate, that for the modified T4 Project, with appropriate settling pond hydraulic efficiency, the capture efficiency achieved is estimated at approximately 99.9% for a 90th percentile overflow event. With a theoretically assumed reduced hydraulic efficiency, the sediment capture efficiency is estimated at approximately 96.3% during a 90th percentile overflow event, which is still above the target of 90%.

Sensitivity to assumed particle size settlement calculations

The EPA raised concerns about the assumed average particle size used for the settlement calculations. The original 20 µm assumption was an estimate for modelling purposes. In response to the EPA's submission, this assumption has been further investigated through a series of particle size analyses at KCT, which is expected to be a good representation of particle size for the T4 Project.

A number of test locations were selected within KCT's water management system, as shown in Figure 3.4. The particle size analysis results are provided in Appendix A. These results generally indicate that a range of typical particle sizes from fine silt up to coarse sands and some gravels are entrained in runoff from KCT.

The results for Sampling Location 1 (within the dump station sump) show that the majority of this sample is either the sand or gravel fraction (ie typically greater than 0.06 mm). This indicates that, as expected, the coarser material drops out in the discharge sumps. Similar sumps will also be provided for the T4 Project, for example at the conveyor transfer points, dump stations and buffer bins.



Source: Royal Haskoning 2014

EMM
EMGA Mitchell McLennan

PORT WARATAH COAL SERVICES

Location of particle size test samples at KCT

T4 Project - Response to Submissions on Preferred Project

FIGURE 3.4

Sampling Locations 2a and 2b are within the channel that conveys surface water towards KCT's settling ponds. The results from these locations are probably the most representative of typical particle size distribution in site runoff, because most of the coarse material (coarse sand and gravel fraction) has likely dropped out in the upstream sumps, with the remaining distribution ranging from silt to sand size fractions. It is noted that at the upstream end of the channel (Location 2a), the majority of the particles are still sand and gravel size, while towards the downstream end of the channel (Location 2b), there is more silt fraction (just less than 40% silt), with most of this being coarser than 10 microns).

Sampling Locations 3a, 3b and 3c are within KCT's Settling Lagoon 1, and are typical representation of the smaller particle sizes that remain after the primary settlement takes place in the inlet sumps and inlet channels. The results indicate some sand, but mostly silt size particles (80 to 90% silt). A positive result is that the KCT ponds seem to be retaining significant quantities of quite small particles, down to at least 2 microns in size. As noted in the RTS/PPR, the pond hydraulic residence time at the T4 Project's water management ponds is expected to be greater than for KCT's settling ponds and so it would be expected that the T4 Project ponds would have a better performance in terms of retaining fine silt particles.

Further settlement calculation sensitivity analyses were undertaken using a range of particle sizes and the results are provided in Figure 3.5. The results indicate that the proposed T4 Project water management ponds will be effective at removing sediment down to approximately 7 to 8 microns in size. Below that level, retention would still be afforded, but at slightly reduced rates. As previously stated, there is a high degree of confidence that the T4 Project's water management ponds will retain the sediment load. As noted in Section 5.1.2(ii) of the RTS/PPR main report:

> There is a strong association between suspended solids and many other contaminants that adhere to suspended solids (Duncan 1999). Therefore, the T4 Project's surface water management system, shown to be efficient in removing suspended solids, will also substantially reduce other contaminant concentrations in the water column, such as hydrocarbons and heavy metals that adhere to suspended solids.

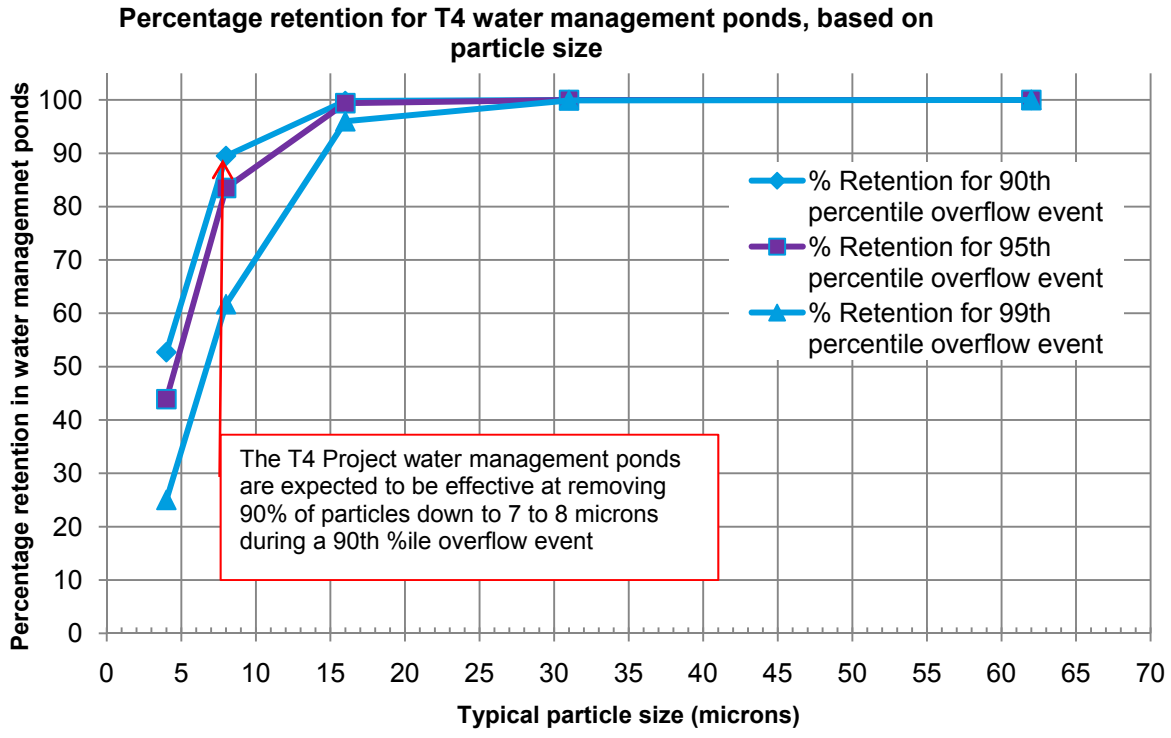


Figure 3.5 Estimated T4 Project water management pond particle retention rates

Comparison of performance between T4 Project and KCT settling ponds

The EA and RTS/PPR included comparisons of measured water quality from KCT's main water management dams (Settling Lagoon 1 and Clarified Lagoon 1) to baseline water quality at various surrounding water bodies, including receiving waters of the Hunter River. This information is presented in the EA and RTS/PPR and Section 5.2.2(i)b of the RTS/PPR main report states:

> Table 3 from the EA Appendix J compared measured water quality from KCT's main water management dams (Settling Lagoon 1 and Clarified [Lagoon] 1) to baseline water quality at various receiving waters. The data indicated that water quality at KCT's water management dams is generally consistent with the water quality of receiving waters.
>
> Since the EA was finalised, PWCS has collected additional quarterly samples at Settling Lagoon 1 and Clarified [Lagoon] 1 and additional wet weather samples from Settling Lagoon 1. The water quality results presented in the EA have been updated to include this additional data. These results are compared against the results for receiving waters in Table 5.3 [of the RTS/PPR main report]. This additional data continues to indicate that water quality within the KCT water management dams is generally consistent with the water quality of the receiving waters, with similar or lower mean total suspended solids (TSS), nutrient and metal concentrations (other than aluminium). This indicates that water overflowing from the T4 Project's settling pond system will not significantly affect receiving water quality.
>
> It is noted that the proposed water management ponds for the T4 Project will have a substantially greater residence time than KCT's water management dams. Hence, it is predicted that they would have even higher sediment removal than KCT's settling pond system.

In summary the KCT water quality data presented in the EA and RTS/PPR and the sediment particle size analysis data presented in this report demonstrate that the water management ponds at KCT are effective at removing TSS and other contaminants from site overflows. The water management ponds proposed for the T4 Project will provide greater hydraulic residence times than those at KCT which is expected to result in improved retention rates of TSS and other contaminants.

3.7 Noise

3.7.1 Issue 24

i. DP&I issue summary

Based on Port Stephens Council's submission, PWCS is to provide "further response to issue of noise impacts at Fern Bay".

ii. Extract from Port Stephens Council submission

The PPR states that the proposed operation of the existing coal terminal and the proposed T4 terminal results in exceedances of the project specific noise criteria in residential areas at Fern Bay. It states that this is mainly due to noise from the existing KCT rather than the proposed project and that PWCS is implementing measures to reduce the noise from the existing KCT. Council would appreciate being kept informed of the progress of these improvements to reduce the noise impact on residents of Fern Bay and other areas of Port Stephens LGA.

Taking into consideration the frequency that noise issues have been raised by stakeholders and past noise complaints it is evident that additional noise would be unacceptable for residents at Fern Bay.

It is not clear from the PPR whether the riverside loading facilities are included within the noise assessment.

Council therefore requests that additional information be provided to clarify the potential noise impacts, especially on the residents of Fern Bay and other areas of Port Stephens LGA.

iii. Response

Condition 2.10 of the KCT Stage 4 Project Approval requires PWCS to investigate all feasible and reasonable noise mitigation measures, as defined in the EPA (2000) *NSW Industrial Noise Policy* (INP), to reduce KCT's potential noise impacts at Fern Bay and Stockton. PWCS currently implements a Continuous Noise Improvement Programme that includes plant and equipment acoustic design, procurement, construction and commissioning requirements to further improve noise performance. It also includes noise monitoring and reporting requirements.

In accordance with Condition 2.10, noise investigations at KCT commenced in 2009. PWCS annually reports on investigations undertaken, mitigation measures implemented and the resultant noise reductions observed. These annual reports are submitted to the EPA and DP&I. The most recent report, *PWCS, 120Mtpa Approval (06_0189 MOD3) Condition 2.10, KCT Annual Noise Investigation Report (2013)*, dated 10 April 2013, was submitted in April 2013. KCT's noise management is a separate matter to the T4 Project, however PWCS is happy to respond directly to Port Stephens Council on queries they may have regarding KCT's noise management.

In relation to the comment about noise complaints it is noted that:

- PWCS has demonstrated ongoing compliance with its approved noise and vibration limits and only received four community enquiries about KCT noise in the past three reporting years (August 2010 to July 2013), for which subsequent investigations confirmed the offending noise source was not KCT.

- Only 2 of the 91 stakeholders interviewed by Coakes Consulting in community surveys undertaken during preparation of the EA identified potential noise impacts as an issue.

- Of the 58% of participants surveyed by phone as part of the community surveys who had concerns about the T4 Project's potential impacts, only 12% mentioned increased noise as a concern.

Regarding acceptability of additional noise at Fern Bay, the potential for noise impacts at Fern Bay was comprehensively assessed by SLR Consulting. The results are provided in Chapter 7 and Appendix N of the RTS/PPR. It is confirmed that existing cumulative noise amenity levels under worst-case INP assessable meteorological conditions (including the contribution from all existing industry in the area) exceed the INP's recommended levels at Fern Bay. While KCT is operating within its approved noise limits and is predicted to continue to do so, PWCS is implementing measures to reduce KCT's noise, as discussed above. The noise contribution from the T4 Project at Fern Bay would however be negligible and would not cause any appreciable increase in the Fern Bay cumulative noise amenity levels. The predicted cumulative noise increase of ≤0.1 dB(A) at Fern Bay when the T4 Project is operating at maximum capacity would make no difference to noise levels experienced by receivers at Fern Bay given that noise differences of less than 1 dB(A) are not noticeable.

Both the EA (Appendix L) and subsequent RTS/PPR (Appendix N) noise assessments conclude that the predicted total T4 Project and KCT operating noise levels at Fern Bay are below the criteria developed for the T4 Project EA or comply with KCT's approved noise limits. Maximum predicted night-time noise levels are below the EPA's sleep disturbance criteria, so no sleep disturbance impacts are anticipated. It is

therefore reasonable to conclude that the T4 Project can be designed, constructed and operated to meet the relevant noise criteria and noise levels are predicted to be acceptable at the nearest sensitive receivers, including at Fern Bay.

It is confirmed that all significant noise-generating plant and equipment likely to be used for the T4 Project's construction and operation, including its wharf facilities, were included in both the EA (Appendix L) and subsequent RTS/PPR (Appendix N) noise modelling and assessments. This included shiploading conveyor systems, transfer stations, shiploaders and on-board generator sets of berthed ships. The modelled plant and equipment and operating locations are identified in Tables 6, 7, 10, 27 and 28 and Appendices C3 and C4 of the noise and vibration assessment in the EA Appendix L. Modelled plant and equipment operating locations for the RTS/PPR noise assessment are in Tables 2, 3 and 8 of the RTS/PPR Appendix N.

3.8 Health

3.8.1 Issue 25

i. DP&I issue summary

PWCS is to provide a response to those matters raised by the Newcastle Public Health Professionals and Doctors for the Environment Australia "as they relate to the Director-General's requirements. The proponent may wish to respond to other matters raised, including train movements to the port, which were not required by the DGRs".

In email advice dated 11 December 2013 DP&I clarified that the intent of this comment "was that PWCS need only respond to the air quality matters as agreed that the project needs to look at (ie the movement of trains along the coal chain from the port is not part of the project, only once they cross the rail bridge and into the site is this included as part of the project)".

ii. Overview of matters raised in the submissions

The submissions by the Newcastle Public Health Professionals and Doctors for the Environment Australia raised several health-related matters, including:

- need for a comprehensive health impact assessment;
- health impacts of particulate matter and noise from the T4 Project;
- health impacts from coal dust, diesel exhaust and noise associated with coal train movements along the rail corridor should be considered in the T4 Project's assessment;
- health impacts of climate change from burning of coal; and
- criticism of Associate Professor David McKenzie's review of air quality-related health effects, which was presented in the RTS/PPR.

The submissions are available in full on DP&I's website. Many of the matters raised are consistent with those raised on the EA and responded to in the RTS/PPR, however PWCS's previous responses to these matters are reiterated below for ease of reference.

ii. Response

As stated in the RTS/PPR, the DGRs did not require a health impact assessment be undertaken for the T4 Project. As such a health impact assessment was not undertaken as part of the EA. In addition, an assessment of health impacts was not required by government as part of the RTS/PPR. Researching the potential health implications of air pollutants and noise was also not required by the DGRs, but rather is a matter for government policy makers to address. However, discussion on health effects of noise, particulate matter and coal dust was provided in the RTS/PPR, in response to similar submissions. This included the review of potential impacts on respiratory health by Associate Professor David McKenzie, provided in Appendix D of the RTS/PPR.

As is standard industry practice, the air quality and noise assessments were completed in accordance with the applicable guidelines, standards and impact assessment criteria for NSW. These standards and criteria have been established by independent bodies based on scientific research, including health risk studies, and set at levels to ensure appropriate environmental outcomes are achieved. Setting these standards and criteria are matters for government, particularly the EPA, who is the regulatory authority for air quality and noise in NSW. The boundaries of the air quality and noise assessments were agreed in close consultation with the EPA and DP&I.

In its submission NSW Health stated that:

> while the modelled air quality impacts comply with the current EPA assessment criteria, should the project be approved it is recommended that the proponent is required to implement all reasonable and feasible measures to control emissions of $PM_{2.5}$ and PM_{10} from all sources. This will ensure that any health impact is minimised.

PWCS has committed to implementing a range of air quality and dust management and monitoring measures, including best practice measures. The air quality specialists that undertook the assessment concluded that "provided these measures are implemented, the T4 Project is not expected to significantly affect surrounding air quality". Similarly, based on detailed noise modelling and assessment, the acoustic specialists concluded in Section 7.2.2(ii) of the RTS/PPR main report that "there is negligible potential for health impacts associated with the T4 Project's noise emissions".

The T4 Project application does not include upstream or downstream activities such as rail or coal combustion projects, which are subject to separate assessment and approval processes by regulators and proponents of these projects. Accordingly, the T4 Project's EA is not required to assess health or other impacts of these separate projects.

It is recognised that potential impacts from coal train movements are of community concern. However, as acknowledged in the submissions by NSW Health and ARTC, PWCS does not have operational control over coal trains travelling to and from the T4 project area. The air quality and noise assessments for the T4 Project's operations included predicted emissions from trains within the T4 project area. A cumulative assessment for the entire rail corridor is however outside the scope of an EA for the T4 Project and was not required by the DGRs.

ARTC and the rail freight operators are responsible for assessing and managing the impacts of coal trains along the Hunter Valley rail corridor outside the T4 project area, including noise, dust and other air emissions. These aspects are regulated by the EPA. Nonetheless, broad consideration of acoustic and air quality impacts of additional trains along the rail corridor was provided in the EA and RTS/PPR. Despite being out of its operational control, PWCS has also committed to "continue to work with ARTC and coal producers around reducing fugitive dust emissions from trains".

In its submission, ARTC states that it manages rail noise along the ARTC corridor in accordance with its EPL and relevant state guidelines. It states that rail noise is an industry issue that is shared between rail generating premises, rail operators and track managers. ARTC also provided information in its submission on how it is contributing to rail noise management.

The EPA, who is the regulatory authority for air quality and noise, confirmed in its submissions on the EA and RTS/PPR, that the air quality and noise assessments had been carried out in accordance with the relevant guidelines and had no requirement to alter the scope or methodology.

3.9 Contamination

3.9.1 Issue 26

i. DP&I issue summary

"Installation of an impermeable liner in Deep Pond is no longer proposed. Instead a low permeability barrier wall along the southern and western sides of Deep Pond to minimise the movement of saline water would be used. Concern is that the wall would not prevent saline water from infiltrating the ground surface into the groundwater table exacerbating the existing soil and groundwater contamination."

ii. Extract from EPA submission

The EPA notes the proponent is no longer proposing to install an impermeable liner in Deep Pond, rather it is proposed to install a low permeability barrier wall along the southern and western sides of Deep Pond to minimise the movement of saline waters through the rail embankment. A low permeability barrier wall would not prevent saline water from infiltrating the ground surface.

The EPA is concerned there is potential for the saline dredge water to seep into the groundwater table below Deep Pond and potentially exacerbate existing soil and groundwater contamination.

The EPA recommends that the handling and deposition of wet sediments and dredge waters only be undertaken in areas of the site which have an impermeable land surface barrier and appropriate drainage such that the risk of saline water entering the groundwater table is minimised as far as practicable.

iii. Response

The T4 project area has two principal groundwater aquifers as detailed in the EA and related documents; an unconfined Fill Aquifer and a confined Estuarine Aquifer. The proposed barrier wall along the western and southern sides of Deep Pond will cut off the Fill Aquifer, minimising the movement of saline water through the rail embankment towards sensitive wetlands. The concern raised by the EPA relates to possible vertical movement of saline water through the base of Deep Pond into the Estuarine Aquifer.

The risk of saline dredge water adversely impacting the Estuarine Aquifer is considered very low on the basis of:

- aquitard thickness and low permeability;
- existing salinity of Estuarine Aquifer; and
- results of groundwater modelling.

These are discussed further in the following.

Aquitard thickness and permeability

The base of Deep Pond consists of low-permeability silty clay/clayey silt forming an aquitard over the confined Estuarine Aquifer. Investigations within and around Deep Pond indicate that the thickness of the aquitard in this area is the thickest of anywhere in the T4 project area. Its thickness ranges from about 4 m on the eastern side of Deep Pond to greater than 14 m on the pond's western side.

In situ and laboratory permeability tests have been undertaken on the silty clay/clayey silt material that forms the aquitard. These indicate permeability in the range of 2×10^{-10} m/s to 5×10^{-9} m/s. This permeability is lower than the specification for the barrier wall, which is 1×10^{-8} m/s.

Existing salinity of Estuarine Aquifer

The Estuarine Aquifer is hydraulically connected to the south and north arms of the Hunter River and has salinity approaching that of sea water. The salinity of sea water (as indicated by electrical conductivity) is about 50,000 microsiemens per centimetre (μS/cm). Tests carried out on samples collected from monitoring wells on the T4 project area show that the salinity of the Estuarine Aquifer is in the range 21,000 to 40,000 μS/cm . The salinity of the Fill Aquifer however is typically an order of magnitude lower, generally in the range of 1,200 to 7,500 μS/cm.

In the unlikely event that saline dredge water infiltrated through the aquitard into the Estuarine Aquifer there would be negligible impact. Furthermore the infiltrated water would eventually (after several decades) flow towards the already saline Hunter River.

Results of groundwater modelling

The groundwater modelling showed that the principal movement of dredge water (and water in the Fill Aquifer) is horizontal rather than vertical. This is primarily due to higher horizontal permeabilities compared to vertical permeabilities.

It is therefore concluded that risk of saline dredge water adversely impacting the Estuarine Aquifer is very low given that vertical movement through the aquitard would be minimal, and even if it did pass through, the effect on the already saline receptors would be negligible.

3.9.2 Issue 27

i. DP&I issue summary

"A better understanding of the proposed timing or staging of the proposed capping and dredge emplacement works across the site is required, with specific reference to the circumstance where the implementation is delayed but capping of cells owned by PWCS is undertaken."

ii. Extract from EPA submission

The specific timing of the capping is not identified in the PPR and is indicated to be after the completion of earthworks and during construction of the stockyard. The EPA recommends that final capping works be implemented and completed prior to any dredge material emplacement, preloading and/or construction activity commencing at the site to ensure surface water infiltration to the groundwater system is minimised.

Consideration of cap integrity also needs to be addressed in relation to installation of any necessary piers, footings or piling works required during the construction phases of the project. The EPA recommends

installation of a 'sacrificial' capping layer over the final cap to prevent damage to the cap during construction, to ensure the design permeability is achieved and maintained for the life of the cap.

The cap should be engineered to ensure it has a life span of at least thirty years as a minimum.

iii. Response

The construction of the final cap prior to dredging, preloading and site construction activities would be ineffective and wasteful for the following reasons:

- The current site levels are mostly below the proposed final ground surface levels (except for the hill in the asbestos disposal area). Dredging is needed to provide the material to fill and regrade the site, so the proposed cap would be buried and subject to fill loads that could damage the cap.

- The development will induce substantial settlements that would further damage any existing cap.

- The construction of the coal stockyard (the major portion of the T4 project area) will form a cap meeting Benchmark Technique 28, as detailed in the landfill closure plan (RTS/PPR Appendix F). Having the cap at the surface which is accessible and uniformly graded will allow maintenance and promote proper drainage. A buried cap would be inaccessible, likely become damaged and form an uneven surface which could trap or direct water in an undesirable manner.

- Upon completion of construction, the buried cap would become redundant as the surface capping described in the landfill closure plan (RTS/PPR Appendix F) would have to be constructed to replace it. This includes a suitably-designed surface cap on areas adjoining the stockyard.

An area which slightly differs to the above is the Delta EMD site. Here a liner will be installed at existing ground surface level prior to dredging to protect the underlying aquifer and nearby water bodies from saline water during dredging. This requirement is due to a thinner and more permeable aquitard at the Delta EMD site, combined with proposed high volume intense application of dredge water. This liner is not intended to be a landfill cap. It will be buried by construction and a surface cap meeting Benchmark Technique 28, as detailed in the landfill closure plan (RTS/PPR Appendix F), will be constructed integrally with the rest of the T4 Project.

All landfill caps will have a design life exceeding 30 years and will be maintained/protected in accordance with management plans. As documented in the revised statement of commitments in Chapter 15 of the RTS/PPR main report, measures will be in place for monitoring and maintaining contamination remediation and management structure proposed for the T4 Project, including the caps, to ensure their effectiveness.

The EPA has recommended a sacrificial cap over the final cap to protect it during construction, however, if the above logic is accepted then the final cap would be built towards the end and would not need protecting during construction. Similarly, the construction of piles and footings would occur prior to completion of the cap.

PWCS will only be providing capping for the T4 project area, as agreed with Hunter Development Corporation, if the project is constructed ie the dredging by PWCS for filling of the T4 project area, as part of site development for the T4 Project, forms the capping for the site. PWCS has not committed to providing any capping at any other time. The timing of the T4 Project's construction is not confirmed. If construction is delayed for some years, PWCS recognises that the EPA may require Hunter Development Corporation to cap the Kooragang Island Waste Emplacement Facility and PWCS to cap the Delta EMD site in accordance with the existing approved cap designs (as would happen if the T4 Project did not exist). In

the case of the fines disposal facility, EPL 5022 does not prescribe capping and closure requirements. It is anticipated that capping would not be required until after the use of the fines disposal facility by PWCS has ceased.

3.10 Obstacle Limitation Surface

3.10.1 Issue 28

i. DP&I issue summary

Based on NCC's submission, PWCS is to respond to "issues relating to Obstacle Limitation Surface (or other matters relevant to operation of the airport and RAAF base)".

ii. Extract from NCC submission

Newcastle Airport is at the RAAF Base Williamtown, approximately 17 km north-east of the Newcastle central business district. Restrictions are placed on the airspace within a 15 km radius from Newcastle Airport to protect aircraft flying in and out of the airport. The subject site is within this catchment.

To ensure safety is not compromised and to limit restrictions to aircraft operations, a notification/ permission process was established in 2012 by Air Base Command of RAAF Base Williamtown concerning construction cranes and other tall structures having a height exceeding 30 m (above ground level) within 15 km of Newcastle Airport.

iii. Response

In response to NCC's submission, EMM contacted Air Base Command of RAAF Base Williamtown regarding the T4 Project and heights of the tallest proposed structures, including buffer bins, recirculation conveyor transfer house, coal stackers, coal reclaimers and shiploaders.

Air Base Command stated that the proposed heights of the structures are unlikely to exceed the obstacle limitation surface (OLS) of Newcastle Airport. It is noted that the OLS defines the airspace which should ideally be kept free of obstacles and only relates to visual operations or the visual stages of an instrument flight. The purpose of the OLS is not to restrict or prohibit all obstacles but to ensure that existing or potential obstacles are examined for their potential impact on aircraft operations and that their presence is properly taken into account.

Notwithstanding the above, PWCS continues to liaise with Air Base Command on this matter and once formal correspondence from them is received it will be provided to DP&I.

3.11 Economics

3.11.1 Issue 29

i. DP&I issue summary

"An economic analysis was not an issue identified in the Director General's Requirements for the project. The economic viability of a project by a non-government entity is not a planning and environment assessment issue (except as it might relate to justification of the project) but one for the proponent. Notwithstanding, given the detail of The Australian Institute submission, it is considered appropriate that the proponent make a response available for the submitter".

ii. Extracts from TAI submission on BCA and responses

Throughput levels

Issue: The Australia Institute (TAI) questions the coal throughput used in the benefit cost analysis (BCA) and states that the economic assessment provides no source for this forecast. Comparison is made to growth in exports through PWCS terminals between 2001 and 2012, stated as being more sedate than forecast in the economic assessment for the coming years. TAI submits that benefits early in a project's life have an important influence in BCA and Gillespie Economics therefore heavily overstates these early revenues from increased throughput. It further states that the sensitivity testing did not test for changes in coal export growth levels.

Response: As identified in Section 2.3 of the economic assessment of the T4 Project (EA Appendix R), the 70 Mtpa throughput scenario adopted for the BCA was based on the anticipated future demand and project timing and staging to meet that demand, estimated by PWCS at the time the BCA was being prepared. PWCS's estimates were in turn based on expressed producer demand via long-term 'ship or pay' contracts (which at that time exceeded approved terminal capacity and therefore triggered the T4 Project) as well as prospective (uncontracted) volumes from mining projects in the planning phase. The modelled throughputs are therefore considered reasonable for a scenario where additional port capacity is required and the T4 Project built.

The reporting however acknowledges that the assumed coal throughputs by year are modelling assumptions only, based on available information at that time, and will change in response to demand and other factors. Demand estimates vary from year to year due to inherently variable market and other factors, and as identified in the RTS/PPR, have decreased since the T4 Project was triggered. A capacity shortfall could however arise at any time in upcoming annual producer nominations requiring PWCS to construct the T4 Project. The T4 Project is proposed to be progressively constructed in response to demands nominated by coal producers and commercial requirements, and the actual timing and scale of its development will be confirmed accordingly. When this happens there is no reason why throughputs would not be similar to the contracted and prospective volumes that underpinned the BCA assumptions. As previously stated, these were based on expressed producer demand and prospective volumes from mining projects. Notwithstanding, sensitivity testing incorporating changes in capital costs, operating costs and export revenue (refer to the EA and RTS/PPR for results), demonstrated that the T4 Project will have substantial net production benefits to Australia under varied assumptions.

Comparisons made by TAI to the historic growth in exports are not relevant. The BCA is not of historic events but of projected coal throughput at the Port of Newcastle under changed demand conditions in the future. Historically, exports through the Port of Newcastle have predominantly been to Japan, Republic of Korea and Taiwan. The major growth in world coal demand is expected to come from China and India. The T4 Project will help enable coal mines in NSW to meet some of this demand growth.

It is correct that the discounting effect in BCA gives greater weight to costs and benefits that occur earlier in the life of a project. Sensitivity testing undertaken for the BCA did not explicitly examine changes in timing of coal export growth, but rather the analysis was based on the anticipated future demand and project timing and staging to meet that demand, estimated by PWCS at the time the BCA was being prepared. However, sensitivity testing did incorporate changes in capital costs, operating costs and export revenue which partly also reflect potential changes in staging.

Scenario analysis at odds with common practice in BCA

Issue: TAI states that the economic assessment of the T4 Project does not adopt the common practice in BCA of comparing one or more 'with-project' cases to a base (no project) case, but instead examines scenarios with different sizes of coal resource. It is not explained why a fixed resource of 8 billion or 16 billion tonnes is assumed.

Response: This is an incorrect interpretation of the BCA. The BCA compares the project case, where additional exports are possible to meet growth in global coal demand, to a base case where exports are constrained by existing port capacity. Because coal is in fixed supply, the T4 Project would allow coal production to be brought forward in time. The scenarios employed in the BCA are because of the uncertainty around the magnitude of the fixed supply of coal in NSW. The recoverable resource figures quoted by TAI are limited to existing projects and ignore the fact that the total recoverable coal resource is considerably greater than just the existing projects.

Scenario 3 – technological change

Issue: TAI states that it does not understand why the BCA has chosen to incorporate changing technology and policy as an abrupt halt in coal exports in 2050 rather than considering this as a factor that might slow the growth of throughput.

Response: A range of hypothetical scenarios were selected for modelling purposes only, to represent a range of potential impacts, one of which is the hypothetical scenario mentioned above by TAI. This scenario was analysed to demonstrate the potential effect of coal export ceasing, for instance due to a change to alternative energy technologies. While in reality a more gradual shift to alternative technologies is likely, the timing and speed of this is highly uncertain. What this scenario (and the other scenarios) demonstrates is that even under a range of scenarios the T4 Project will have considerable net production benefits to Australia and NSW. Approval of the T4 Project would ensure that predicted port capacity constraints are removed allowing Australia and NSW to capture the economic benefits of helping to meet increasing world coal demand.

Evaluation period for the BCA

Issue: TAI considers that undertaking the BCA over an extended timeframe is inappropriate and inconsistent with NSW Treasury Guidelines.

Response: Most guidelines consider that an evaluation period of 20 to 30 years is sufficient because, as identified in TAI's reference to the NSW Treasury Guidelines "the analysis will be relatively insensitive to the choice of a longer project period due to the discounting of future costs and benefits". However, there is nothing wrong with using a longer time period where projects will have a longer economic life and lead to ongoing costs and benefit. This is the case for the T4 Project. The longer evaluation period used for the T4 Project was to demonstrate the sensitivity of the results to different assumed magnitudes of recoverable coal resource. This clearly showed that the net production benefits of the T4 Project would increase with higher estimates of recoverable coal reserves in NSW. The BCA showed that the T4 Project would have considerable net production benefits to Australia and NSW under all scenarios evaluated. The highest net production benefits were predicted for the hypothetical scenario where all coal export ceases in 2050, for example due to a transition to alternative energy sources. This was partly because if this occurred, the T4 Project, by increasing port capacity to meet demand, would enable export of additional coal (and associated export earnings) in the coming years that would not otherwise be exported in the distant future if coal export ceased.

In respect of the use of a longer project evaluation period, it is noted that environmental applications of BCA, such as that by Garnaut (2011) in a review of climate change policy, used an evaluation period in excess of 80 years.

Metallurgical coal price

Issue: TAI considers that the BCA of the T4 Project overstates its value because a value of $200/tonne (t) was applied to the 20% of production through the T4 Project assumed to be metallurgical coal when most of the metallurgical coal from NSW is lower value 'semi-soft' coking coal.

Response: Coal is a heterogeneous product. The actual proportion of hard versus semi-soft coking coal that will be exported in the future via the T4 Project is unknown. Similarly, the proportion of thermal coal exported of various qualities is unknown. These variables were estimated for modelling purposes based on PWCS's predictions of future coal export by type, as available at the time of the assessment. For modelling purposes only, a single value was used for metallurgical coal and a single value for thermal coal. The BCA used AUD$200/t for the 20% of coal throughput assumed to be metallurgical coal and AUD$100/t for the 80% of coal throughput assumed to be thermal coal. The volume weighted value for coal used in the analysis was therefore AUD$120/t. NAB's (2013 - August) forecast benchmark price for thermal coal in June 2015 was USD$100[1]. The NAB's (2013) forecast AUD/USD exchange rate in June 2014 was 0.8. This equates to a thermal coal price in 2015 of AUD$125. The volume weighted value used for coal in the BCA of the T4 Project is therefore considered reasonable and potentially conservative.

As identified in the EA and RTS/PPR there is uncertainty around several variables used in the modelling, including future coal prices. Therefore sensitivity analysis was undertaken by changing the values of these variables, to determine the effect on the BCA results. This included testing the estimated net production benefits and company tax and royalties for a 20% increase or decrease to export revenue at a 4%, 7% and 10% discount rate. The BCA results were found to be most sensitive to assumptions about mining costs and export coal prices/predicted export demand. General findings of the sensitivity analysis are presented in the EA and also apply to the modified project assessed in the RTS/PPR.

While there is uncertainty around future coal prices, the BCA, including model reruns assuming lower export revenues, demonstrated that the T4 Project will potentially have very significant economic benefits and economic activity to the Australian, NSW and regional economies.

Mining and transport costs

Issue: TAI considers the free-on-board (FOB) mining costs included in the BCA to be too low and questions the appropriateness of the references used for mining costs.

Response: The FOB mining costs used in the analysis were based on detailed financial data for 13 coal mines prepared by Ernst and Young (2010) as part of the take-over bid of Centennial Coal by Banpu. In addition, data from Marston (2010) was used. Marston is an international mining consultancy firm that has undertaken comparative cost studies of mining regions around the world. TAI states that neither source reflects changes that have occurred since 2009, however both sources post-date 2009. The original economic analysis of the T4 Project was undertaken in 2011 and the sources used at that time represented the most contemporary information available. Alternative sources mentioned by TAI such as Wood McKenzie are not freely available published data.

[1] Financial institutions do not maker longer term projections.

As identified in the EA and RTS/PPR there is uncertainty around several variables used in the modelling, including capital and operating costs. Therefore, sensitivity analysis was undertaken to demonstrate the sensitivity of the net production benefit estimates to 20% changes in operating costs. As identified in the EA and RTS/PPR the results are sensitive to assumptions about mining costs. However, even under a 20% increase in assumed operating costs the T4 Project would have considerable net production benefits to Australia.

Royalties calculation unclear

Issue: TAI states that that it is not clear how royalties were estimated or if the royalty estimate per tonne of coal is in Australian or US Dollars.

Response: As stated throughout the EA and RTS/PPR, the BCA of the T4 Project was undertaken in Australian dollars. As identified in the economic assessment:

> weighted royalty costs were estimated to be $8/t based on the proportion of underground and open cut mining in the Hunter, Gunnedah and Newcastle Coalfields and royalties charged at 7.2% of revenue for underground mines and 8.2% of revenue for open cut mines.

The BCA also identifies that the:

> export coal price is assumed to remain constant at AUD$100/t for thermal coal and AUD$200/t for metallurgical coal (ABARES 2011), with 20% of exports facilitated by the T4 Project being metallurgical coal.

This gives a weighted average revenue of $120/t. Applying the weighted average royalty per tonne to the weighted average revenue per tonne gives a royalty of $9.84 per tonne.

Royalties overstated as the calculation does not include deductions

Issue: TAI considers that the royalties from the project are overestimated because it is unclear if they have allowed for any of the allowable deductions such as $3.50 per tonne deduction for beneficiation.

Response: Allowable deductions include deductions for levies and beneficiation of the coal but make only a few percentage points difference to estimation of royalties based solely on the royalty rate. This is well within the sensitivity testing range undertaken in the BCA. As noted in the economic assessment, the results of the BCA are most sensitive to the changes in the value of coal rather than other assumptions such as the royalty rate.

Concerns raised in the submission may have stemmed from TAI's misunderstanding of how deductions are calculated. Inclusion of allowable deductions involves subtracting the allowable deductions from the gross value of the coal to provide an adjusted gross value of the coal to which the royalty rate is applied. In its recent submission on a separate coal project, TAI (2013) erroneously estimated the royalty amount in the normal way and then subtracted the allowable deductions from the royalty amount itself, resulting in a significant underestimation of royalties. For example, with all other things being equal, this approach would result in a 38% underestimation of annual royalties at 70 Mtpa production.

Calculation of Commonwealth taxes overstated

Issue: TAI states that the BCA makes no explanation of how Commonwealth taxes were calculated, which it considers a concern "as there is a significant difference in the theoretical and effective tax rates paid by mining companies in Australia".

Response: The estimate of company tax payable in the BCA of the T4 Project was calculated by applying the Australian Tax Office (ATO) corporate tax rate of 30% to the estimated gross profit of the project. This estimate of gross profit was based on assumed coal prices which, as identified above, are considered to be reasonable assumptions for the purposes of the BCA.

In its submission, TAI suggests that the effective company tax rate is likely to be lower, at 13.9% of gross profit and not 30% as required by the ATO, due to potential rebates, tax exemptions and depreciation allowances. Two studies are quoted to support this.

One of the studies referenced by TAI (Markle & Shackelford 2009) calculates the effective tax rate for the entire 'mining sector' (not the coal mining sector only or individual coal mining projects) in relation to gross operating surplus (GOS) not gross profit. GOS does not consider the costs of production such as consumption of fixed capital, interest, royalties, land rent payments and direct taxes payable on inputs. Therefore, it is the incorrect denominator to use for estimating the effective tax rate.

The second study referenced by TAI (Richardson & Denniss 2011) also refers to the Australian 'mining sector' (all mining rather than the coal mining sector or individual coal mining projects) and it is not clear if any coal mining companies were included in the data used in the analysis.

As identified by Mott (1997) incorporating the full rate of corporation tax ensures that the analysis of the project is independent of tax events not pertaining to the project.

It should also be noted that the BCA of the T4 Project included sensitivity testing on revenue levels, including increasing and decreasing revenue estimates by 20% for each of three discount rate percentage assumptions. This is the equivalent of undertaking sensitivity testing on company tax levels.

While the level of the effective tax rate on the mining sector in general and on this specific project can be debated, changes to the tax rate do not change the conclusion of the BCA that the T4 Project will have considerable net production benefits to Australia.

<u>Alternative modelling by TAI</u>

Issue: TAI undertakes alternative modelling based on a range of assumptions and concludes that the T4 Project is not financially viable and will not proceed.

Response: The modelling by TAI is not considered credible given the assumptions it is based on. This includes incorrect estimates of royalties and company tax, conservative price estimates, and a short evaluation period of 30 years that ignores significant costs and benefits that would occur in the future (particularly as TAI assumes that the project will not be built until well into this evaluation period, for example 16 years into it under its mid-case scenario).

The T4 Project's BCA, as published in the EA and RTS/PPR, clearly demonstrates that the T4 Project will have very significant economic benefits and provide economic activity to the Australian, NSW and regional economies. Notwithstanding, it is not the role of an EA, including its economic assessment, to determine whether or not a project is financially viable, but rather to assess its economic effects. The financial viability of a project is a matter for a project proponent and its investors.

Nonetheless, TAI's conclusion that the T4 Project is not financially viable and therefore will not proceed is disputed from two perspectives. Firstly, it is contrary to the commercial arrangements between PWCS and coal producers. The long-term operational framework for the Hunter Valley Coal Chain, including a framework for identifying demand for additional coal export capacity, is underpinned by the CFAs, which are described in the EA and RTS/PPR. As part of its obligations under the CFAs, PWCS has entered into

long-term 'ship or pay' contracts with coal producers and is responsible for ensuring its port facilities have sufficient capacity to handle the contracted coal throughputs. Where a capacity shortfall is predicted which cannot be accommodated by further expansion of its existing coal export terminals, the CFAs include a contractual obligation for PWCS to build a new terminal, that is the T4 Project or its equivalent elsewhere. Construction of a new terminal must be finalised within four years of the capacity shortfall being formally acknowledged.

Based on the 2010 nominations by the coal producers, a capacity shortfall was identified that triggered the need for PWCS to gain approval for and construct a new terminal (T4) by 2015. Since the EA there has been a reduction in export forecasts, however a capacity shortfall could arise again at anytime in upcoming annual producer nominations and PWCS remains obligated to construct the additional capacity in certain timeframes when this occurs. The Hunter Valley Coal Chain is of considerable economic importance to Australia, NSW and the Hunter region and the T4 Project is an important part of the long-term export plan for coal produced in the region.

Secondly, the T4 Project funding is based on commercial arrangements with costs to be recouped via port charges to users. It will only proceed if coal producers require it to meet their export demands, and subject to provisions of the CFAs, project approval and commercial requirements. To build the T4 Project, PWCS will be required to outlay an estimated $4.8 billion (B) in capital expenditure. If it is unviable and not required to meet demand it will not proceed, regardless of any government approval.

External costs not valued

Issue: TAI identifies that the BCA "makes no attempt to value the external costs associated with the Project". It suggests that this is contrary to the NSW Treasury (2012) guidelines that identify that the BCA framework should take account of the full range of potential benefits and costs.

Response: TAI misrepresents the NSW Treasury (2012) guidelines as they do not suggest that all costs and benefits must be valued. The NSW Treasury (2012) guidelines in fact clearly identify that "some impacts may not be quantified" (p.8) and that "unquantified impacts should be discussed in the CBA report" (p.8). As identified in the DP&I's *Draft Guideline for economic effects and evaluation in EIA* (James and Gillespie 2002), "where there are difficulties in estimating the non-market values of development proposals, the threshold value approach can serve as a useful 'second best' way of considering resource use options".

It is impractical to attempt to value all the potential external impacts that may arise from the T4 Project and upstream mine and rail projects. Consequently, in the BCA of the T4 Project the threshold value approach is used. Qualitative discussion is provided on the potential impacts of bringing forward in time mine development and rail development/operation as well the construction and operation of the T4 Project.

However, as identified in the economic assessment of the T4 Project, each of these activities along the coal supply chain are subject to detailed environmental impact assessment and approval procedures under the relevant legislation, for example the EP&A Act and potentially the EPBC Act. Environmental management and mitigation measures are implemented accordingly. The port, mining and rail costs input to the BCA include the costs of implementing environmental management and mitigation measures to avoid or minimise adverse impacts. If the potential impacts are mitigated so there are no significant effects, then external economic costs will not arise, however, costs of any residual impacts, not able to be mitigated, require consideration.

Using the threshold value approach, any residual (unmitigated) environmental impacts of the T4 Project's coal supply chain to Australia can be weighed up against the estimated net production benefits to Australia to determine whether the project is justifiable in economic efficiency terms. It is left to decision-makers, not PWCS, to judge whether the environmental, social and cultural costs of the T4 Project after offsetting, mitigation and compensation will exceed the considerable net production benefits that are identified.

Health

Issue: TAI specifically identifies that the mining cost estimates "make no consideration of the external costs such as reduced air quality and associated damage to human health". Therefore it states that the BCA "understates the costs of the Project and overstates its value to the NSW community".

Response: The BCA of the T4 Project clearly identifies that it has estimated the net production benefits of the T4 Project and considers potential residual environmental, social and cultural impacts using the threshold value approach. Whether the unquantified residual effects of the T4 Project after mitigation, offsetting and compensation exceed the net production benefits is left to the decision-maker. Using this approach it is not possible to understate the environmental costs of the project or overstate its net value to the NSW community, as suggested by TAI.

It should be noted that any health impacts as a result of bringing mining forward in time is an area that will be subject to detailed assessment in individual EISs/EAs for the mining projects. Government policy establishes individual project air quality criteria relating to total suspended particulates, PM_{10} and $PM_{2.5}$ that take into consideration the existing background air quality in a region. These criteria have been established by independent bodies based on scientific research, including health risk studies. They are risk-based, and intended to be at levels where the statistical risk of adverse health consequences is considered acceptable and the majority of susceptible individuals would not get symptoms.

Native vegetation and biodiversity

Issue: TAI identifies that the BCA of the T4 Project does not include values for potential ecological impacts from both mine expansion and construction of the T4 Project. TAI identifies that financial benefits of mining will, in some cases, be offset by damage to native vegetation and biodiversity. It states that this damage will be borne by the local community while most of the benefits are directed towards overseas shareholders.

Response: As identified above, the BCA of the T4 Project uses the threshold value method and so does not directly value potential residual impacts on ecology from construction of the T4 Project and mining developments that are brought forward in time, or construction or operation of rail transport. However, each of these activities along the coal supply chain are subject to detailed environmental impact assessment procedures under the relevant legislation, for example the EP&A Act and potentially the EPBC Act. This includes detailed assessment of potential impacts on ecology and development of impact mitigation and offsetting measures. Mining developments typically include proposed biodiversity offsets that, consistent with the NSW Government policy, aim to 'maintain or improve' biodiversity values.

The T4 Project includes a comprehensive biodiversity mitigation and offset package to compensate for the project's residual significant, or potentially significant ecological impacts that were not able to be avoided or mitigated. The ecological assessment in the RTS/PPR demonstrated that the conservation and restoration of the proposed offset sites will ensure that the biodiversity values in the surrounding region are maintained and improved and the continued viability of threatened species and communities that could be significantly affected by the T4 Project, over the medium to long term.

The TAI's assertion that most of the benefits of mining accrue to overseas shareholders is not correct. Significant benefits accrue to Australia and NSW such as through royalty payments and company tax which are subsequently used to fund provision of government infrastructure and services across Australia, including regional areas. While stakeholders outside of Australia will benefit from the T4 Project, the significant net production benefits reported in the RTS/PPR are all benefits to Australia. The T4 Project BCA conservatively assumed that all mines that will use the T4 Project are foreign-owned and so all mining profits were excluded from the calculations. Even with these conservative assumptions the modelling demonstrates that the T4 Project will generate substantial net production benefits to Australia and NSW and significant economic activity in Australia, NSW and the Newcastle region during construction and operations.

Definition of the project

Issue: TAI questions the definition of the project used in the BCA which encompasses not just the construction and operation of the T4 Project but also its implications for mining. TAI suggest that the BCA should just include the revenues from port operation and the costs of construction and operation of the coal terminal.

Response: The T4 Project does not include mining or transport of coal to the terminal, all of which are subject to separate environmental assessment and approval processes. However, from a BCA perspective, the coal terminal cannot be considered in isolation. Its purpose and economic context must be considered, being to service the coal industry and provide additional port capacity required to meet demand and enable mined coal to be exported to market. This in turn enables Australia and NSW to capture the economic benefits of meeting increasing world energy demand. The BCA is an assessment that takes into consideration the benefits and costs for Australia and NSW. It looks at broader economic implications and flow on effects. For the T4 Project this means taking into account the whole coal chain including mining, rail and port activities. All the costs and benefits to Australia of mining, transporting and exporting the additional coal through the proposed T4 Project are relevant to the BCA and have been considered accordingly.

In contrast, the input-output analysis focuses only on the impact of constructing and operating the T4 Project itself. It does not consider impacts of the investment that would be stimulated along the coal supply chain, such as from mining.

Greenhouse gas emissions

Issue: TAI considers that the BCA of the T4 Project should have included the GHG emissions associated with the additional burning of coal in the world as a result of the project. It states that the present value of the costs of these emissions exceeds the project's benefits.

Response: To compare the GHG costs of burning coal to the benefits of the T4 Project is methodologically incorrect. The burning of coal has no relevance to a BCA of the T4 Project which is concerned with removing port capacity constraints and accommodating growth in coal mining and export from the Hunter Valley Coal Chain (allowing it to occur earlier than would otherwise be possible) to meet increased market demand.

The BCA is of the development of the T4 Project to service the mining of coal and delivery of coal to port. Accordingly, the environmental effects relevant to the T4 Project's BCA are those associated with the port and mining and delivery of coal to port. Coal is an intermediate good ie it is an input to the production of other goods and services such as production of electricity and steel. However, these downstream uses of the coal constitute different projects that have their own set of costs and benefits and can themselves be subject to BCA. For example, BCA of a coal-fired electricity generation project would include the cost of

coal, labour, land and capital inputs, electricity distribution and environmental impacts (such as GHG emissions from the burning of coal). The BCA of electricity generation would also include benefits such as the community's willingness to pay for electricity. There may also be externality benefits for economic development, education, and medical care. All of these costs and benefits are relevant considerations in the BCA at this next stage of the production process but not of a BCA of the T4 Project.

ii. Extracts from TAI submission on input-output modelling and responses

Issue: TAI considers that the results of the economic impact assessment of the T4 Project are misleading due to two key flaws:

- they are based on unrealistic rates of throughput; and
- the assumptions inherent in input-output (IO) models.

These issues are addressed below.

Throughput assumptions

Issue: TAI states that the IO analysis assumes that the T4 Project would be constructed to full capacity over four years and that throughput would quickly reach full capacity which will be maintained throughout the assessment period. TAI considers this unrealistic and identifies that if the rate of growth of throughput at PWCS facilities continues at the rate of the historic growth then construction would not begin until 2023-24, with economic impacts growing at a far slower rate.

Response: As identified previously, the 70 Mtpa throughput scenario adopted for the BCA was based on the anticipated future demand and project timing and staging to meet that demand, estimated by PWCS at the time the BCA was being prepared. PWCS's estimates were in turn based on expressed producer demand via long-term 'ship or pay' contracts (which at that time exceeded approved terminal capacity and therefore triggered the T4 Project) as well as prospective (uncontracted) volumes from mining projects in the planning phase. The modelled throughputs are therefore considered reasonable for a scenario where additional port capacity is required and the T4 Project built.

Comparisons made by TAI to the historic growth in exports are not relevant. The BCA is not of historic events but of projected coal throughput at the Port of Newcastle under changed demand conditions in the future. Historically, exports through the Port of Newcastle have predominantly been to Japan, Republic of Korea and Taiwan. The major growth in world coal demand is expected to come from China and India. The T4 Project will help enable coal mines in NSW to meet some of this demand growth.

Notwithstanding the assumptions used for modelling purposes, the ultimate timing and size of staging will be subject to demands nominated by coal producers and commercial requirements. Further response on this matter is provided in Section 3.11.1(ii), under the heading "Throughput levels".

Criticisms of input-output modelling

Issue: TAI states that economists and public institutions have criticised the use of IO for years. TAI refers to criticisms by the Australian Bureau of Statistics (ABS), Productivity Commission and in the Warkworth Judgement.

Response: The main concern that economists have with the use of all methods which examine the economic activity of projects (for example IO analysis, computable general equilibrium (CGE) modelling and Keynesian multipliers) is their correct interpretation.

As clearly identified in the economic assessment of the T4 Project:

> The BCA reported in Section 2 is concerned with whether the incremental benefits of the T4 Project exceed the incremental costs and therefore whether the community will in aggregate be better off 'with' the Project compared to 'without' it. In contrast, the focus of regional economic impact assessment is the effect of an impacting agent on an economy in terms of a number of specific indicators of economic activity.

IO analysis is a suitable methodology for predicting changes in the structure of regional economies and is consistent with the DP&I's *Draft Guideline for economic effects and evaluation in EIA* (James and Gillespie 2002) which states:

> If a proposal is predicted to have significant economic impacts at the regional or State scale, it is appropriate to assess these economy-wide effects...These impacts can be assessed by means of a multi-sectoral or input-output model which identify regional impacts in terms of changes in the value of output for separate sectors of the regional economy, as well as changes in value-added, income and employment.

The assumptions underlying IO analysis are well documented, including in the economic assessment for the T4 Project (EA Appendix R, Appendix 1).

The issues with IO analysis referred to in the TAI submission relate to its inappropriate use. The concerns of the Productivity Commission referred to in the TAI submission relate to using IO analysis to "make the case for government intervention". It is agreed that this would be an inappropriate use of IO but this is not how IO analysis has been used in the economic assessment of the T4 Project. A separate BCA has been undertaken to weigh up the T4 Project's costs and benefits. The IO analysis provides additional information on regional economic activity associated with the T4 Project.

The reference TAI makes to ABS concerns with IO analysis relate to it being "biased estimates of the benefits or costs of a project". It is agreed that IO analysis is not a good indicator of costs and benefits but this is not how IO analysis has been used in the economic assessment. A separate BCA has been undertaken to examine costs and benefits.

TAI also makes reference to the Warkworth Judgement which criticised IO analysis for not "assisting in weighing the economic factors relative to the various environmental and social factors, or in balancing economic, social and environmental factors". However, this is an inappropriate criticism of the IO method, since it does not pretend to do this. IO analysis is solely concerned with estimating the level of economic activity associated with a project and this was how it was used in the economic assessment of the T4 Project. It provides one piece of information for consideration by the decision-maker, alongside all the other pieces of information provided via the environmental assessment process.

<u>Computable general equilibrium modelling is preferable to input-output modelling</u>

Issue: TAI expresses a preference for the "more sophisticated" CGE modelling to assess the T4 Project as it does not have IO assumptions of fixed prices and no supply side constraints.

Response: IO analysis and CGE modelling are two alternative modelling methods for estimating the economic activity associated with a project. IO analysis has historically been applied at the regional level while CGE modelling has historically been applied at the national and state level for major policies and developments. CGE modelling has recently been adapted for use at the regional level.

IO analysis identifies the direct and indirect **additional (positive) regional economic activity** associated with a project in terms of a number of indicators of economic activity, that is, output, income, value-added and employment. The impacts from IO analysis are based on a number of simplifying assumptions, most notably that the regional economy has access to sufficient labour and capital resources (from both inside and outside the region) so that an individual project does not result in any regional price changes eg wages in other industries or house rentals. Consequently, there are no partially offsetting reductions in economic activity ('crowding out') in other sectors in the region. The results of IO modelling can be seen as representing an upper bound for the net economic activity associated with a project. IO analysis is a static analysis that looks at impacts in a particular year, chosen by the analyst.

CGE modelling estimates the additional **net (positive and negative) regional economic activity** associated with a project in terms of a number of economic indicators including value-added and employment, but also real income, gross domestic product, house rentals and so on. CGE modelling is underpinned by an IO database as well as a system of interdependent behaviour and accounting equations (several thousand equations) which are based on economic theory (but mostly without econometric backing at the regional level). These equations ensure that any change in demand in a region, no matter how small, translates into some change in prices and hence there is some 'crowding out' of other economic activity in the region. Results can be sensitive to changes in these behavioural assumptions. For example, Abelson (2011) highlights an example where using the Monash multi-region forecasting CGE model, the Productivity Commission and the main creator and user of the model, Peter Dixon, estimated substantially different level of impacts. The CGE modelling can be dynamic or comparative static.

Which modelling approach best represents the true situation depends on whether and to what extent price changes occur at a regional level as a result of individual projects, not the industry as a whole. This is an empirical issue and would depend on the migration of labour into the region and timely management of land releases by Councils. Few studies exist that examine this issue. However, Deloitte Access Economics (2012) in a study for Singleton Council "found insufficient evidence to conclude that house prices, rent or grocery prices were, on the whole more expensive than other regional communities". This was in relation to all mining in the region rather than a single project and casts doubt on the price changes assumed by CGE modelling.

In response to TAI's submission, a CGE analysis was undertaken for the T4 Project (refer to Appendix B), in addition to the IO analysis already undertaken and presented in the RTS/PPR. The CGE analysis was undertaken by Dr Glyn Wittwer of the Centre of Policy Studies, Monash University. Both approaches indicate that the T4 Project will provide significant economic activity, including employment, to the Newcastle region.

The CGE analysis indicates a regional construction workforce of up to 2,500 people as a result of the T4 Project and regional employment of between 500 and 1,000 when the T4 Project is operating at full capacity. This is comparable to the IO analysis which indicated construction employment impacts of up to 2,919 and regional employment of 304 jobs when the T4 Project is operating at full capacity. The higher regional workforce during operation of the T4 Project indicated by the CGE modelling, partly reflects the influence of expanded coal mining in the Hunter Valley and beyond on the Newcastle economy. These influences are not captured by the IO modelling.

The CGE modelling also indicates additional value-added for the Newcastle economy of between $434 M and $1.2 B when the T4 Project is operating at maximum capacity, in comparison to the $336 M indicated by the IO modelling. Again the higher figure from the CGE modelling partly reflects the influence of expanded coal mining on the Newcastle economy.

The CGE modelling also indicates increased economic activity for the Newcastle economy as a result of the T4 Project in terms of additional aggregate investment, aggregate consumption, real gross domestic product, capital stocks, real wages and housing rentals. The CGE analysis concludes that the T4 Project (as modelled) will result in a welfare impact on the Australian economy of $35 B (at 7% discount rate). The equivalent figures assuming discount rates of 4% and 10% are $55 B and $22 B respectively. 'Welfare' is a cumulative measure of the change in public and private consumption as a result of a project or policy. It is an indicator of how much better off society is with a project or policy compared to without it.

Input-output analysis assumes there is a ghost pool of unemployed labour

Issue: TAI references a finding from the Warkworth Judgement criticising IO analysis because it assumes "that there is a ghost pool of highly skilled yet unemployed people in the Hunter region, from which labour for the existing mine would be drawn".

Response: Contrary to the assertions in the Warkworth Judgement, IO analysis does not assume that there is a pool of highly skilled yet unemployed people in the region to work on a project. It assumes that relative to the level of increased demand for labour in the region, there is substantial available employed or unemployed labour in the world that can be accessed. This simplified assumption negates the need to attempt to model the extremely difficult and contentious matter of price rises and 'crowding out' of other economic activity in the region. Furthermore, it is noted that a considerable portion of the T4 Project's workforce will be its construction workforce. Construction workforces can transition from other construction projects in the region or elsewhere that are winding down or completed. Based on experience with the KCT and NCIG construction projects, it is expected that a considerable portion (up to 85%) of the T4 Project's construction workforce can be sourced locally.

'Crowding out' would be most prevalent if the regional economy was at full employment and it was a closed economy with no potential to use labour and other resources that currently reside outside the region. In this situation, a mining project requiring labour and other resources would compete for them with existing activities. However, the Newcastle regional economy is not at full employment and is not a closed economy. Projects in the Newcastle region have potential access to employed and unemployed labour and capital resources from across the country and internationally. ABS data indicates significant in-migration into the Newcastle region in recent years[2], illustrating that increased direct or indirect demand for labour from projects may be met via in-migration. In these situations there is little impact on other sectors in the regional economy.

Even where a project utilises labour resources from inside the region, there is a natural filter effect where these jobs are filled by other employed or unemployed labour resources inside and outside the region, including the continual addition to the labour force from school leavers, TAFE and university graduates and potentially those not currently seeking employment. This in turn creates vacancies that are then filled by other employed or unemployed labour resources, coming from both inside and outside the region.

The potential labour force to meet demand in a region is considerably greater than just the labour force in the region and hence from a regional perspective is virtually unlimited. Consequently, for small open economies, 'crowding out' of other economic activity from individual projects is likely to be small.

While more complex models such as CGE modelling can conceptually deal with the positive economic activity impacts of a project and any partially offsetting negative economic activity impacts, for small regional economies it is unlikely that these more complex models will surpass the simpler IO model.

[2] For instance, of the Newcastle LGA population aged five years and over in 2011, 40% lived outside the Newcastle LGA five years ago.

Firstly, the small open economy condition minimises the need to address offsetting impacts. Secondly, given considerable difficulties associated with estimating a large number of coefficients and parameters required for CGE models (when there is virtually no local data available), many exogenous assumptions are required to be made by the modeller and so the increased 'fuzziness' is likely to more than offset the increase in model sophistication.

Crowding out

Issue: TAI refers generally to 'crowding out' that is shown in CGE models as indicating the level of jobs that are 'destroyed' at a local level. TAI implies that jobs associated with the project will come from existing positions, delaying and 'crowding out' other projects rather than creating new jobs.

Response: This is an incorrect interpretation of the results of CGE models. Any 'crowding out' of other economic activities estimated via CGE modelling does not indicate job losses but the shifting of labour resources to higher valued economic activities. This reflects the operation of the market system where scarce resources are reallocated to where they are most highly valued and where society will benefit the most from them. This reallocation of resources is therefore considered a positive outcome for the economy not a negative.

The inference in the submission is that no new jobs are ever needed in the economy as all demand for labour diverts labour from other sectors. This assumes a closed economy that is at full employment which is not the case for the Newcastle, NSW or Australian economies.

Economic impacts

Issue: TAI submits that the economic impacts on the wider economy, including employment impacts, are likely to be minimal.

Response: Response to this matter is provided in Chapter 13 of the RTS/PPR main report. In summary the economic assessment demonstrated that the T4 Project would potentially have very significant economic benefits and economic activity to the Australian, NSW and regional economies, including employment generation. It would overcome port capacity constraints and enable additional coal export through the Port of Newcastle that would not be possible if the T4 Project did not go ahead. This would ensure Australia and NSW can capture the economic benefits of helping to meet increasing world energy demand.

Independence of assessment and review

Issue: TAI questions the credentials of Gillespie Economics, the author of the economic assessment, stating that Gillespie Economics is a firm that has consulted almost exclusively to the coal industry for several years. TAI also questions the independence of Professor Jeff Bennett as a peer reviewer of the economic assessment. This is on the grounds that Professor Bennett is the PHD supervisor of Robert Gillespie, the Principal of Gillespie Economics, and they have jointly consulted to the coal industry and written academic papers together.

Response: Robert Gillespie is a highly credentialed and experienced environmental economist. He has undergraduate degrees in Science and Economics as well as Master of Planning and Master of Economics degrees. He is also currently undertaking a PHD. Robert Gillespie has close to 30 years professional experience, with over 12 years experience as a scientist, town planner and economist in the NSW Government, and over 15 years experience as an environmental economist in the private sector. He consults to a wide range of clients including:

- government agencies including the DoE, DP&I, EPA, RMS, NPWS, Sydney Water, NSW Department of Finance and Services, NSW Department of Land and Water Conservation, NSW Fisheries, NSW Marine Parks Authority, NSW Premier's Department, NSW Tourism, Environment ACT, Sutherland Council, Victorian Environmental Assessment Council and Murray Darling Basin Commission;

- environmental groups including the Total Environment Centre, Australian Conservation Foundation, Victorian National Parks Association, Blue Mountains Conservation Society and the Colong Foundation for Wilderness;

- industry including BHP Billiton, Rio Tinto, PWCS, NCIG, Xstrata, Centennial Coal, Peabody Australia, Whitehaven, Gloucester Coal, Concrite Quarries, and Cleary Bros (Bombo);

- industry organisations including the NSW Minerals Councils, Australian Marine Park Tourism Operators and Australian Farm Institute; and

- catchment trusts including the Hawkesbury Nepean Catchment Management Trust and the Hunter Catchment Management Trust.

Professor Bennett is a highly respected academic environmental economist. He is a Professor of Environmental Management at the Australian National University with around 40 years of experience as a researcher, teacher and consultant in the field of environmental and resource economics. He is a Fellow of the Academy of Social Sciences in Australia and a Distinguished Fellow of the Australian Agricultural and Resource Economics Society. His specific areas of expertise are incorporating environmental impacts into economic assessments and the role of the private sector in environmental conservation. He has published over 100 papers in refereed journals and is the author or editor of over a dozen books. He has acted as an advisor to numerous Commonwealth and state government departments and authorities (currently for Food Standards Australia and New Zealand and the NSW Marine Estate Authority), was a pro-bono member of the board of Wetland Care Australia and was Director of the Environmental Economics Research Hub, funded by the Commonwealth DoE.

It is for these reasons that Gillespie Economics was chosen to undertake the economic assessment of the T4 Project, Professor Bennett was used as a peer reviewer of the economic assessment and Robert Gillespie has chosen to study at the ANU under Professor Bennett's tutelage. The work of Professor Bennett and Robert Gillespie in the field of environmental economics is of high academic standard and has been published in international peer reviewed academic journals.

4 Conclusions

PWCS's proposed T4 Project will provide additional port capacity required to accommodate future growth in coal exports from the Hunter Valley and NSW more broadly. The T4 Project is proposed to be developed progressively in response to demand for increased coal export capacity nominated by coal producers, and would provide a nominal coal throughput capacity of up to 70 Mtpa. This is in addition to PWCS's existing approved capacity of 120 Mtpa at KCT and 25 Mtpa at CCT, and would give PWCS a total approved capacity of 215 Mtpa. The project's design allows for future stockyard and rail receival expansion within the T4 project area to achieve a nominal capacity of 120 Mtpa, when required by demand.

As part of the T4 Project approval process, two comprehensive environmental assessments have been prepared and publicly exhibited, an EA which was publicly exhibited between 8 March and 7 May 2012, and an RTS/PPR which was publicly exhibited between 16 September and 22 November 2013.

In response to exhibition of the EA, PWCS received 488 submissions on the project, including a large number of form letters and multiple submissions from some respondents. Most of the submissions were from objectors to the project though some supporting submissions and general comments were received. All submissions were reviewed and issues raised were summarised and responded to in the RTS/PPR.

Following exhibition of the EA, the T4 Project's design was also modified. Modifications were made in response to submissions and government feedback, to further minimise environmental impacts, to reflect the reduced maximum proposed coal throughput capacity from 120 Mtpa to a nominal 70 Mtpa, and to incorporate engineering improvements and the biodiversity offset package. These modifications were described and assessed within the RTS/PPR.

In response to the exhibition of the RTS/PPR, approximately 995 submissions were received, including a large number of form letters and multiple submissions from some respondents. Almost two-thirds of the submissions (approximately 619) supported the T4 Project and approximately 355 were opposed to it. The remaining 21 provided general comments on the project. The majority of the submissions (approximately 926) were from individuals and 64 were from organisations and government agencies.

Reasons given for support relate mostly to the T4 Project's economic and social benefits including employment; role in accommodating future growth in coal exports from the Hunter Valley; comprehensive environmental mitigation, management and offset measures including noise, dust and water management measures, biodiversity offsets, and private sector funded management, remediation and use of significantly contaminated land; and PWCS's ongoing contribution to the community and proven track record in successfully operating coal terminals in the Port of Newcastle.

Consistent with submissions on the EA, common reasons for objection included concerns around the project's potential adverse air quality, health and ecological impacts; broader concerns about the rail corridor and coal industry, including its contribution to GHG emissions and climate change; and the view that there is no project need.

A small number of submissions, mainly from government agencies, provided comments on the project, its assessment and suggested conditions of approval but did not necessarily support or object to it. Matters raised in objecting and commenting submissions are mostly consistent with matters raised in submissions on the EA, which it is considered are adequately addressed in the RTS/PPR, or relate to matters typically addressed in negotiating conditions of approval. The DP&I identified 29 matters which it requested PWCS provide responses to. This report provides responses to each of these matters, prepared by the technical specialists that undertook the assessments in the EA and RTS/PPR, with input from PWCS.

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Acronyms

The following acronyms or abbreviations have been used in this report:

λ	hydraulic efficiency factor
ABS	Australian Bureau of Statistics
AEP	annual exceedance probability
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	average recurrence interval
ARTC	Australian Rail Track Corporation
AS	Australian standard
ASS	acid sulphate soil
ATO	Australian Tax Office
B	billion
BBAM	BioBanking Assessment Methodology
BCA	benefit cost analysis
BOM	Bureau of Meteorology
CCT	Carrington Coal Terminal
CEMP	construction environmental management plan
CFAs	Capacity Framework Arrangements
CGE	computable general equilibrium
CMA	catchment management authority
dB(A)	A-weighted decibels
DECC	former NSW Department of Environment and Climate Change
DGRs	Director-General's Requirements
DoE	Commonwealth Department of the Environment
DPI	Department of Primary Industries
DP&I	NSW Department of Planning and Infrastructure
E	endangered
EA	environmental assessment
ECD	ecological character description
EEC	endangered ecological community
EIA	environmental impact assessment
EIS	environmental impact statement
EMM	EMGA Mitchell McLennan Pty Limited
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPL	environment protection licence
FOB	free-on-board
GHG	greenhouse gas
GOS	gross operating surplus
ha	hectares
HBOC	Hunter Bird Observers Club

IO	input-output
INP	NSW Industrial Noise Policy
KCT	Kooragang Coal Terminal
km	kilometres
LA1(1minute)	Noise level exceeded for 1% of a measurement period.
LAC	limits of acceptable change
LGA	local government area
m	metres
M	million
m/s	metres per second
m^2	square metres
m^3	cubic metres
ML	megalitres or one million litres
mm	millimetres
MNES	matters of national environmental significance
Mtpa	million tonnes per annum
NCC	Newcastle City Council
NCIG	Newcastle Coal Infrastructure Group Pty Limited
NPC	Newcastle Port Corporation
NPWS	NSW National Parks and Wildlife Service
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OLS	obstacle limitation surface
PAC	NSW Planning Assessment Commission
PMF	probable maximum flood
$PM_{2.5}$	Particulate matter less than 2.5 microns in aerodynamic diameter.
PM_{10}	Particulate matter less than 10 microns in aerodynamic diameter.
PWCS	Port Waratah Coal Services Limited
RMS	NSW Roads and Maritime Services
RTA	former NSW Roads and Traffic Authority
RTS	response to submissions
RTS/PPR	response to submissions and preferred project report
SEPP	state environmental planning policy
t	tonne
T4 Project	Terminal 4 Project
TAI	The Australia Institute
TIA	traffic impact assessment
TSC Act	NSW *Threatened Species Conservation Act 1995*
TSS	total suspended solids
µm	micrometres
µS/cm	microsiemens per centimetre
v	vulnerable
WAD	Works Authorisation Deed

APPENDIX A

KCT particle size analysis results

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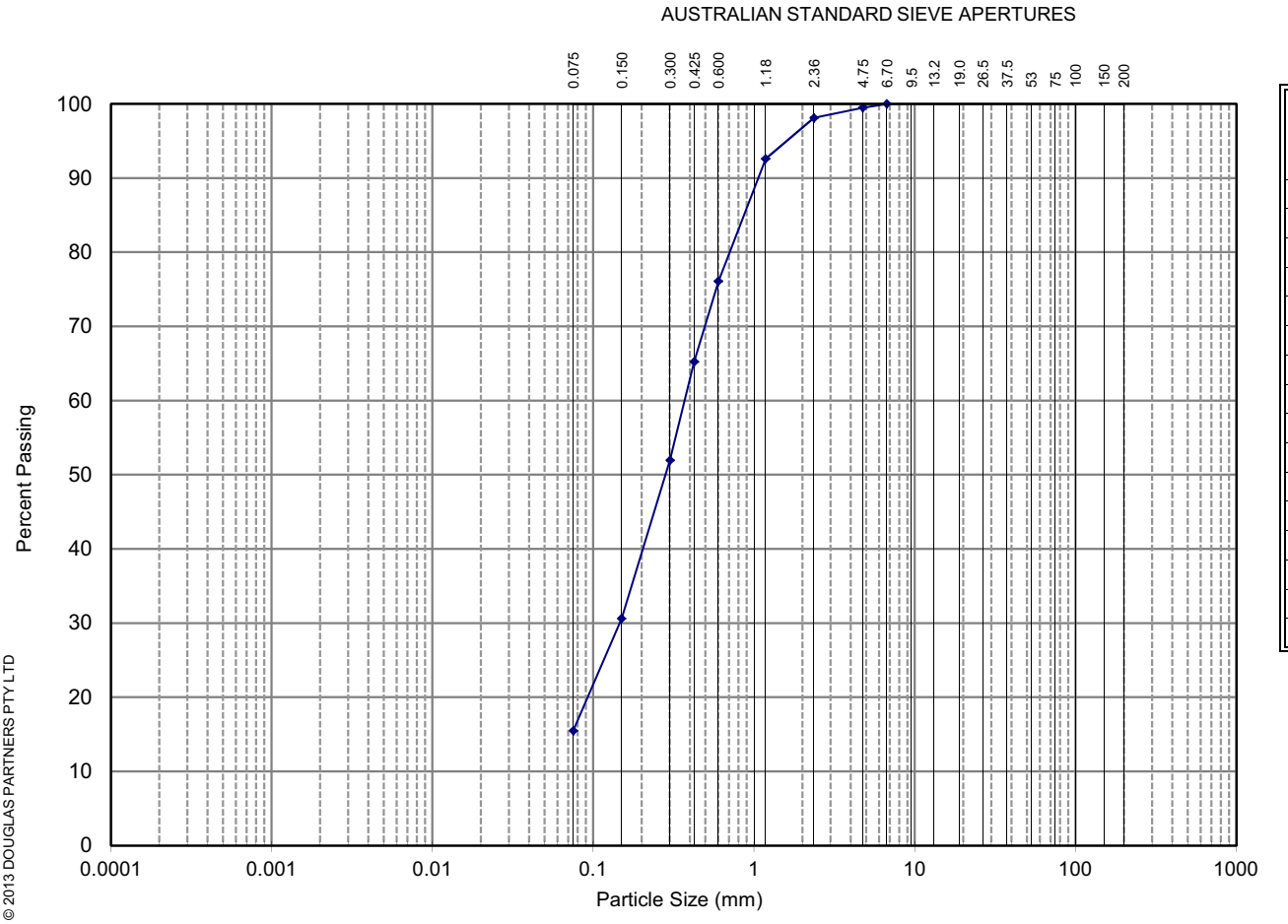
Results of Particle Size Distribution

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_1
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	1 (Discharge Sump at Dump Station)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	**100%**
4.75	**99%**
2.36	**98%**
1.18	**93%**
0.600	**76%**
0.425	**65%**
0.300	**52%**
0.150	**31%**
0.075	**15%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Engineering Department

Remarks: Field Moisture Content - 47.4%

NATA Accredited Laboratory Number: 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested:	JH
Checked:	DM

Dave Millard
Laboratory Manager

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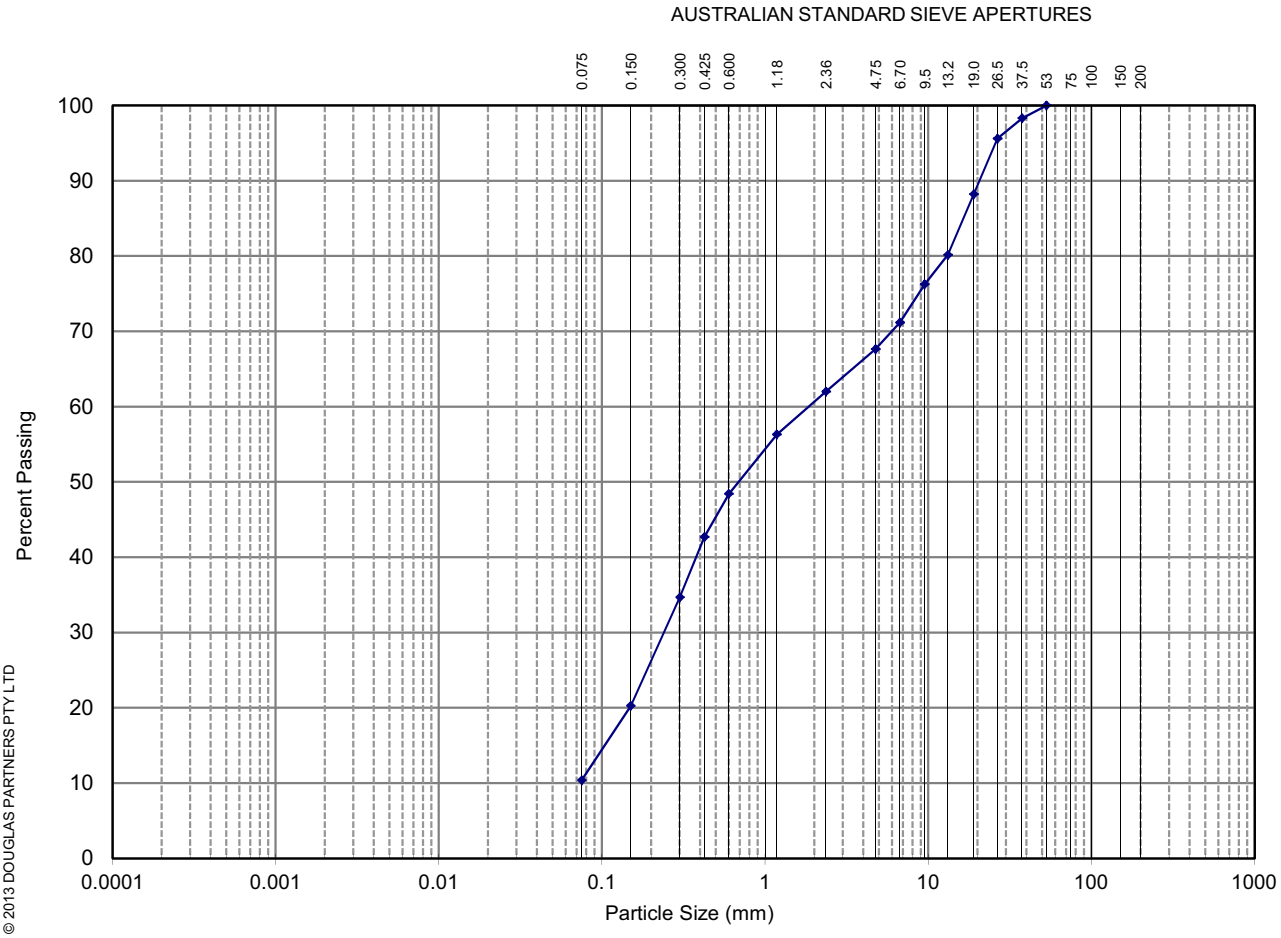
Results of Particle Size Distribution

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_2
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	2a (Upstream End of Inlet Channel)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	**100%**
37.5	**98%**
26.5	**96%**
19.0	**88%**
13.2	**80%**
9.5	**76%**
6.7	**71%**
4.75	**68%**
2.36	**62%**
1.18	**56%**
0.600	**48%**
0.425	**43%**
0.300	**35%**
0.150	**20%**
0.075	**10%**

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Engineering Department

Remarks: Field Moisture Content - 20.9%

NATA Accredited Laboratory Number: 828
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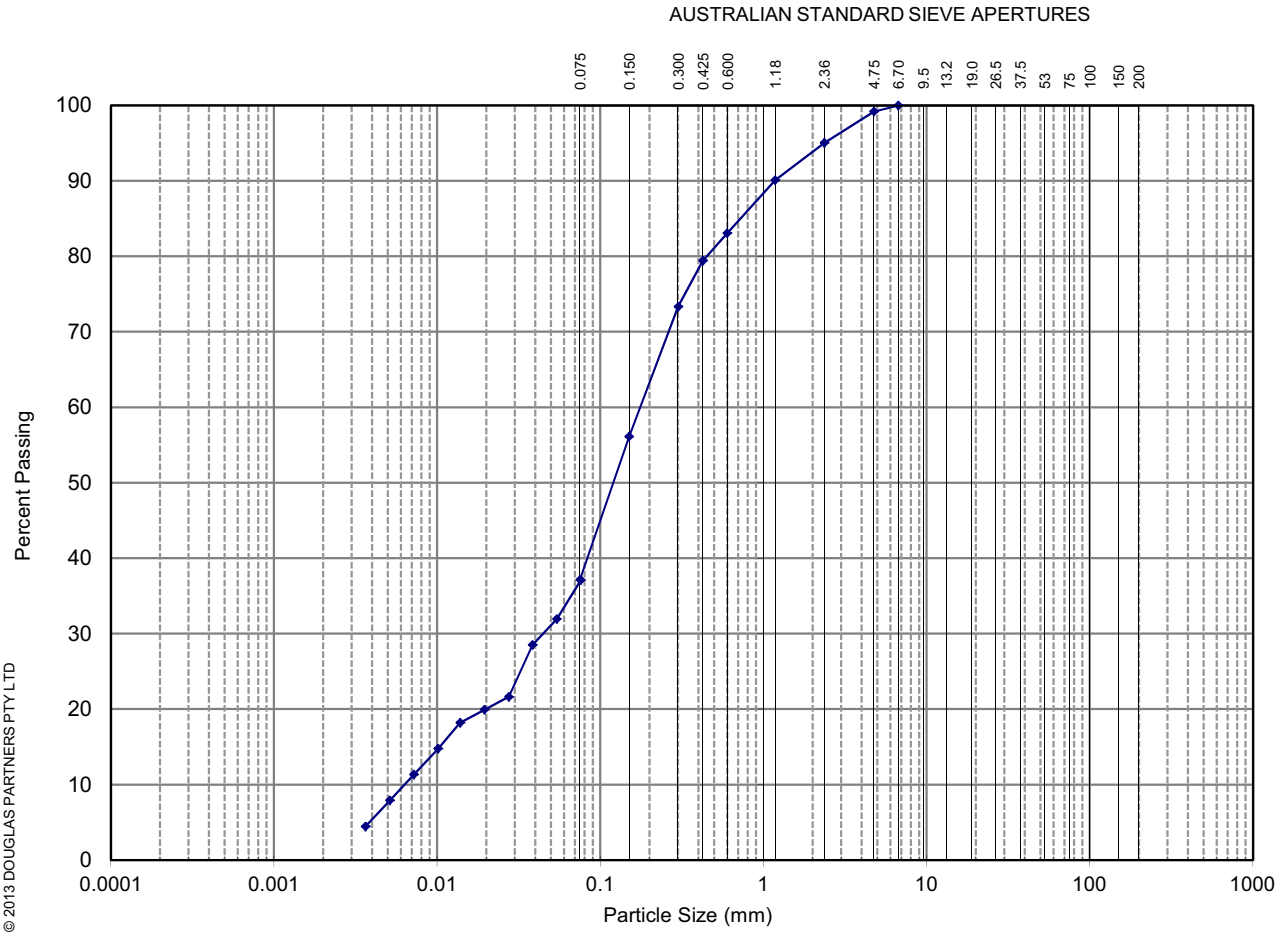
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_3
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	2b (Downstream End of Inlet Channel)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	**100%**
4.75	**99%**
2.36	**95%**
1.18	**90%**
0.600	**83%**
0.425	**79%**
0.300	**73%**
0.150	**56%**
0.075	**37%**
0.054	**32%**
0.038	**29%**
0.027	**22%**
0.019	**20%**
0.014	**18%**
0.010	**15%**
0.007	**11%**
0.005	**8%**
0.004	**4%**
#N/A	~
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 58.5%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Tested:	JH
Checked:	DM

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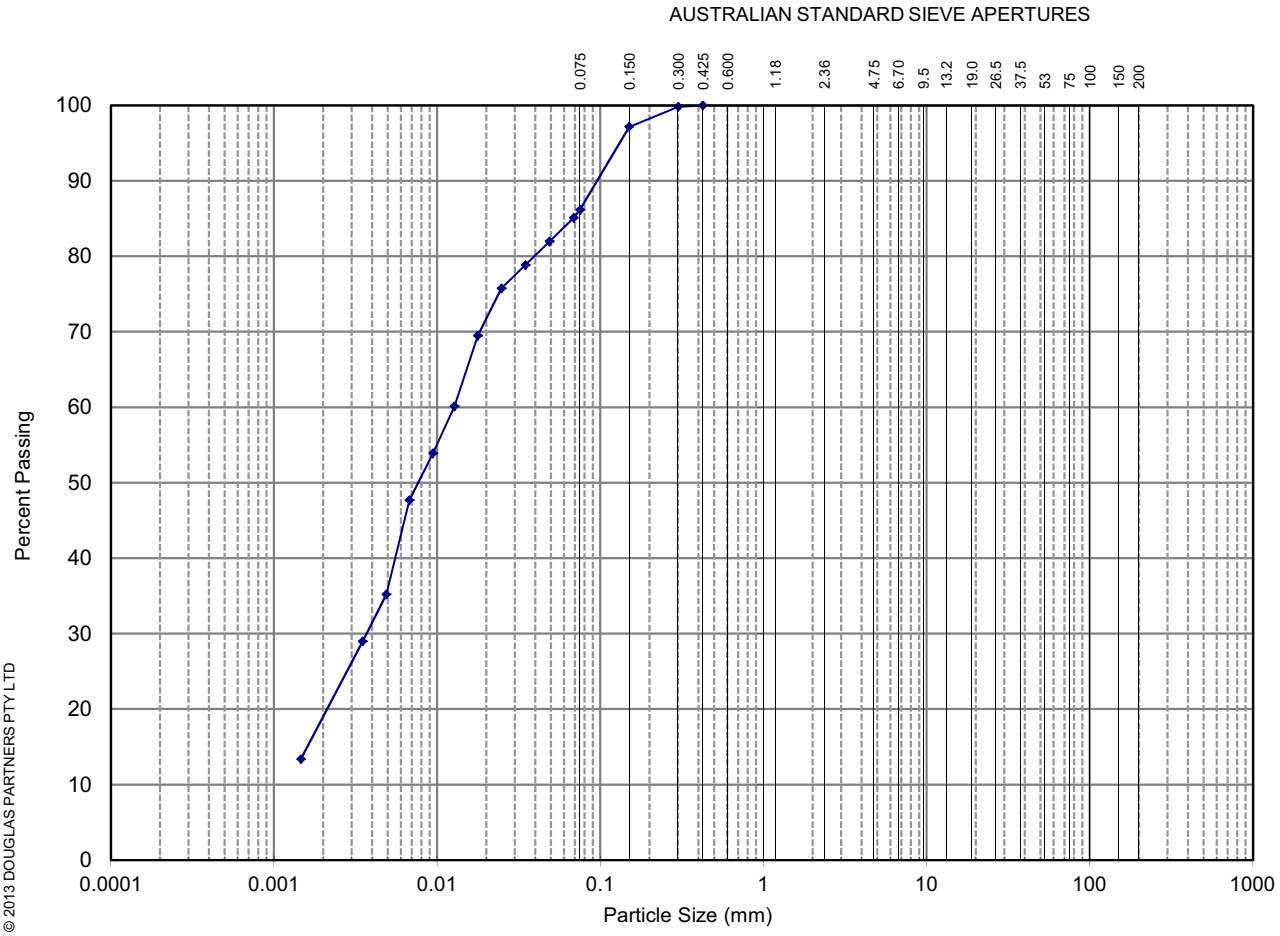
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_4
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	3a (Inlet Zone Setting Lagoon No 1)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	~
1.18	~
0.600	~
0.425	**100%**
0.300	**100%**
0.150	**97%**
0.075	**86%**
0.049	**82%**
0.035	**79%**
0.025	**76%**
0.018	**70%**
0.013	**60%**
0.009	**54%**
0.007	**48%**
0.005	**35%**
0.003	**29%**
0.001	**13%**
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 82.1%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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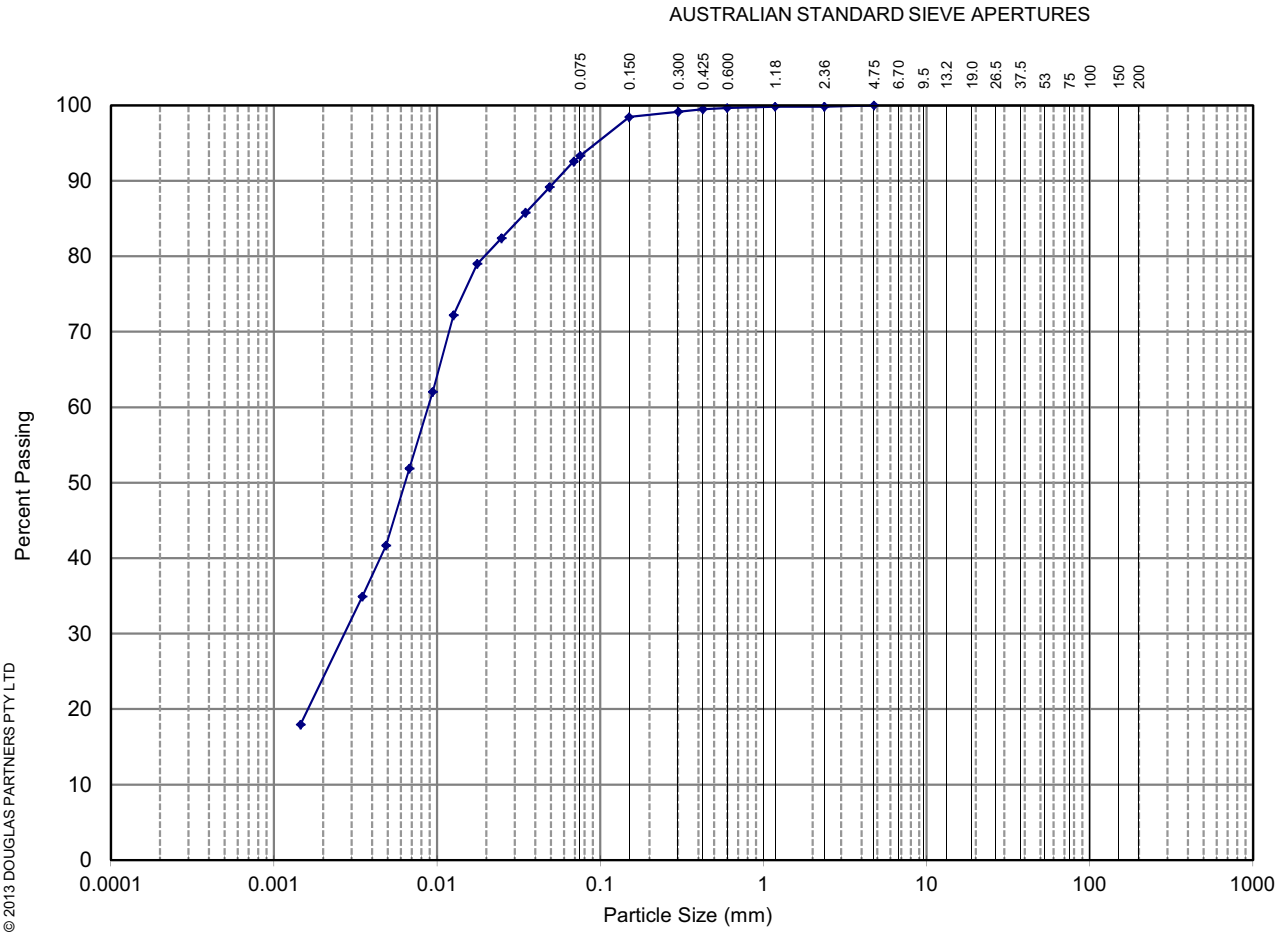
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_5
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	3b (Middle Zone Setting Lagoon No 1)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**100%**
0.600	**100%**
0.425	**99%**
0.300	**99%**
0.150	**98%**
0.075	**93%**
0.049	**89%**
0.035	**86%**
0.025	**82%**
0.018	**79%**
0.013	**72%**
0.009	**62%**
0.007	**52%**
0.005	**42%**
0.003	**35%**
0.001	**18%**
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 91.2%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Checked:	DM

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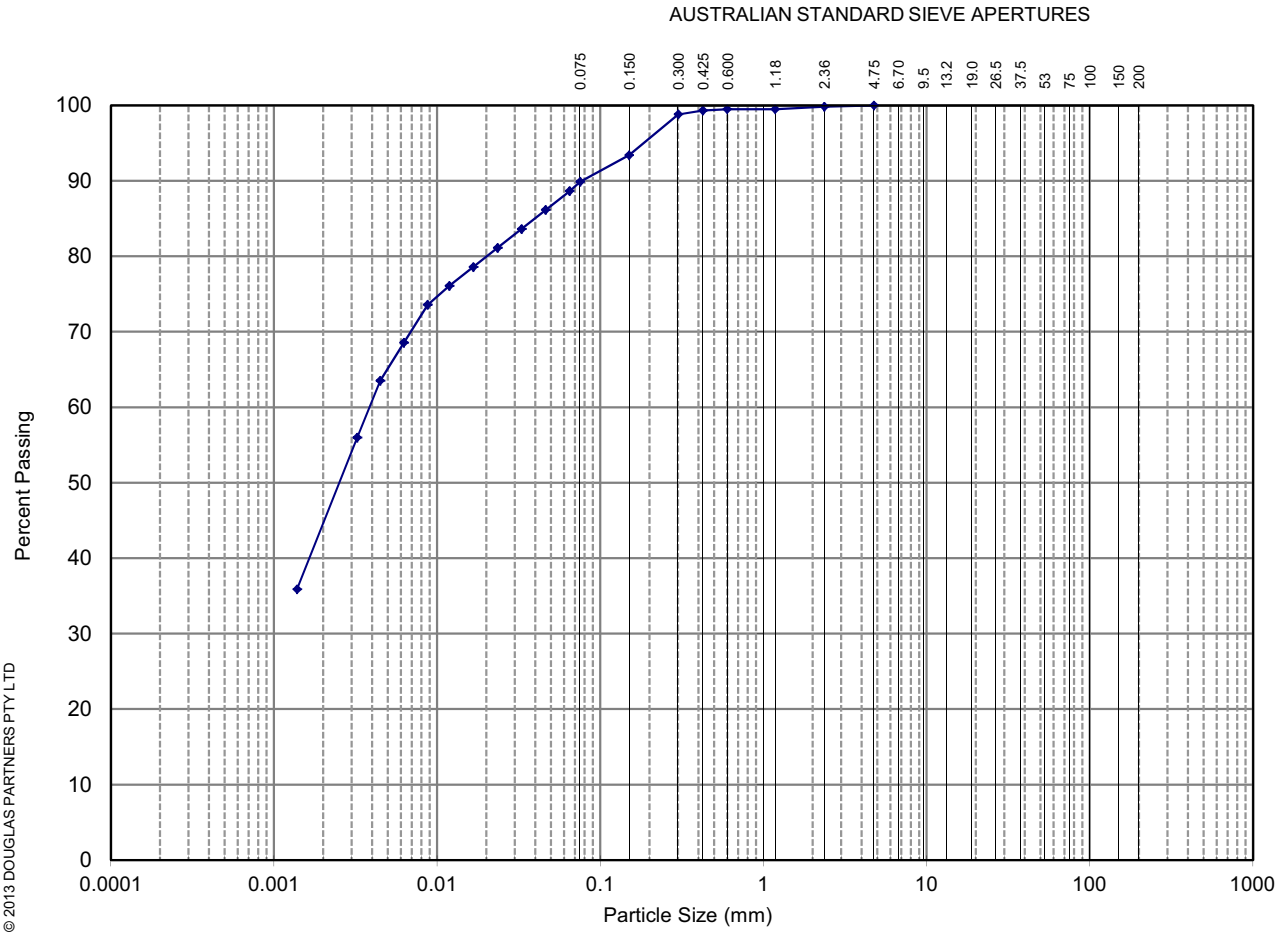
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_6
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	3c (Outlet Zone Setting Lagoon No 1)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**99%**
0.600	**99%**
0.425	**99%**
0.300	**99%**
0.150	**93%**
0.075	**90%**
0.046	**86%**
0.033	**84%**
0.023	**81%**
0.017	**79%**
0.012	**76%**
0.009	**74%**
0.006	**69%**
0.004	**64%**
0.003	**56%**
0.001	**36%**
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 191.2%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Tested:	JH
Checked:	DM

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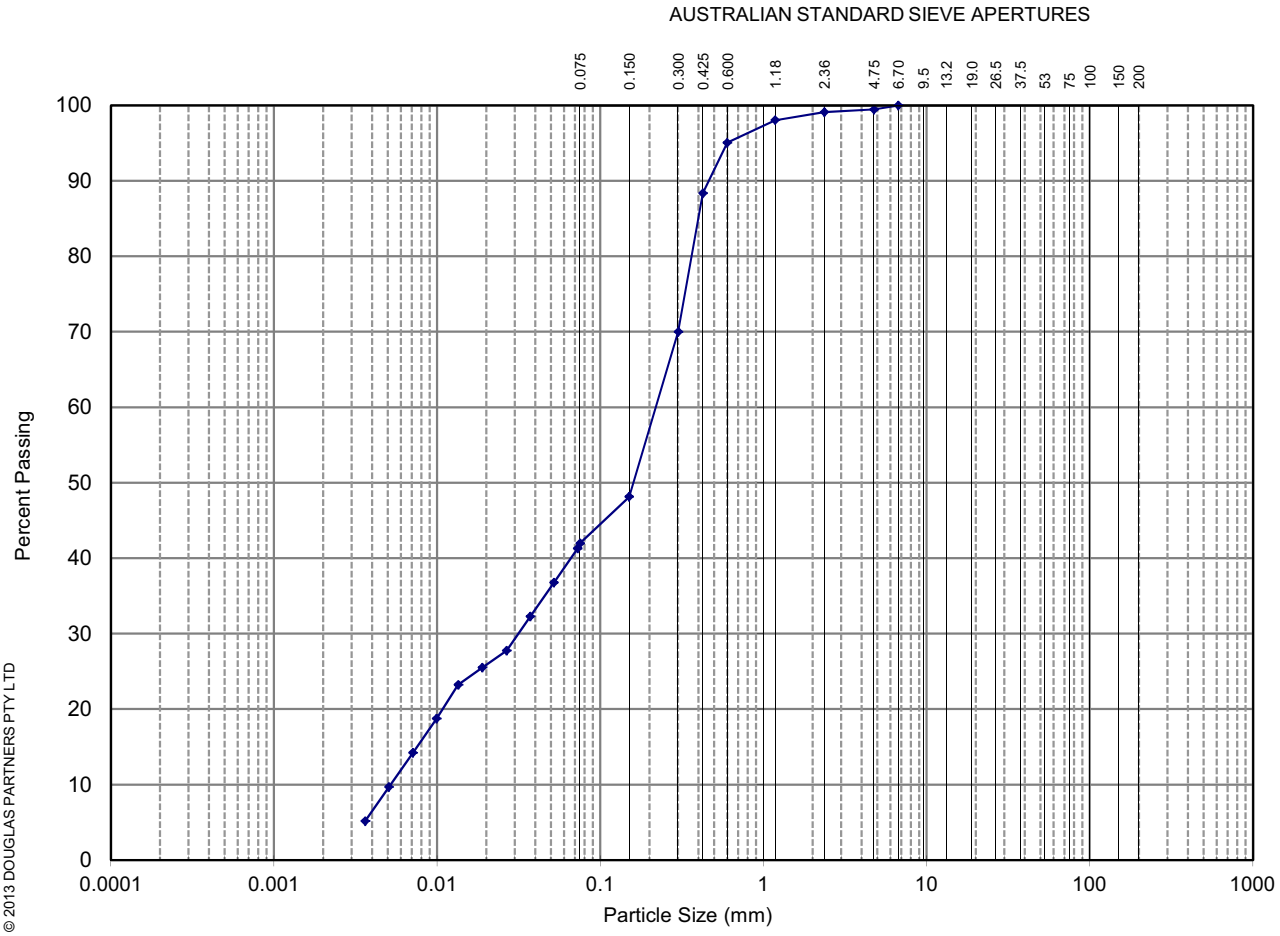
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_7
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	5 (Pump Intake Zone Flood Plain B)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	**100%**
4.75	**99%**
2.36	**99%**
1.18	**98%**
0.600	**95%**
0.425	**88%**
0.300	**70%**
0.150	**48%**
0.075	**42%**
0.052	**37%**
0.037	**32%**
0.027	**28%**
0.019	**26%**
0.013	**23%**
0.010	**19%**
0.007	**14%**
0.005	**10%**
0.004	**5%**
#N/A	~
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02		0.06	0.2	0.6	2.0	6.0	20	60

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 139.3%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
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Checked: DM

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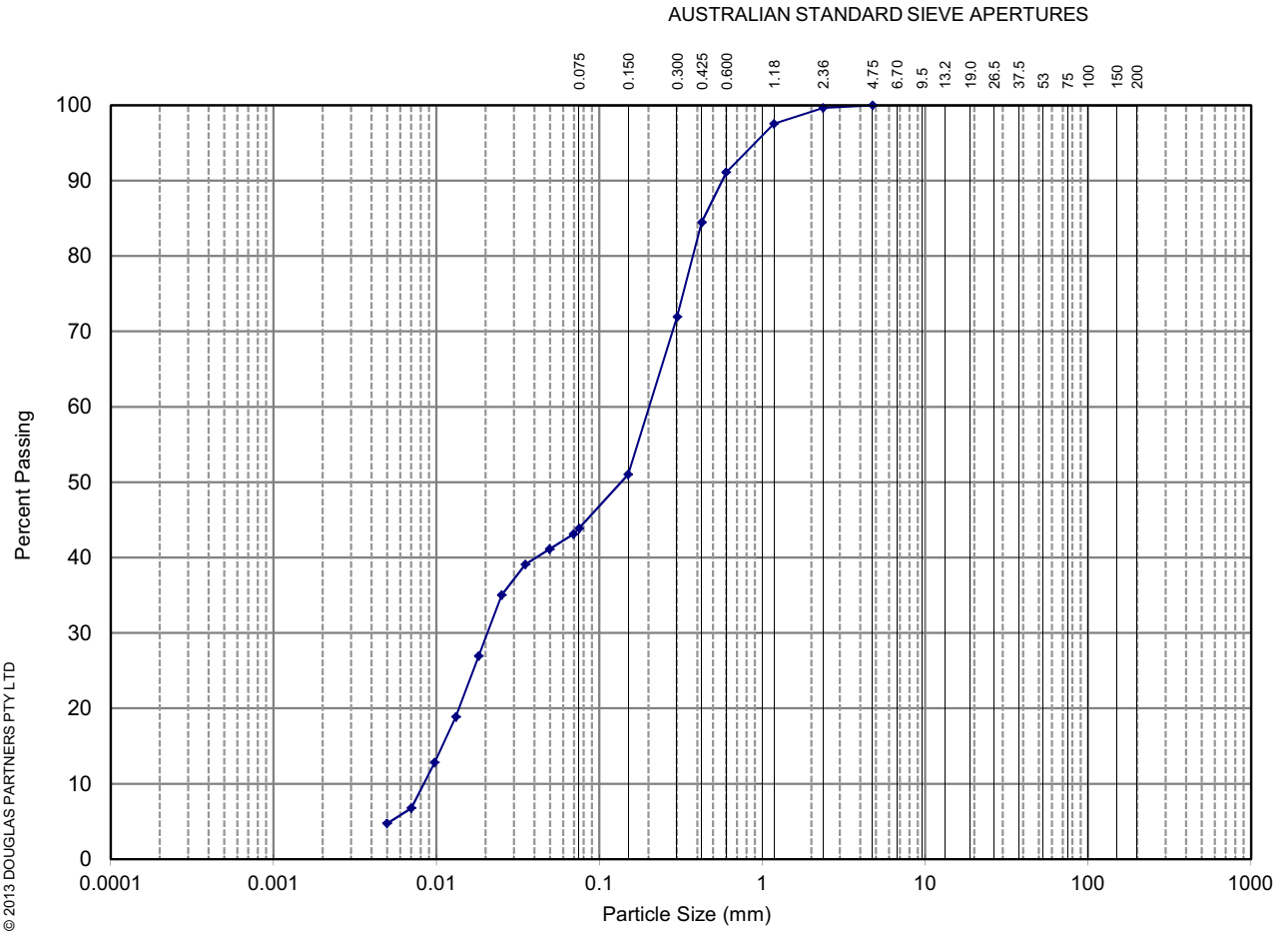
Results of Particle Size Distribution (Hydrometer)

Client :	Port Waratah Coal Services Limited	**Project No. :**	49533.16
		Report No. :	N14-009_8
Project :	Coal Sediment Particle Size	**Report Date :**	14.01.2014
Location :	-	**Date Sampled:**	19.12.2013
Test Location:	6 (Oulet Zone Flood Plain B)	**Date of Test:**	06.01.2014
Depth / Layer:	0.0-0.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	**100%**
2.36	**100%**
1.18	**98%**
0.600	**91%**
0.425	**84%**
0.300	**72%**
0.150	**51%**
0.075	**44%**
0.049	**41%**
0.035	**39%**
0.025	**35%**
0.018	**27%**
0.013	**19%**
0.010	**13%**
0.007	**7%**
0.005	**5%**
#N/A	~
#N/A	~
#N/A	~

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: COAL SEDIMENT

Test Method(s): AS 1289.3.6.1, AS 1289.3.6.3

Sampling Method(s): Sampled by DP Engineering Department

Loss in pretreatment: 0%

Remarks: Field Moisture Content - 295.5%

Type of Hydrometer: g/l

NATA Accredited Laboratory Number:828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested:	JH
Checked:	DM

Dave Millard
Laboratory Manager

APPENDIX B

Regional economic impact assessment by CGE modelling

The Regional Economic Impacts of the T4 Project in Newcastle

Glyn Wittwer
Centre of Policy Studies
Monash University

26 November 2013

TABLE OF CONTENTS

Definitions

Aggregate consumption: total household expenditure in each region deflated by CPI. Nominal household expenditure is linked to nominal labour income in the model in each region.

Aggregate investment: total investment, in real terms divided by an investment price deflator. In the model, in each industry current period capital is equal to previous period capital net of depreciation plus previous period investment.

Capital (stocks): the quantity of capital. This is summed from the industry level to the regional level using capital rental weights. The link between industry capital and industry investment is defined under "Aggregate investment".

Consumer surplus: consumer willingness to pay minus consumer expenditure

Net foreign debt: calculated at the national level, this is the stock of debt owed to foreigners minus the assets of Australians owned overseas. There is no elaborate treatment of debts and equities in the model.

Newcastle: Lower Hunter Statistical Subdivision defined as comprising the Statistical Local Areas of Newcastle, Lake Macquarie, Port Stephens, Cessnock and Maitland.

Private and public consumption: private (household) consumption and aggregate consumption are used interchangeably. Public consumption refers to current government spending, that is, non-investment expenditures.

Producer surplus: producer revenue minus producer marginal cost

Quantity: quantity of housing stocks: this is a measure of the quantity of dwellings in the model.

Real GDP: this is equal to sum of value-added in all industries (defined below) in a region plus the sum of indirect taxes in that region.

Real wage: this refers to nominal wages deflated by CPI. Each region in the model has CPI calculated separately.

Regional income: real regional income is the same as real GDP.

Rentals: this usually refers to the earnings of capital, although it could refer to the earnings of land and capital.

Terms of trade: the price of exports relative to the price of imports.

Value-added: this is the value of output exclusive of the cost of material inputs. It includes the earnings of labour, land and capital.

Welfare: a cumulative measure of the change in public and private consumption as a result of a project or policy. It is an indicator of how much better off society is with a project or policy compared to without it. It does not include non-market impacts.

Note – in reporting the variables above, reference is usually to a change in the level of a variable relative to a business-as-usual baseline. Often, % changes are reported as they do not require units. Sometimes, $ million or full-time equivalent (in the case of workers) units are used.

Executive Summary

This study models the potential economic impacts of the construction and operations of the proposed T4 Project in Newcastle. Dynamic TERM, a computable general equilibrium model, is used in this study. The model represents Newcastle, the rest of Hunter, the rest of New South Wales and the rest of Australia as four distinct regions. However, the focus of the study is on Newcastle's economy.

The total construction expenditure is $4.8 billion (2011 dollars), with most costs being incurred in year 3 ($0.9 billion), year 4 ($1.7 billion) and year 5 ($1.3 billion). Operation of the Project is modelled until year 24.

The Project has not been modeled in isolation because it is being constructed in anticipation of expansion in coal mining output in and beyond the Hunter Valley. Although this study does not concentrate on the expansion of coal mining in other regions, concurrent expansion is part of the modeled scenario. This is because the T4 Project is part of the necessary supporting infrastructure for expanded coal mining output in the rest of New South Wales.

During the construction of the T4 Project, employment rises to a peak of 1% or 2,500 jobs above forecast in year 4. In year 5, employment moves back towards forecast as real wages continue to rise. In year 6, with real wages at 1.1% above forecast in Newcastle, employment falls slightly below forecast as T4 construction expenditure winds down. With the T4 Project operating at full capacity from year 10 on, employment remains 0.2 to 0.4% or 500 to 1,000 jobs above forecast.

Aggregate household consumption remains above forecast in Newcastle in all years of the scenario, peaking at almost 2% above forecast in year 6. Thereafter, due to a combination of real wages which remain above forecast and employment which returns to above forecast from year 7, aggregate consumption persists at around 1.5 to 2.0 % above forecast.

The welfare calculation includes the impacts of both coal mine expansion in New South Wales and the construction and operation of the T4 Project, as the latter is supporting infrastructure. At a 4% discount rate, the net present value of the welfare impact is $55 billion. At a 7% discount rate, the impact is $35 billion and at a 10% discount rate, it is $22 billion.

1.0 Introduction

1.1 Background

This study models the potential economic impacts of the construction and operations of the proposed T4 coal loading facility (the T4 Project) in Newcastle using Dynamic TERM, a computable general equilibrium (CGE) model. The scenario modelled is as per the assumptions used in the benefit cost analysis and input-output analysis undertaken for the Preferred Project Report of the Modified Design. That is, for modelling purposes it is assumed that throughput commences after the construction of a nominal terminal capacity of 70 million tonnes per annum (Mtpa) (referred to as Stage 1 in the Environmental Assessment). However, in reality staging and size of staging will be subject to demand and commercial requirements.

The T4 Project is being constructed in anticipation of expanded coal mining output in and beyond the Hunter Valley. The construction phase of the T4 Project, which will cost an expected $4.8 billion from year 1 to year 6, will have substantial impacts on the local economy of Newcastle. The temporary jump in demand for labour during the construction of the T4 Project will occur as coal mines are being expanded elsewhere in New South Wales.

While the results reported in this study concentrate on the impacts on Newcastle of the T4 Project, it is appropriate to include the construction and operational phases of expanded coal mines in the rest of New South Wales in the scenario at the same time. This is because the T4 Project is being built in response to coal mine expansion. The T4 Project will be competing for labour with coal mines during the construction phase. During the operational phase, the T4 Project will be used to load additional coal in preparation for export. Consequently, the T4 Project will remove a constraint on expansion of coal exports.

1.2 The baseline and the policy scenario

Dynamic TERM uses a baseline that includes an underlying forecast for the economy of Australia. Although the model is multi-regional, the regional forecasts are driven by the industrial structure of each region, without any information on forecast regional demographics or migration.

The policy scenario includes the underlying productivity, endowment and demand shifts of the forecast baseline, but adds specific shocks to depict the scenario. This scenario includes the construction of the T4 Project in Newcastle and additional coal mining in the Hunter Valley and elsewhere. In the policy scenario, the construction phase for the T4 Project proceeds from year 1 to year 6. From year 6, expanded coal exports moved through T4 commence. In year 6, an additional 5 million tonnes (mt) of coal are produced for export in the state. This rises to 15 mt in year 7, 40 mt in year 8 and 62 mt in year 9 before plateauing at 70 mt in year 10. This scale of operations continues through to year 24.

The modelling results provide the impacts of the policy scenario *relative to the forecast baseline* in the form of cumulative deviations from the forecast baseline.

2.0 Model Results

2.1 Results

Dynamic TERM includes a theory of labour market adjustment that includes sticky wages (refer to Appendix 1). Since there is a strengthening of Newcastle's labour market relative to forecast during construction of the T4 Project, real wages rise over time relative to what they would be otherwise. The expansion of coal mines elsewhere in New South Wales further strengthens Newcastle's labour market.

Employment in Newcastle rises to 0.26% or around 600 jobs above forecast in year 2, when construction expenditure exceeds $380 million. In year 3, when expenditure rises to over $900 million, Newcastle's employment rises to 0.75% or around 1,800 jobs above forecast. At the same time, real wages in Newcastle rise to 0.5% above forecast, subduing additional jobs growth. A further increase in construction expenditure to almost $1.7 billion in year 4 is accompanied by employment rising to 1.03% or 2,500 jobs above forecast, with real wages rising further to 0.95% above forecast. In year 5, construction expenditure falls to $1.3 billion, but employment moves back towards forecast, to 0.5% above forecast as it was in year 3 when construction expenditure was smaller (i.e. $0.9 billion in year 3 compared with $1.7 billion in year 5).

With the assumption of sticky wages, there is no immediate adjustment in year 6 when construction expenditure falls to $475 million. Consequently, with real wages persisting at 0.9% above forecast, Newcastle's employment falls below forecast (-0.06% or around 150 jobs) in year 6. Thereafter, the labour market strengthens slightly again as throughput at the T4 Project increases. Over time, real wages move slightly further above forecast, plateauing at 1.5% above forecast (Figure 1).

Figure 1: Newcastle labour market (% change relative to forecast)

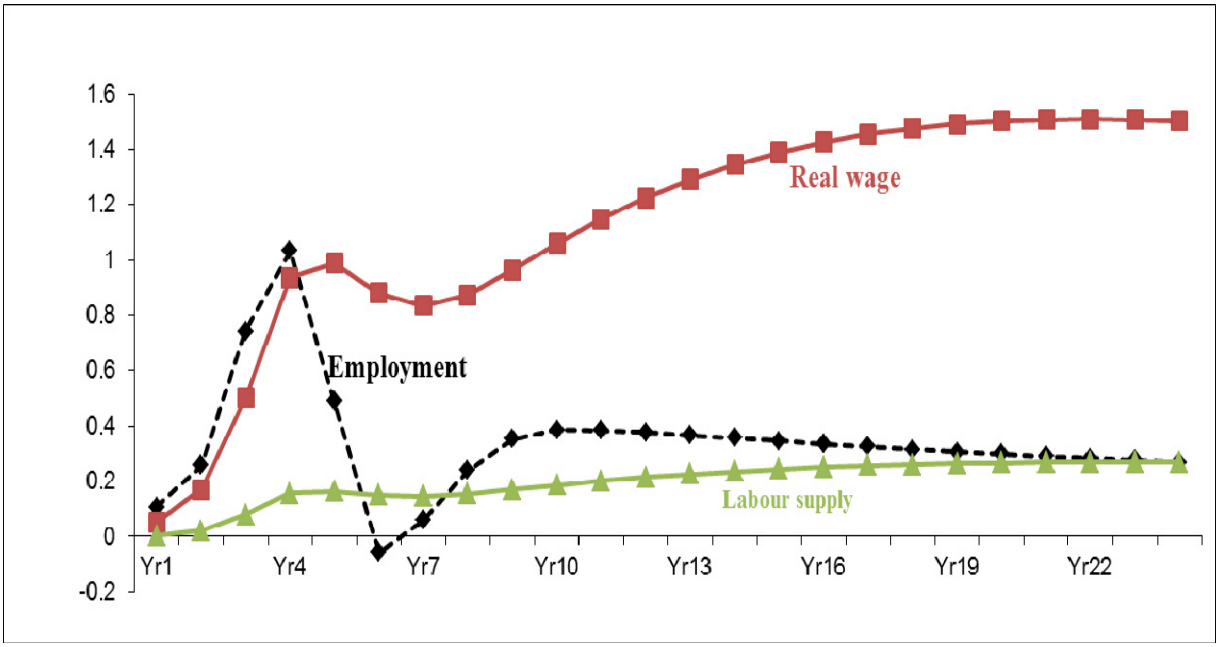
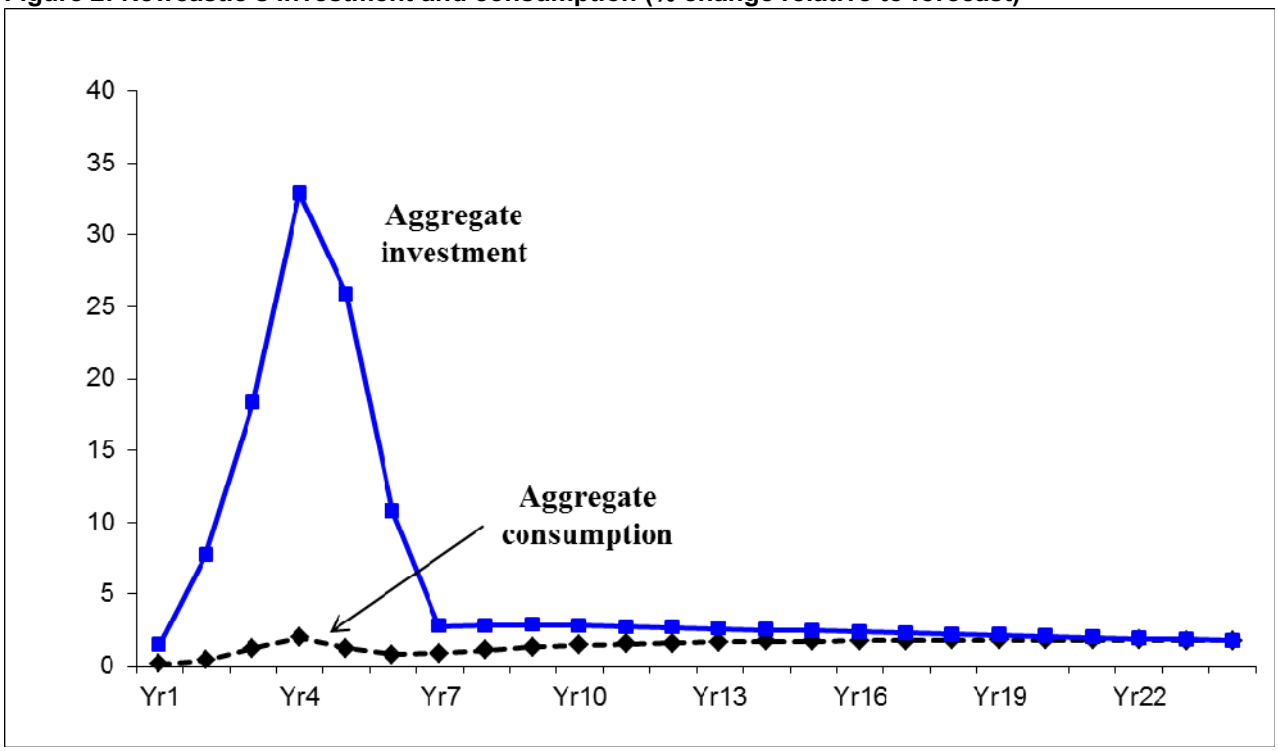
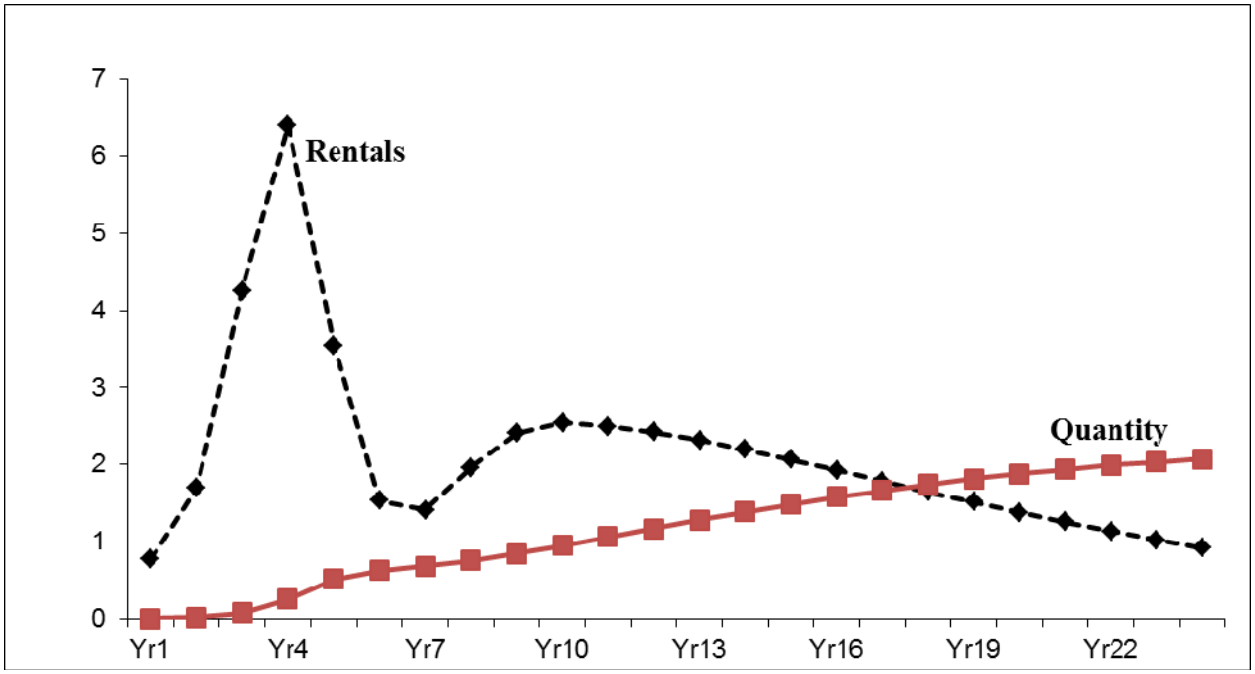


Figure 2: Newcastle's investment and consumption (% change relative to forecast)



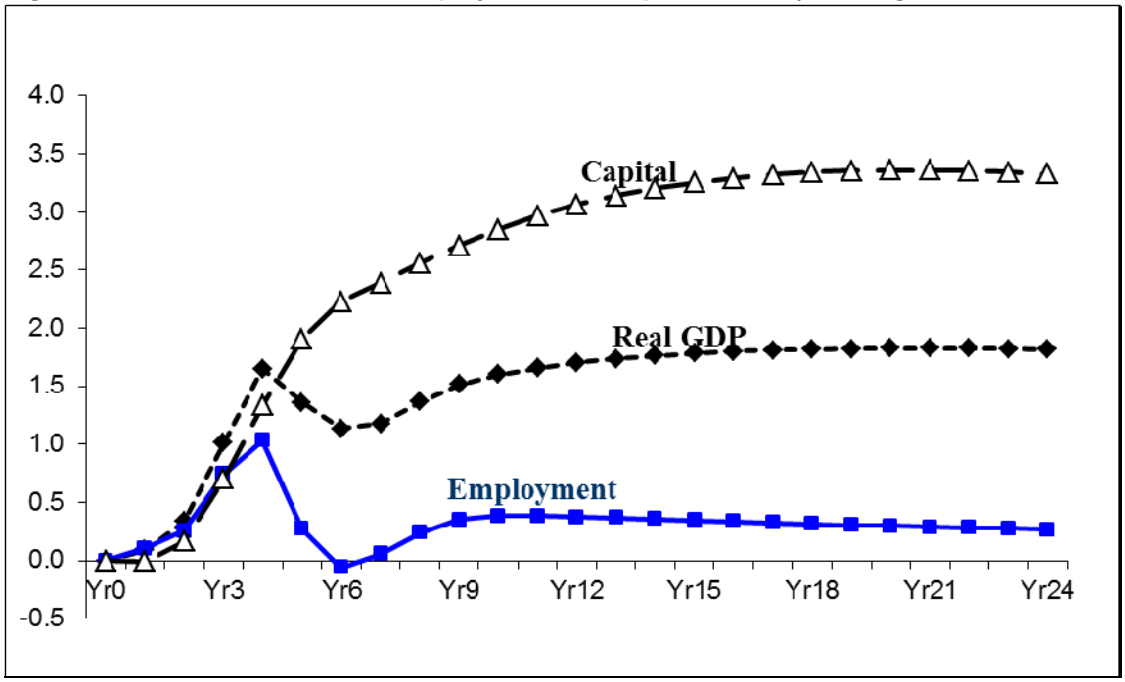
The size of the T4 Project construction relative to the Newcastle economy is reflected in Figure 2. Investment peaks in year 4 at more than 30% above forecast. Aggregate consumption peaks in the same year at almost 2% above forecast. During the operational phase of the T4 Project, aggregate consumption persists at around 1.5% above forecast.

Figure 3: Newcastle's housing rentals (% change relative to forecast)



The construction phase has an impact on Newcastle's housing rentals. At the peak of the T4 Project investment phase in year 4, rentals are more than 6% above forecast, before dropping as the T4 Project investment winds down and finishes. The housing market is strengthened during the operational phase of the T4 Project. Since housing stocks are assumed to adjust slowly, housing rentals persist above forecast throughout the time period of the simulation.

Figure 4: Newcastle's real GDP, employment and capital stocks (% change relative to forecast)



Newcastle's real GDP rises during the construction phase of the T4 Project driven mainly by the jump in employment. During the operational phase, the contribution of increased capital stocks makes a more substantial contribution to increased real GDP than employment.

Table 1 shows the percentage deviation in output by industry year-by-year in Newcastle. Table 2 shows the corresponding results for output on a value-added basis ($m, 2011 dollars).

As expected, other construction activity dominates the industry results during the construction phase. As the T4 Project operations scale up from year 6 to year 10, rail transport and other transport (which includes the T4 Project) activity increase relative to forecast. Some service industry demands are driven mainly by household consumption. These industries include hotels & cafes, trade and ownership of dwellings. Although their outputs remain above forecast in Newcastle throughout the scenario, higher than baseline real wages (with the exception of ownership of dwellings which uses no labour) subdue further output growth.

Table 1: Newcastle's outputs (% deviation from forecast)

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10	Yr11	Yr12	Yr13	Yr14	Yr15	Yr16	Yr17	Yr18	Yr19	Yr20	Yr21	Yr22	Yr23	Yr24
Livestock	-0.1	-0.3	-0.8	-1.5	-1.5	-1.1	-0.9	-1.0	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.0	-1.0	-1.0	-1.0	-0.9	-0.9	-0.9	-0.9
Crops	-0.1	-0.2	-0.5	-0.9	-0.8	-0.6	-0.6	-0.7	-0.8	-0.8	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
Grapes	-0.1	-0.2	-0.5	-0.8	-0.8	-0.7	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
OtherAgriclt	0.0	-0.1	-0.3	-0.6	-0.6	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2
AgrSrvFisFor	-0.1	-0.4	-0.9	-1.6	-1.6	-1.3	-1.2	-1.3	-1.4	-1.4	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5	-1.4	-1.4	-1.4	-1.4	-1.3	-1.3
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	1.0	1.3	1.5	1.8	2.1	2.3	2.5	2.7	2.9	3.1	3.2	3.4	3.5	3.6	3.8	3.9
OthMining	0.0	-0.3	-1.1	-2.2	-3.2	-3.9	-3.8	-3.2	-2.8	-2.3	-2.0	-1.6	-1.2	-0.9	-0.6	-0.4	-0.1	0.1	0.3	0.6	0.7	0.9	1.1	1.2
FoodPrds	-0.1	-0.4	-1.1	-2.0	-1.7	-1.3	-1.1	-1.0	-1.0	-0.9	-0.9	-0.8	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.3	-0.3
WineSpirits	-0.2	-0.5	-1.0	-1.8	-2.2	-2.2	-2.0	-1.8	-1.7	-1.6	-1.5	-1.4	-1.2	-1.1	-1.0	-0.9	-0.9	-0.8	-0.7	-0.6	-0.6	-0.5	-0.4	-0.4
OtherManuf	-0.2	-0.4	-0.8	-1.2	-0.9	-0.7	-0.7	-0.6	-0.7	-0.7	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	-0.5	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3
OtherMachnry	-0.4	-0.8	-2.2	-3.8	-3.1	-2.2	-2.1	-2.4	-2.7	-2.8	-2.9	-2.9	-2.8	-2.8	-2.8	-2.7	-2.7	-2.6	-2.6	-2.5	-2.5	-2.4	-2.3	-2.2
ElecCoal	0.0	-0.3	-1.0	-2.0	-2.3	-2.0	-1.1	0.3	1.4	2.1	2.5	2.8	3.1	3.4	3.6	3.8	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7
ElectricSup	0.0	-0.1	0.0	0.0	-0.3	-0.1	0.3	0.6	0.9	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.7
GasWaterSup	0.0	0.0	0.1	0.2	-0.1	-0.2	0.1	0.4	0.7	0.9	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
ResConSrv	-0.4	-1.5	-2.1	-3.9	-4.4	-1.2	1.9	2.8	3.5	4.0	4.2	4.4	4.4	4.4	4.3	4.3	4.2	4.1	4.0	3.8	3.7	3.6	3.5	3.4
OthConstruct	0.2	2.5	9.1	14.2	12.1	13.3	15.5	15.3	15.0	14.6	14.2	13.8	13.4	13.1	12.8	12.6	12.4	12.3	12.1	12.0	11.9	11.9	11.8	11.8
Trade	0.3	0.8	1.9	3.1	2.5	1.3	0.8	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1
HotelsCafes	0.1	0.3	0.9	1.4	0.7	0.3	0.5	0.8	1.1	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.7
RoadTransprt	0.0	-0.1	-0.3	-0.5	-0.3	-0.3	0.0	0.9	1.6	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.7	1.7	1.7
RailTransprt	-0.4	-0.9	-1.9	-3.2	-2.9	-1.5	0.2	2.6	4.7	5.3	5.4	5.3	5.3	5.3	5.3	5.3	5.3	5.2	5.2	5.2	5.2	5.3	5.3	5.3
OthTransport	0.0	4.1	22.1	40.6	51.1	52.8	51.6	49.7	47.9	46.0	44.2	42.5	40.8	39.3	37.8	36.4	34.9	33.5	32.1	30.8	29.5	28.2	26.9	25.7
Communicatn	0.0	0.0	0.3	0.5	0.3	0.4	0.7	1.0	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.7	1.8	1.8	1.8	1.8	1.8	1.8	1.8
BusinessSrv	0.0	0.1	0.2	0.4	0.4	0.4	0.4	0.7	0.8	1.0	1.1	1.1	1.2	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.3
OwnerDwellng	0.0	0.0	0.1	0.3	0.5	0.6	0.7	0.8	0.8	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.0	2.1
GovAdm	0.1	0.1	0.3	0.4	0.4	0.4	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6
Defence	0.2	0.2	0.3	0.4	0.3	0.1	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Education	0.1	0.0	-0.3	-0.7	-0.7	-0.6	-0.5	-0.5	-0.4	-0.4	-0.5	-0.5	-0.6	-0.6	-0.7	-0.7	-0.8	-0.8	-0.9	-0.9	-0.9	-1.0	-1.0	-1.0
Health	0.2	-0.1	-0.7	-1.5	-1.2	-1.0	-0.8	-0.6	-0.5	-0.4	-0.4	-0.5	-0.5	-0.5	-0.5	-0.5	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
OtherSvc	0.1	0.0	-0.2	-0.6	-0.6	-0.6	-0.4	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2

Table 2: Newcastle's outputs ($m real value-added deviation from forecast)

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10	Yr11	Yr12	Yr13	Yr14	Yr15	Yr16	Yr17	Yr18	Yr19	Yr20	Yr21	Yr22	Yr23	Yr24
Livestock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OtherAgriclt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AgrSrvFisFor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coal	0	0	0	0	0	0	2	8	13	17	22	26	30	35	39	43	47	51	55	59	63	67	71	75
OthMining	0	0	-1	-2	-3	-4	-4	-4	-4	-3	-3	-2	-2	-2	-1	-1	0	0	1	1	2	2	3	3
FoodPrds	0	-1	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
WineSpirits	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	0	0	0	0	0
OtherManuf	-2	-4	-9	-15	-11	-9	-9	-10	-10	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11	-11
OtherMachnry	0	-1	-3	-6	-5	-4	-4	-5	-6	-7	-7	-8	-8	-9	-9	-9	-10	-10	-10	-11	-11	-11	-11	-11
ElecCoal	0	0	-1	-1	-1	-1	-1	0	1	2	2	2	3	3	4	4	4	5	5	6	6	7	8	8
ElectricSup	0	0	0	0	0	0	0	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4	4	5
GasWaterSup	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4	4	4	5	5	5	6	6	6	6
ResConSrv	0	-2	-3	-5	-6	-2	3	5	6	8	9	10	11	11	12	13	13	14	14	15	16	16	17	17
OthConstruct	1	16	59	97	90	108	137	146	156	165	175	185	196	209	223	240	258	278	302	328	357	390	427	468
Trade	5	18	43	72	60	34	21	27	33	37	41	44	47	51	54	58	61	65	69	73	77	82	87	91
HotelsCafes	1	2	5	8	4	2	4	6	9	11	13	16	18	20	22	24	26	28	30	32	34	36	39	41
RoadTransprt	0	0	0	-1	0	0	0	2	3	4	4	4	4	5	5	5	5	5	6	6	6	6	7	7
RailTransprt	0	-1	-2	-3	-3	-1	0	3	5	6	6	6	6	6	6	6	6	7	7	7	7	7	7	8
OthTransport	0	7	39	72	94	101	103	104	105	107	108	110	112	114	116	119	122	124	126	129	131	133	136	138
Communicatn	0	0	1	1	1	1	2	3	4	5	5	6	7	8	8	9	10	11	11	12	13	14	15	16
BusinessSrv	1	4	9	17	19	17	22	34	46	57	66	75	84	92	100	108	116	124	131	139	147	155	163	171
OwnerDwellng	0	1	2	9	19	25	29	35	41	49	58	69	80	92	105	119	133	149	165	181	199	217	236	256
GovAdm	0	0	1	1	1	1	2	2	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5
Defence	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Education	1	0	-4	-9	-9	-9	-8	-7	-7	-8	-10	-11	-13	-16	-18	-20	-23	-26	-30	-33	-37	-41	-45	-50
Health	2	-1	-9	-18	-15	-15	-12	-10	-8	-8	-9	-10	-11	-13	-14	-16	-18	-20	-21	-23	-25	-27	-30	-32
OtherSvc	1	0	-2	-5	-6	-7	-5	-2	-1	0	0	0	0	0	-1	-1	-2	-2	-3	-3	-4	-4	-5	-6
Total	10	38	124	210	225	235	280	337	389	434	475	516	558	603	648	697	748	802	859	919	984	1053	1127	1206

Table 3: Newcastle's employment (FTE deviation from forecast)

	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10	Yr11	Yr12	Yr13	Yr14	Yr15	Yr16	Yr17	Yr18	Yr19	Yr20	Yr21	Yr22	Yr23	Yr24
Livestock	0	-1	-1	-2	-1	-1	0	0	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
Crops	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grapes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OtherAgriclt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AgrSrvFisFor	0	-1	-2	-3	-3	-2	-1	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-1	-1
Coal	-22	-48	-107	-174	-161	-127	-112	-110	-111	-102	-88	-75	-63	-53	-43	-34	-26	-19	-12	-6	-1	3	8	11
OthMining	-1	-5	-16	-31	-32	-31	-27	-24	-21	-19	-16	-14	-12	-10	-8	-6	-5	-3	-2	-1	0	2	3	4
FoodPrds	-4	-13	-32	-54	-42	-27	-20	-20	-21	-21	-20	-20	-19	-18	-18	-17	-17	-16	-16	-15	-15	-14	-14	-13
WineSpirits	-1	-2	-5	-8	-7	-5	-5	-5	-5	-5	-5	-4	-4	-4	-4	-4	-3	-3	-3	-3	-3	-3	-3	-3
OtherManuf	-58	-101	-217	-319	-203	-140	-139	-149	-167	-173	-171	-169	-167	-165	-162	-159	-155	-152	-148	-144	-140	-137	-133	-130
OtherMachnry	-12	-26	-73	-129	-96	-55	-60	-76	-92	-98	-100	-100	-101	-101	-101	-100	-99	-97	-95	-93	-90	-87	-84	-81
ElecCoal	0	-4	-10	-18	-16	-8	3	17	27	31	31	32	32	32	33	33	33	33	34	34	34	34	34	35
ElectricSup	-1	-1	4	7	4	11	20	24	27	29	30	31	31	32	33	33	33	34	34	35	35	35	35	36
GasWaterSup	2	3	11	16	11	13	18	18	18	17	15	14	12	11	10	10	9	8	8	7	7	6	6	6
ResConSrv	-12	-45	-59	-106	-117	-17	78	92	104	110	112	114	114	114	113	112	111	110	108	107	105	103	101	99
OthConstruct	31	221	1064	1624	95	-286	-50	-25	-5	9	20	30	40	49	59	69	79	89	100	111	123	136	149	162
Trade	150	471	1064	1724	1300	647	323	409	474	499	503	505	506	506	505	504	503	502	500	499	498	496	495	493
HotelsCafes	21	49	147	224	130	91	111	130	145	150	149	148	146	144	142	141	139	137	135	133	132	130	129	127
RoadTransprt	-2	-4	-9	-15	-10	-8	1	28	48	52	49	47	45	43	42	40	39	39	38	37	37	36	35	35
RailTransprt	-11	-23	-44	-69	-56	-22	13	59	96	104	100	96	92	89	86	83	80	78	76	74	72	70	68	66
OthTransport	0	27	114	110	65	45	48	60	73	79	82	87	91	97	102	108	113	119	124	128	132	136	139	142
Communicatn	2	5	31	48	38	50	69	74	78	79	78	78	77	76	75	73	72	71	70	68	67	66	64	63
BusinessSrv	30	100	242	397	404	322	314	387	425	432	428	423	419	415	411	408	405	402	398	396	393	390	387	384
OwnerDwellng	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GovAdm	9	10	20	27	31	31	40	48	54	55	55	55	54	53	52	51	50	49	49	48	47	46	45	44
Defence	6	7	11	14	11	6	7	10	13	14	14	14	13	13	13	13	12	12	12	12	11	11	11	11
Education	29	-9	-103	-220	-199	-179	-138	-111	-98	-102	-112	-124	-137	-151	-164	-177	-189	-200	-210	-220	-228	-236	-242	-247
Health	58	-16	-218	-438	-348	-315	-253	-191	-150	-143	-152	-165	-179	-193	-207	-221	-234	-246	-257	-268	-278	-287	-295	-303
OtherSvc	34	8	-49	-124	-136	-138	-90	-42	-8	4	5	4	1	-3	-8	-13	-18	-23	-28	-33	-38	-43	-47	-52
Total	247	603	1763	2483	663	-146	149	602	900	999	1005	1001	989	975	960	945	932	921	911	903	897	893	890	888

2.2 Welfare impacts

In a partial equilibrium framework (e.g. benefit cost analysis), welfare is calculated as the sum of producer and consumer surpluses. In a CGE model, producers and consumers are connected. Increased industry value-added adds to regional income, which feeds into the consumption function that links income to household spending, and therefore links producers and consumers. There is not necessarily a proportional link between real income and real spending, as they have different price deflators (the GDP deflator for real income and the CPI for household spending). If the terms of trade deteriorate, real consumption will shrink relative to real GDP.

The welfare impact of the Project is calculated only on the Project operations and associated coal mining expansion, without any consideration of other effects such as environmental impacts. Welfare(dWELF) is calculated at the national level as the net present value of the year-on-year deviations in private and public consumption at the national level, minus the real discounted change in net foreign debt in the final year of the simulation (year 2035):

$$\mathrm{dWELF} = \sum_{d}\sum_{t} \frac{\mathrm{dCON}(d,t) + \mathrm{dGOV}(d,t)}{(1-r)^{t}} - \frac{\mathrm{dNFL}(z)}{(1-r)^{z}}$$

Where: dCON and dGOV are the deviations in real household and government spending in region *d* and year *t*;
dNFL is the deviation in real net foreign liabilities in the final year (*z*) of the simulation; and
r is the discount rate.

At the national level, welfare impacts depend on the discount rate and on baseline assumptions about the export price of coal. The increase in Australia's welfare as a consequence of the coal mining development in NSW accompanied by the T4 Project construction and operation is $55 billion at a 4% discount rate, $35 billion at a 7% discount rate and $22 billion at a 10% discount rate (2011 dollars).

Appendix 1 - Dynamic TERM

Figure A1: Statistical sub-divisions in NSW outside Sydney that can be represented in TERM.

1	Sydney (splits possible)	21	UpDarling
2	Lower Hunter	22	Bathurst
3	Hunter	23	CentTble
4	Wllngng	24	Lachlan
5	NwraBmdr	25	Orange
6	IllawrraB	26	Qunbeyan
7	TwdHdsT	27	STblelnd
8	Lismore	28	LwrSthCst
9	RchmndTw	29	Snowy
10	CffsHrbr	30	Wagga
11	PtMcquari	31	CentMrmb
12	Clarence	32	LMrmb
13	Hastings	33	Albury
14	Tamworth	34	UpMrry
15	NthnSlopes	35	CentMrry
16	NthnTablelands	36	MrryDrlng
17	NorthCentral	37	FarWest
18	Dubbo		
19	CentMacqu		
20	McqrieBar		

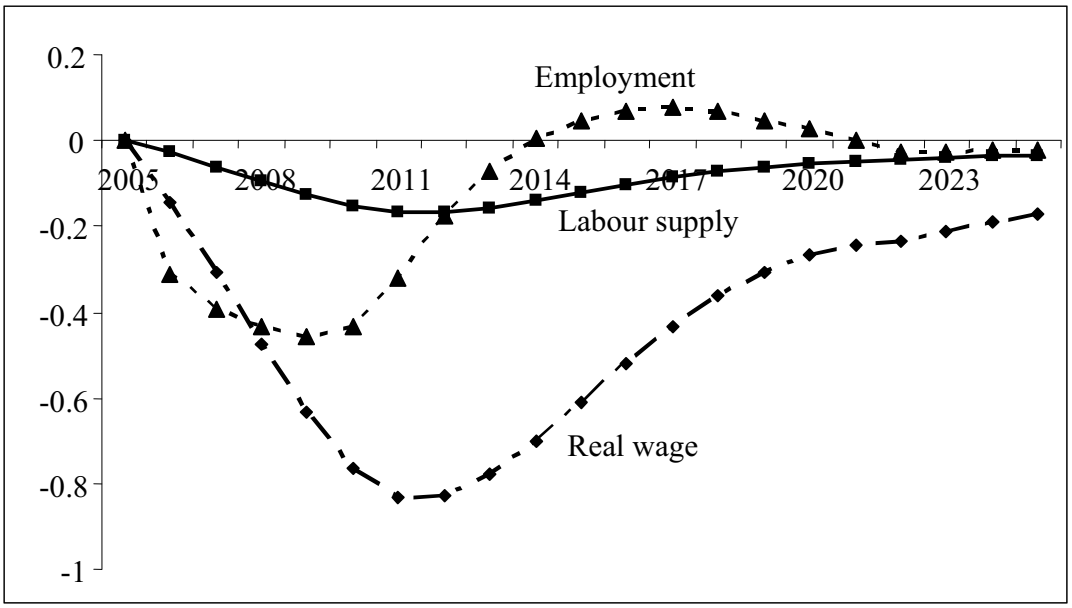
TERM was originally developed by Mark Horridge at the Centre of Policy Studies (see http://www.monash.edu.au/policy/term.htm). Since then, Glyn Wittwer has developed a dynamic version of the model, an application of which Wittwer *et al*. (2005) is an example.

In dynamic TERM, we use an underlying forecast. This may be based on the macro forecasts of other agencies. The underlying forecast or baseline gives us a year-by-year "business as usual" case.

Labour market – forecast v. policy scenario

In the theory of regional labour market adjustment, if regional labour market conditions improve or deteriorate relative to forecast, adjustment occurs in the short term mainly via changes in employment. Regional wages adjust sluggishly, with gradual adjustment in regional labour market supply (i.e., through migration between regions). Real wages will fall or rise to close the gap between employment and slowly adjusting labour supply. Once the deviation in employment is equal to the deviation in labour supply, real wages reach a turning point (either they bottom out, in the case of a weakening labour market, or peak, in the case of strengthened labour market conditions). Within this theory, adjustment in the longer term occurs via a combination of altered regional labour supply and real wages that deviate relative to those in other regions. Figure A2 shows an example, in which weakened labour market conditions in a region lead to unemployment in the short run and a lower real wage in the region in the long run.

Figure A2: An example of a weakened regional labour market with eventual recovery (% change from forecast)



CGE models such as TERM can be run under many different sets of assumptions concerning macro- and micro-economic behaviour.

Production technologies

TERM contains variables describing: primary-factor and intermediate-input-saving technical change in current production; input-saving technical change in capital creation; and input-saving technical change in the provision of margin services (e.g. transport and retail trade).

TERM's unique treatment of transport to assess the regional benefits of the project

The supply of margins originating in one region can lower the costs of moving goods between regions further afield. Previous multi-regional models (for example, Naqvi and Peter, 1996) assign the margins supply of a sale either to the origin or destination of the sale.

GEMPACK software

Dynamic TERM uses GEMPACK software for implementation (Harrison, *et al*. 2013; Harrison and Pearson, 1996).

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