Gunns LIMITED
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Bell Bay Pulp Mill
Environmental Impact Management Plan (EIMP)
Module L: Precommissioning management

Prepared for the
Commonwealth Minister for the Environment, Heritage and the Arts
in accordance with approval EPBC 2007/3385

GNS-PLN-1000-1400-0017

16 December 2008

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Revision Status

Revision	Date	Revision Description	Prepared	Reviewed	Approved
A	15 August 2008	For submission to DEWHA for review	IW	PR/LH/JD	CF
B	10 October 2008	For submission to DEWHA for review	IW	JD	CF
C	17 November 2008	For submission to DEWHA for review	IW	JD	CF
D	1 December 2008	For submission to DEWHA for review	IW	CF	CF
E	10 December 2008	For submission to DEWHA review	IW	CF	CF
F	16 December 2008	For submission to DEWHA review	IW	CF	CF

1. OVERVIEW

1a. A description of the proposal and associated infrastructure

A description of the pulp mill project has been provided in EIMP Module A. Other modules describe various components of the mill and associated infrastructure.

This module relates to studies and investigations that the approval requires to be undertaken prior to the commissioning of the mill. Under the approval (condition 9), no commissioning activity is to commence until the final and complete EIMP has been approved by the Minister.

The approval defines "*commissioning*" to be "when construction activities of the pulp mill have been concluded and the pulp mill is commencing start-up" (the approval does not define the end of commissioning). "Start-up" is not defined in the approval but it is an accepted industry term marking the first input of chips to the pulp mill's digester. For this project, start-up will also include any trials of the pulp drier using purchased pulp because these trials could lead to fibre contamination of water that will be discharged from the ocean outfall.

This module also describes trigger levels, maximum limits and associated response measures that will be initiated if those trigger levels are reached.

The findings of the studies and investigations described in this module will inform the monitoring program described in Module M and the trigger levels, maximum limits and response measures are collated in Module N. Module M is accompanied by a Commonwealth Baseline and Operational Monitoring Plan (C-BOMP) that is attached to Module M.

1a.1 Purpose

On 4 October 2007, the Commonwealth Minister for the Environment and Water Resources approved the taking of an action under the *Environment Protection and Biodiversity Conservation Act 1999*, namely "to construct and operate a bleached Kraft pulp mill at Bell Bay, Tasmania, and associated infrastructure" (EPBC 2007/3385).

Condition 2 of the approval requires Gunns to develop and submit an Environmental Impact Management Plan (EIMP), the objective of which is to ensure that there are no adverse impacts on matters of National Environmental Significance as a result of the action.

The purpose of the EIMP, and the further investigations that are required in order to prepare some of its components, is to ensure that matters of National Environmental Significance are protected during the construction and operation of the pulp mill project.

The EIMP and those investigations are not a continuation or extension of the project's approval assessment process. The approval process concluded with the issue of approval EPBC 2007/3385 on 4 October 2007. The EIMP is designed to ensure that the conditions of the EPBC approval are satisfied.

This module of the EIMP addresses those conditions of the approval that are relevant to precommissioning activities.

1a.2 Scope

The EIMP deals only with matters relevant to the EPBC approval. It does not deal with the much wider range of matters relevant to the State approval conditions other than those that are also relevant to the EPBC approval.

The staging of the project will be different for different elements of the project.

Hence, in accordance with conditions 7 and 8, which recognise a sectional and staged approach, the EIMP development and approval has a modular structure.

A separate EIMP Module A: Overview (GNS-PLN-1000-1400-0006) provides an overarching context and structure for the EIMP. Other modules address particular elements of the project, such as the clearing and preparation of the mill site, the construction of the mill itself, the construction of the wharf and the construction of the water and effluent pipelines.

Module M describes monitoring strategies.

This EIMP, Module L: Precommissioning Management should be read in conjunction with the EIMP Module A Overview and EIMP Module M Monitoring in particular.

Further information about the environmental management measures that will be implemented for the pulp mill project is available at www.gunnspulpmill.com.au.

1a.3 EIMP Structure

Schedule 2 of the EPBC 2007/3385 approval provides an outline for the EIMP (although the Schedule does not address all the permit conditions relating to the EIMP). The EIMP must set out specific issues and specific measures at each of the key preliminary phases of the project, these being:

- Preconstruction
- Construction
- Precommissioning.

The EIMP must also describe environmental management measures that will be implemented once the mill is operational, including:

- Ongoing monitoring
- Remedial and response strategies if trigger levels are likely to be exceeded or maximum target levels reached.

The operational phase modules of the EIMP describe trigger levels, maximum limits, response measures and a monitoring program to ensure protection of matters of National Environmental Significance from the operation of the mill.

The Department of Environment, Water, Heritage and the Arts (DEWHA) has specified that the EIMP structure must reflect the structure of Schedule 2 of the EPBC 2007/3385 approval.

These structural requirements overlay the project's staging, leading to the modular breakup shown in Table 1 that Gunns has adopted for EIMP preparation. Table 1 also shows the anticipated module submission dates. If these dates vary, DEWHA will be advised accordingly. As a matter of course, an updated Table 1 will be presented in each module of the EIMP.

The original separation of the pipelines into the four modules was based on the projected construction timetable at that time. Subsequent project delays and consequential changes to the construction timetable mean that the separation is no longer warranted. In addition, recent advice from DEWHA is that the approval conditions treat the effluent pipeline as a single action, which means that construction on any one element of the pipeline cannot proceed until all EIMP modules relating to it have been approved.

To minimise unnecessary duplication, EIMP Modules F, G, H and K were therefore combined into a single module that addresses those elements of the EIMP that are relevant to the water supply pipeline construction, effluent pipeline construction, shore crossing and ocean outfall construction. Similarly, EIMP Modules I and J were combined into a single module that addresses the solid waste disposal facility and the local reservoir.

These structural requirements overlay the project's staging, leading to the modular breakup shown in Table 1 that Gunns has adopted for the EIMP preparation. Table 1 also shows the submission (or approval) dates for each module.

Table 1: Modular elements of the EIMP and submission (or approval) dates

	Module	Estimated submission date	Gunns document number
	Overview		
A	EIMP Overview	Approved 01-Feb-08	GNS-PLN-1000-1400-0006
	Preconstruction and construction		
B	Vegetation clearing - mill site and wharf access	Approved 01-Feb-08	GNS-PLN-1000-1400-0007
C	Bulk earthworks mill site	Approved 31-Mar-08	GNS-PLN-1000-1400-0008
C1	Mill construction	Submitted 14-Jul-08	GNS-PLN-1000-1400-0022
D	Wharf construction	Submitted 10-Jul-08	GNS-PLN-1000-1400-0009
E	Accommodation facility construction	Approved 23-May-08	GNS-PLN-1000-1400-0010
F	Water supply pipeline construction	Submitted 11-Jul-08	GNS-PLN-1000-1400-0011
G	Shore crossing	Submitted 11-Jul-08	GNS-PLN-1000-1400-0011
H	Ocean outfall construction	Submitted 11-Jul-08	GNS-PLN-1000-1400-0011
I	Solid waste disposal construction	Submitted 21 Jul-08	GNS-PLN-1000-1400-0014
J	Local reservoir construction	Submitted 21-Jul-08	GNS-PLN-1000-1400-0014
K	Effluent pipeline construction	Submitted 11-Jul-08	GNS-PLN-1000-1400-0011
	Precommissioning		
L	Precommissioning management	Submitted 15-Aug-08	GNS-PLN-1000-1400-0017
	Ongoing monitoring		
M	Monitoring program	Submitted 2-Jul-08	GNS-PLN-1000-1400-0018
	Remedial and response strategies		
N	Remedial and response strategies	Submitted 22-Aug-08	GNS-PLN-1000-1400-0019
	Habitat measures		
O	Habitat offsets & reserves	Submitted 2-Jul-08	GNS-PLN-1000-1400-0020

Note that although the modules are labelled sequentially for convenience, as shown by the anticipated submission dates they have not been submitted in strict sequential order.

The EPBC 2007/3385 conditions addressed by each EIMP module are shown in Table 2.

Table 2: Modular elements of the EIMP and the EPBC 2007/3385 conditions they address

	Module	Conditions addressed	
	Overview		
A	EIMP Overview	1, 2, 6, 7, 8, 9, 10, 11, 12, 13, 20, 44, 45, 46, 47, 48	
	Preconstruction and construction	Preconstruction	Construction
B	Vegetation clearing - mill site and wharf access	14, 15, 17, 18, 20, 23, 25, 26	14, 15, 17, 18, 20, 23, 25, 26
C	Bulk earthworks mill site	14, 17, 18, 20, 23, 25, 26	14, 17, 18, 20, 23, 25, 26
C1	Mill Construction	14, 17, 20, 23, 25, 26	14, 17, 20, 23, 25, 26
D	Wharf construction	14, 20, 27, 28, 29, 30	14, 20, 27, 28, 29, 30
E	Accommodation facility construction	14, 20, 23, 25	14, 20, 23, 25
F	Water supply pipeline construction	14, 20, 21, 22, 23, 25	14, 19, 20, 21, 23, 25
G	Shore crossing	14, 20, 23, 25, 27	14, 20, 23, 24, 25, 27
H	Ocean outfall construction	14, 20, 27, 28, 30, 38, 39	14, 20, 26, 27, 28, 30
I	Solid waste disposal construction	14, 17, 20, 23, 25	14, 17, 20, 23, 25, 26
J	Local reservoir construction	14, 17, 20, 23, 25	14, 17, 20, 23, 25, 26
K	Effluent pipeline construction	14, 20, 21, 23, 24, 25	14, 19, 20, 21, 22, 23, 24, 25
	Precommissioning		
L	Precommissioning management	3, 4, 9, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42	
	Ongoing monitoring		
M	Monitoring program*	3, 4, 15, 31, 32, 33, 36, 37, 40, 41, 42, 43*	
	Remedial and response strategies		
N	Remedial and response strategies	3, 4, 5, 19, 26, 29, 30, 31, 32, 33, 39	
	Habitat measures		
O	Habitat offsets & reserves	15, 16, 17, 18	

*For completeness, Module M also reiterates monitoring described in other modules relevant to conditions 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 29, 30, 31, 34, 35, 36 and 38

Module A Overview was the first module prepared and approved. Table 2 of that module listed the conditions which at that time were anticipated to be addressed by each of the succeeding modules. As those other modules have been developed, some changes to the allocation of conditions to modules emerged as being desirable to best reflect the scope and contents of each module and their relationship to the approval conditions. The changes from the Module A anticipated allocations are indicated in the above table.

Additions are shown in dark blue and removals are shown in light grey. Module G has been renamed from dune crossing to shore crossing.

Note also that Module C1 has been added since Module A was finalised. Module C1 does not introduce any environmental issues not already addressed by Modules B and C but it is provided as an informative document to describe the pulp mill's buildings and structures.

This module follows the outline required by Schedule 2 of the conditions of approval.

The EIMP Overview Module A provides additional detail that demonstrates relationships between approval conditions, project elements, EIMP modules and EIMP components from various perspectives.

Appendix A provides an integrated summary of all those perspectives. Note that there have been some changes to the allocation of Schedule 2 issues to modules since Module A was approved. These changes emerged during the development of the modules as being desirable to best reflect the scope and contents of each module and their relationship to the Schedule 2 issues.

Appendix B sets out in tabular form the approval conditions addressed by this Module and the actions that Gunns has taken or will take to comply with the conditions, including management measures. In the event of any inconsistency between the text in these tables and the text in the body of the EIMP, the latter prevails.

The EIMP modules cover both the construction (B-K, O) and operational phases of the project (L, M, N), with Module A being an overview of the EIMP.

All EIMP modules have been prepared and submitted to the Minister to achieve final approval under condition 7 of the approval by 5 January 2009. This date was extended from the original 4 October 2008 approval date by consent of the Minister in accordance with that condition.

The construction phase modules describe management measures that will be implemented to ensure that there are no significant impacts on matters of National Environmental Significance due to the construction of the pulp mill and associated infrastructure.

The operational phase modules describe trigger levels, maximum limits, response measures and a monitoring program to ensure that there are no significant impacts on matters of National Environmental Significance due to the operation of the pulp mill.

Gunns will present the findings and conclusions of these studies and investigations to the Minister. The Minister would then determine under condition 44 of the approval whether to request Gunns to revise the EIMP to reflect these findings. On receipt of such a request, Gunns would revise the EIMP and submit the revision to the Minister for approval.

1a.4 A description of the proposal and associated infrastructure

A description of the pulp mill project has been provided in EIMP Module A.

This module does not relate to construction but rather to studies and investigations that will be undertaken prior to the commissioning of the mill:

1. Effluent trigger levels and maximum limits for condition 32 table parameters and for additional effluent parameters (condition 32)
2. Effluent trigger levels and maximum limits for all phases of development (condition 33)
3. Effluent toxicity testing using effluent from overseas mills (conditions 34, 37 and 41)
4. Laboratory studies of the fate of fine particulate organic matter in effluent (condition 35)
5. Additional hydrodynamic modelling of the fate of effluent (conditions 38 and 41)
6. Response strategies relevant to the above matters.

These studies arise from the recommendations of the Chief Scientist's Expert Panel to manage residual risks and uncertainties about the impacts of the project on the Commonwealth marine environment and also fulfil specific requirements of the approval conditions.

Although the (then) Commonwealth Department of Environment and Water Resources in its recommendation report to the Minister concluded that "*Based on the available evidence, the Department has not identified any likely significant impacts on the marine environment in Commonwealth waters from the proposed pulp mill*[1]", the Chief Scientist made recommendations for additional studies and investigations to address the residual risks and uncertainties[2].

The Chief Scientist found that "*Partly due to lack of relevant international experience with comparable technologies in comparable greenfield marine sites, the possibility of longer-term unacceptable environmental impacts under Commonwealth jurisdiction cannot be eliminated, but there is not a* prima facie *case for high risk. The residual risk can in the view of the Panel be managed by appropriate monitoring, informed by a revised hydrodynamic and sediment transport model, including the fall-back management option of insisting on tertiary treatment in the worst case.*"

The hydrodynamic and sediment transport model forms the core of the further investigations and studies described in this module, with other studies feeding information into the model.

These studies and investigations are intended to further inform understanding of effluent characteristics and the design of the monitoring program. Gunns may also use the results of some of these studies and investigations to contribute to a request to the Minister to revise the trigger levels and maximum limits as provided for under condition 32.

The findings of the completed studies will need to be approved by the Department prior to commissioning commencing.

The results of the approved studies will need to be incorporated into the monitoring program (C-BOMP), or other documents as required, to the satisfaction of the Department prior to commissioning commencing. The results of baseline surveys being undertaken to inform the monitoring program will also be incorporated into the monitoring program. (Note: The approval variously uses the terms "background" and "baseline" in different conditions. To minimise confusion, the term "baseline" will be used in this module for consistency unless the context means that it is not appropriate.)

An example of how the results of the further studies described in this module will influence the design of the final monitoring program is through the revision to and addition of sampling sites.

The hydrodynamic and sediment transport model required by condition 38 of the approval are central to the further studies and investigations described in this module. As required by condition 39 a range of responses are outlined in this module depending on the sediment deposition and effluent plume behaviour predicted by the hydrodynamic modelling study.

As with the other studies, the results of the hydrodynamic modelling will be used to inform the design of the monitoring program prior to commissioning commencing. In addition, if the result of the modelling study show that a more significant response is required, such as

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[1] Paragraph 36 of Australian Government Department of the Environment and Water Resources (2007) *Recommendation Report prepared for EPBC Project 2007/3385 under Section 95C of the Environment Protection and Conservation Biodiversity Act 1999*.

[2] Chief Scientist (2007) *Chief Scientist's Report on the scientific aspects of the Department of Environment and Water Resources recommendation report, relevant supporting documentation and public comments on the Gunns Limited pulp mill proposal (EPBC 2007/3385) in Tasmania*

changing the design of the diffuser or implementing tertiary treatment, the Minister would then determine under condition 44 of the approval to request Gunns to revise the EIMP as necessary. On receipt of such a request Gunns would revise the EIMP and submit the revision to the Minister for approval.

Some of the studies can be undertaken in parallel while others must be undertaken sequentially. Mill commissioning is expected to occur 26 months after the Gunns Limited Board gives the project Notice to Proceed (NTP). The timetable of the studies and investigations is therefore relative to the date of NTP, which is subject to the finalisation of project financing.

The completion of baseline surveys and further studies outlined in this module can be grouped into five programs of activity:

1. Hydrodynamic modelling
2. Field measurements
3. Baseline monitoring
4. Effluent testing
5. Biota monitoring.

Outputs from the programs will include reports to the Department and at various stages Departmental approval will be required. Key milestones for the five programs, all of which are required to be achieved prior to mill commissioning commencing, are identified in the flowcharts in Figure 1 and the approval decisions are summarised in Table 3.

The five programs of activity outlined in Figure 1 cover the majority of further work to be undertaken by Gunns as part of the operational phase modules prior to commissioning. Where there are other activities to be completed these will be incorporated into the C-BOMP, or other documents as required, to be approved by the Department prior to commissioning commencing.

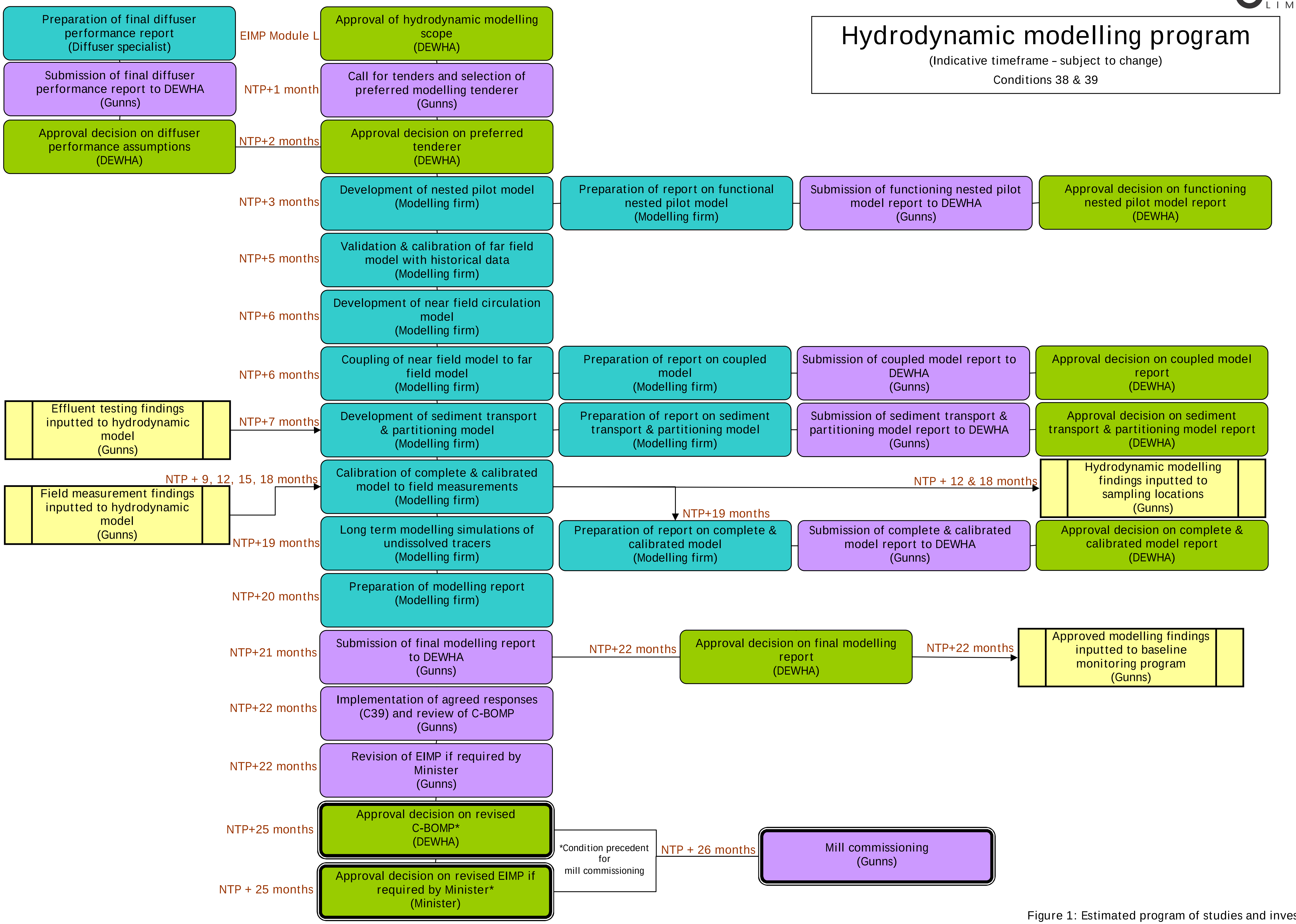
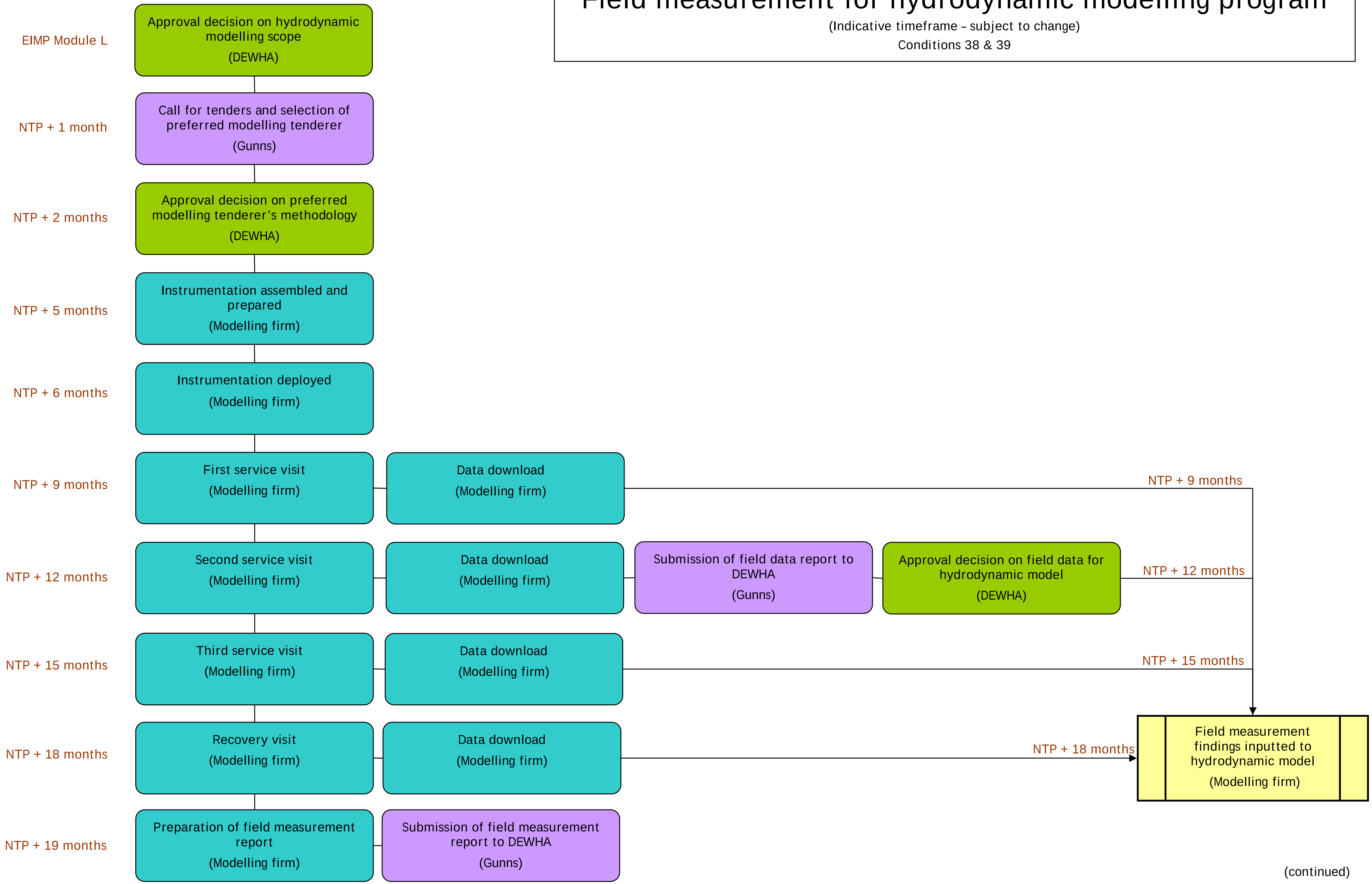


Figure 1: Estimated program of studies and investigations

Field measurement for hydrodynamic modelling program

(Indicative timeframe – subject to change)

Conditions 38 & 39

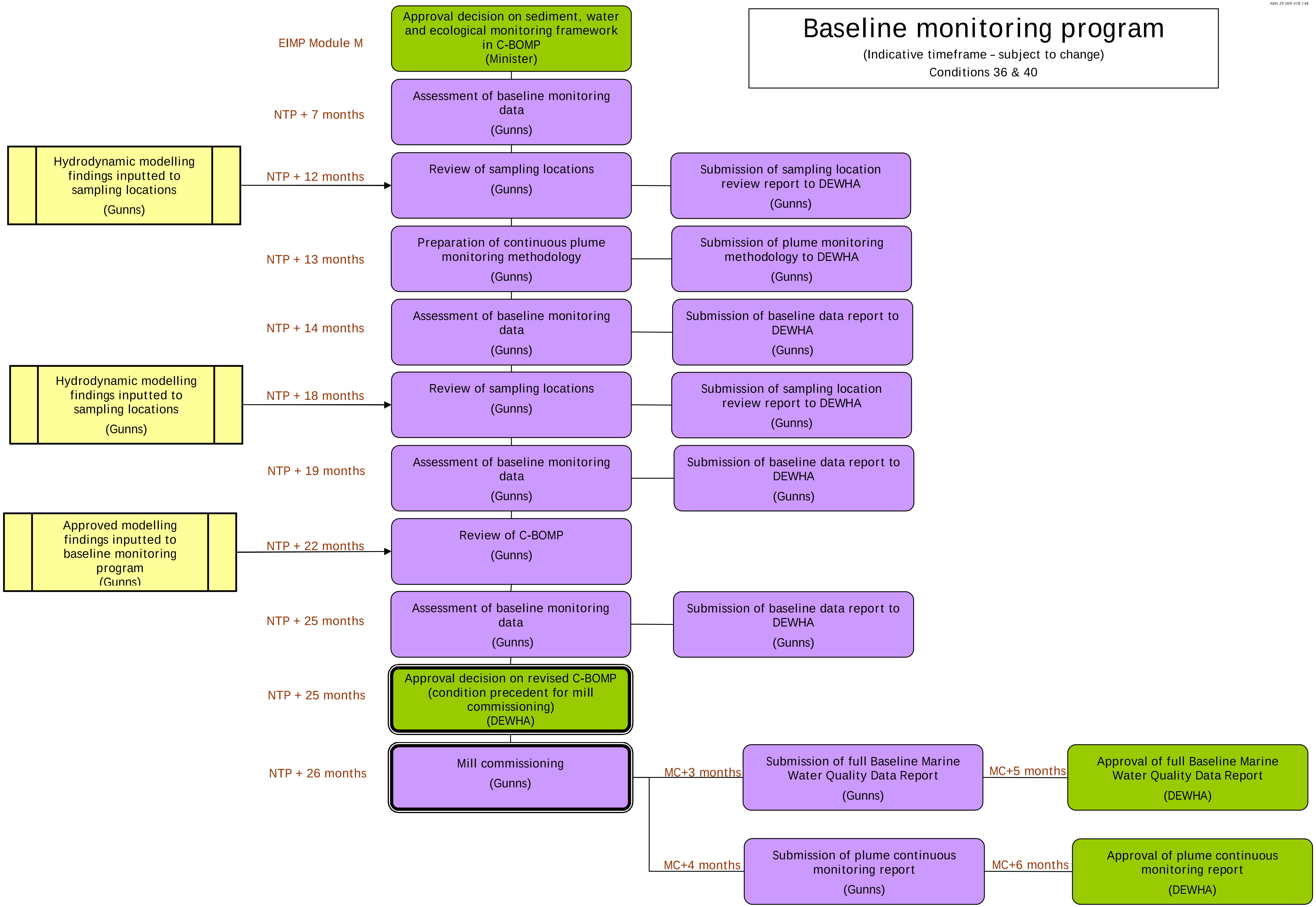


(continued)

Baseline monitoring program

(Indicative timeframe – subject to change)

Conditions 36 & 40



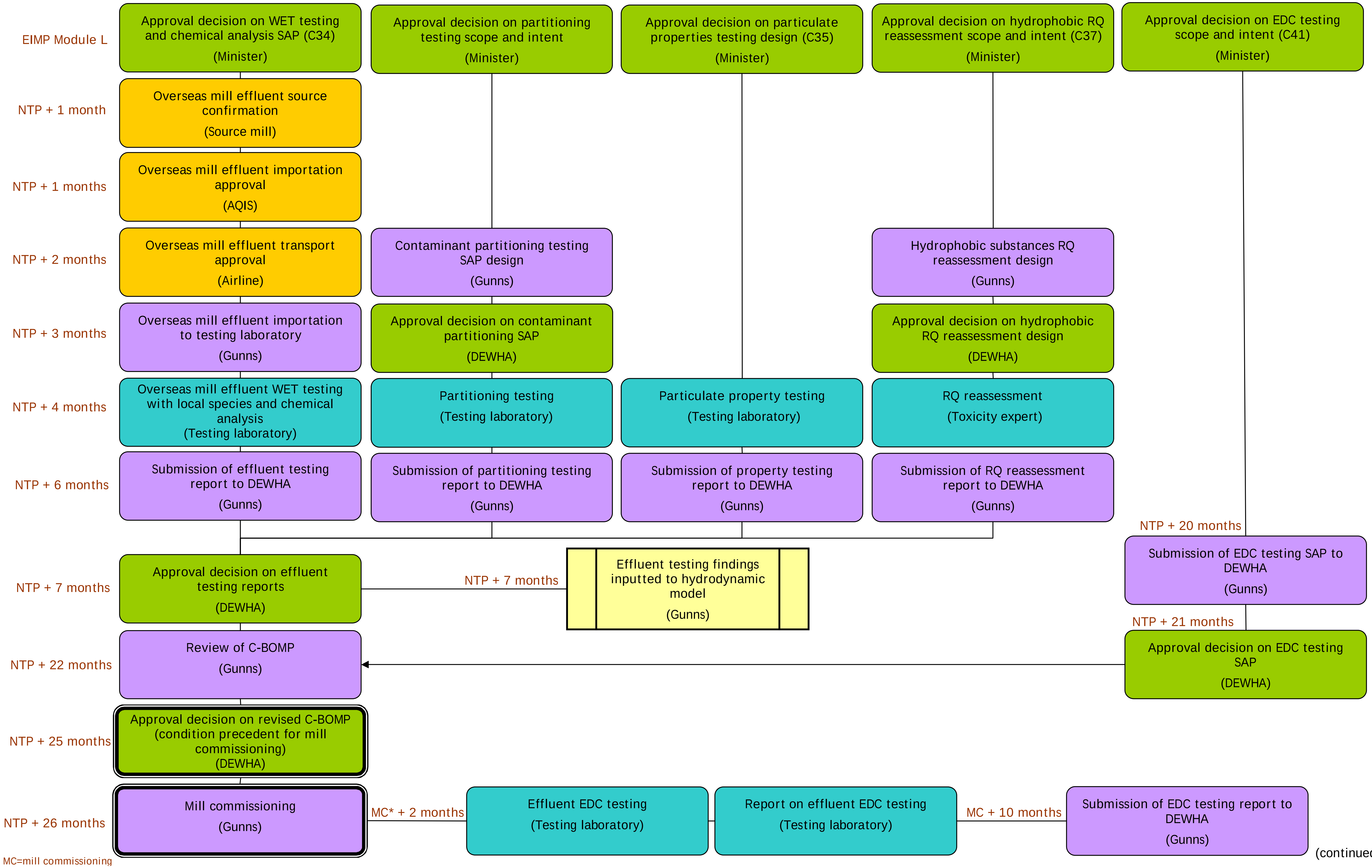
MC = mill commissioning

(continued)

Effluent testing program

(Indicative timeframe – subject to change)

Conditions 34, 35, 37 & 41



(continued)

Biota monitoring program

(Indicative timeframe – subject to change)

Condition 36

Timeframe	Activity	Parallel activity
EIMP Module M	Approval decision on biota monitoring framework in C-BOMP (Minister)	
October 2008 – March 2009	Pilot seal and penguin sampling by State government (DPIW)	Preparation of seal and penguin pilot sampling report (DPIW)
March 2009 – May 2009	Trial deployment of sentinel bivalves & pilot fish sampling (Gunns)	
July 2009	Review of bivalve and fish monitoring methodology (Gunns)	Submission of bivalve and fish sampling report to DEWHA (Gunns)
August 2009	Review of biota monitoring framework (Gunns)	Submission of biota monitoring framework review to DEWHA (Gunns)
October 2009	Approval decision on reviewed biota monitoring framework in C-BOMP (DEWHA)	
NTP + 1 month*	Deployment of sentinel bivalves & start of biota monitoring (Gunns)	
NTP + 22 months	Review of C-BOMP (Gunns)	
NTP + 25 months	Approval decision on revised C-BOMP (condition precedent for mill commissioning) (DEWHA)	
NTP + 26 months	Mill commissioning (Gunns)	

*May be earlier than June 2009

Table 3: Planned report submissions and DEWHA approval decisions leading up to mill commissioning

Estimated date*	Report submission	DEWHA approval decision
July 2009	Bivalve and fish sampling report	
August 2009	Biota monitoring framework review	
October 2009		Reviewed biota monitoring framework
NTP** + 1 month	Final diffuser performance report Preferred modelling tenderer	
NTP + 2 months	Contaminant partitioning design Hydrophobic RQ reassessment design	Preferred modelling tenderer Diffuser performance assumptions
NTP + 3 months	Functioning hydrodynamic pilot model report	Functioning hydrodynamic pilot model report Contaminant partitioning design Hydrophobic RQ reassessment design
NTP + 6 months	Coupled hydrodynamic model report Effluent testing reports	Coupled hydrodynamic model report
NTP + 7 months	Sediment transport and partitioning model report	Effluent testing reports Sediment transport and partitioning model report
NTP + 12 months	Field data report Sampling location review	Field data report
NTP + 13 months	Plume monitoring methodology	
NTP + 14 months	Baseline data report	
NTP + 18 months	Sampling location review	
NTP + 19 months	Field measurement report Baseline data report Calibrated model report	Calibrated model report
NTP + 20 months	EDC testing SAP	
NTP + 21 months	Final modelling report	EDC testing SAP
NTP + 22 months	Review of C-BOMP If required by Minister, review of EIMP	Final modelling report
NTP + 25 months	Baseline data report	Revised C-BOMP (condition precedent for mill commissioning) If revision of EIMP is required by Minister, approval of revision by Minister (would be condition precedent for mill commissioning)
NTP + 26 months	Mill commissioning (MC)	
MC + 3 months	Baseline Marine Water Quality Data Report	
MC + 4 months	Continuous plume monitoring report	
MC + 5 months		Baseline Marine Water Quality Data Report
MC + 6 months		Continuous plume monitoring report

1a.5 Relevant environmental commitments

Gunns' environmental commitments for the project as they relate to matters of Commonwealth interest are described in documents submitted to the Minister under the EPBC Act approval process:

- Preliminary Documentation: Gunns Limited Bell Bay Pulp Mill Project Impact Assessment under the *Environment Protection Biodiversity Conservation Act 1999*; and
- Response to Submissions: Gunns Limited Bell Bay Pulp Mill Project Response to Submissions under the *Environment Protection Biodiversity Conservation Act 1999*.

These commitments are described in EIMP Module A. Commitments relevant to this module (Precommissioning) are:

- Key constituent concentrations within the treated effluent will be measured and monitored in the effluent treatment plant prior to its disposal via the effluent pipeline and diffuser.
- Treated effluent dispersion monitoring, and monitoring for possible long-term impacts of treated effluent on the marine environment will be undertaken.
- The effluent treatment plant will feature the following main operations:
  - pre-treatment, primary clarification and stabilisation of the raw effluent quality to remove coarse impurities, control effluent pH, remove suspended solids and level down the variability of raw effluent quality. These stages are necessary to safeguard the highest possible performance of the biological treatment process of the effluent;
  - an emergency basin to prevent the potential shock loads from jeopardizing biological effluent purification process in the secondary treatment stage;
  - a secondary treatment stage, where most of the dissolved organic matter and certain inorganic constituents in the raw effluent are removed by a sequence of an anoxic reactor (chlorate removal), selector basins and the final aeration basin (COD and residual toxicity removal); and
  - two secondary clarifiers, in which the final effluent is clarified before being discharged into a surge basin and pumped through the effluent outfall pipeline.
- The effluent treatment plant components are designed to cope with the daily variability of effluent loads, such that the final loads to Bass Strait are virtually constant and change only slowly, ensuring longer term protection of the receiving environment.

1a.6 Relevant approval conditions and management measures

Descriptions of the EPBC 2007/3385 approval conditions 3, 4, 9, 31, 32, 33, 34, 35, 37, 38, 39, 41 and 42 that are relevant to this EIMP module are provided in Appendix B together with actions that have been taken by Gunns to prepare this module. The outcomes of those actions and any resultant environmental management measures are also shown in that table. These management measures will ensure that the requirements of the approval conditions are met.

Schedule 2 of EPBC 2007/3385 requires the EIMP to reflect commitments made by Gunns in its preliminary documentation and also in its response to public submissions. Schedule 2 also requires the EIMP to address issues and concerns raised by the (then) Department of the Environment and Water Resources in its Recommendation Report and also matters raised in the Chief Scientist's report to the Minister. The EIMP satisfies those requirements also.

1b. Identification of clear environmental objectives

Overarching environmental objectives for the project to ensure that no adverse impacts occur on matters of National Environmental Significance have been outlined in Module A – Section B.

Specific environmental objectives relevant to this EIMP module are to:

- Set new world's best practice benchmarks for the operation and monitoring of pulp mills, incorporating early warning trigger levels that initiate response measures that will ensure that matters of National Environmental Significance are protected (conditions 3, 4, 31, 32, 33, 39, 41)
- Determine appropriate effluent trigger levels and maximum limits for effluent parameters that are relevant to matters of National Environmental Significance (condition 32)
- Determine effluent trigger levels and maximum limits for effluent parameters that are relevant to matters of National Environmental Significance for all phases of development, including the commissioning and ramp-up phase (condition 33)
- Determine effluent toxicity levels using effluent from overseas mills and reassess risk quotients for hydrophobic substances (conditions 34, 37 and 41)
- Determine flocculation and settling characteristics of effluent particulates (condition 35)
- Determine likely 3-dimensional transport of effluent constituents, including particulate deposition zones (condition 38)
- Prepare response strategies relevant to the above matters.

1c. Identification of environmental indicators, and translation of objectives into agreed targets and performance measures

Performance measures relating to the above objectives are:

- Establishment of effluent trigger levels and maximum limits for effluent parameters that are relevant to matters of National Environmental Significance for all phases of development, including the commissioning and ramp-up phase
- Confirmation or revision of effluent toxicity levels of effluent constituents and confirmation or revision of risk quotients for hydrophobic substances
- Establishment of flocculation and settling characteristics of effluent particulates for input into hydrodynamic modelling
- Description of likely 3-dimensional transport of effluent constituents, including particulate deposition zones
- Identification of response strategies that will protect matters of National Environmental Significance.

1d. Design and implementation of an appropriate monitoring program

The monitoring program has been described in Module M. Some components of the monitoring are already underway, having commenced more than 2 years ago. Other components are scheduled to commence within the next few months or following Notice to Proceed (NTP). The monitoring will continue while the studies and investigations described in the current Module L are being undertaken.

The findings of these studies and investigations may lead to the monitoring program being refined. For example, the hydrodynamic modelling may suggest better locations for monitoring stations such as those that focus on sediment chemistry.

As described in Module M, refinements to the monitoring will be implemented by updating Module M and its associated C-BOMP and submission of the updates to DEWHA for approval. Module M and the C-BOMP describe how monitoring will be undertaken.

1e. Identification of, and commitment to, agreed trigger or response levels for key indicators

Trigger levels are described in section 4c of this module.

This Module L describes additional studies and investigations that will be undertaken to address residual risks and uncertainties identified by the Chief Scientist. The findings of these studies and investigations may lead to a need to amend trigger levels, maximum limits, response measures and/or the monitoring program. If this circumstance arises, proposed amendments will be submitted to DEWHA for approval, and if a revision of trigger levels and/or maximum limits is warranted a request will be made to the Minister as provided for by condition 32.

1f. Identification of specific remedial management responses to be undertaken when trigger point levels are exceeded

Response measures are described in section 6 of this module.

2. PRECONSTRUCTION

2a. Management of impacts on the wedge-tailed eagle – Tasmanian

This issue relates to construction and is not relevant to this module.

2b. Management of risks to listed flora from plant pathogens

This issue relates to construction and is not relevant to this module.

2c. Management of risks and uncertainties associated with the non-detection of listed flora

This issue relates to construction and is not relevant to this module.

2d. Management of risks associated with the decline of difficult-to-detect listed flora

This issue relates to construction and is not relevant to this module.

2e. Management of risks associated with the decline of *Xanthorrhoea aff. bracteata*

This issue relates to construction and is not relevant to this module.

2f. Management of risks associated with the amphibian chytrid fungus *Batrachochytrium dendrobatidis*

This issue relates to construction and is not relevant to this module.

2g. Management of risks associated with trenching

This issue relates to construction and is not relevant to this module.

2h. Mitigation of impacts on the pipeline corridors

This issue relates to construction and is not relevant to this module.

2i. Establishment of baseline surveys for roadkill

This issue relates to construction and is not relevant to this module.

2j. Undertaking appropriate surveys and establishing mitigation measures for impacts on listed migratory birds

This issue relates to construction and is not relevant to this module.

2k. Undertaking appropriate examination of likely impacts of pile-driving noise associated with the wharf construction

This issue relates to construction and is not relevant to this module.

2l. Establishing baseline levels of vessel strike in the region

This issue relates to construction and is not relevant to this module.

2m. Monitoring the baseline levels of contaminants in listed species

This issue is addressed in EIMP Module M, which relates to monitoring. Information from the monitoring will be used to develop trigger levels for contaminants in biota.

2n. Developing rehabilitation and offset plans for listed threatened species

This issue is addressed in EIMP Module O, which relates to habitat offsets and reserves. It is not relevant to this module.

2o. Establishing measures for habitat protection

This issue is addressed in EIMP Module O, which relates to habitat offsets and reserves. It is not relevant to this module.

3. CONSTRUCTION

3a. Management of risks associated with the amphibian chytrid fungus

This issue relates to construction and is not relevant to this module.

3b. Management of risks associated with roadkill

This issue relates to construction and is not relevant to this module.

3c. Management of pile-driving noise

This issue relates to construction and is not relevant to this module.

3d. Development of strategies to minimise vessel strike

This issue relates to construction and is not relevant to this module.

3e. Appropriate strategies to minimise impacts on listed migratory birds

This issue relates to construction and is not relevant to this module.

3f. Strategies to ensure no increase in the levels of contaminants in listed species

The purpose of trigger levels and response measures described in section 4 of this module is to ensure no increase in the levels of contaminants in biota, including listed species.

3g. Management of risks associated with listed crayfish

This issue relates to construction and is not relevant to this module.

4. PRECOMMISSIONING

The approval requires trigger levels and maximum limits to be established for the mill. If trigger levels are reached during the operation of the mill, response measures are required to be implemented so that the maximum limits are not exceeded.

Two general approval conditions are relevant:

> *3) The EIMP must include trigger points and maximum limits in relation to effluent discharge from the operation of the pulp mill as well as specific remedial management responses to be undertaken by Gunns Limited if trigger points are exceeded or maximum limits are reached. It shall be an operational objective of the pulp mill, and reflected in the EIMP, that trigger points, and maximum limits, are not to be reached.*
>
> *4) If at any time during the taking of the action there are reasonable grounds for any of Gunns Limited, the Minister, the Department, the Independent Expert Group or the Independent Supervisor to believe that the maximum limits for effluent discharge in this approval, or in the EIMP, are likely to be exceeded, then that party (if it is not Gunns Limited) shall immediately inform Gunns Limited. Once Gunns Limited has either been so informed or itself believes maximum limits are likely to be exceeded, it must immediately implement the response strategies in the EIMP, in accordance with the stipulated timeframes. If within the stipulated timeframe Gunns Limited is unable to demonstrate to the satisfaction of the Minister that response strategies are achieving their objective as set out in the EIMP to reverse the undesirable impacts, the mill must cease to operate until such time as a tertiary treatment solution satisfactory to the Minister is installed.*

In addition to these general conditions, other specific conditions are relevant as described in the following sections.

4a. Toxicity testing of Elemental Chlorine Free mill effluents

4a.1 Approval requirements

Relevant to this issue, condition 34 of the approval requires:

> *In accordance with the EIMP, Gunns Limited must obtain (from overseas pulp mills already using technologies similar to that proposed) effluent samples, and conduct chemical analyses and whole effluent toxicity testing to identify the key contaminants and their concentrations and the effluent dilutions needed in the mixing zone for the proposed mill. Gunns Limited must report on the temporal variability in both the contaminant concentrations and toxicity in the effluents from these mills.*

Also relevant to this issue, condition 37 of the approval requires:

> *Gunns Limited must determine, in accordance with the EIMP, effluent monitoring requirements prior to the commencement of pulp mill commissioning. This must include but not be limited to:*
>
> > *…*
> > *b) a re-assessment of the Risk Quotients (RQs) for hydrophobic substances, in all media, being taken into account; and*
> > *….*

Also relevant to this issue (although relating to monitoring of the Bell Bay pulp mill effluent rather than testing of overseas mill effluent), condition 41 of the approval requires:

> *In accordance with the EIMP, Gunns Limited must prepare and have approved by the Minister, prior to commencement of mill commissioning, strategies for monitoring the impacts of the mill effluent on the marine environment. These strategies must include but not necessarily be limited to:*
>
> *...*
>
> *c) Chemical and ecotoxicological assessments including assessments of endocrine disrupting ability, and ecological assessments.*
>
> *...*
>
> *l) Whole-effluent toxicity testing using species relevant to Commonwealth waters in Bass Strait.*
>
> *...*

4a.2 Toxicity testing to be undertaken

Toxicity testing conducted under condition 34 will establish reference findings against which regular operational toxicity monitoring required under condition 41 can be compared.

Whole effluent testing (condition 34)

A working draft of a toxicity testing sample and analysis plan[3] (SAP) has been submitted to DEWHA for review and for comment by the Independent Expert Group. The SAP has been prepared to address the requirements of approval condition 34.

The following summarises the draft SAP as it relates to the monitoring strategy. The draft SAP has been refined following comment received from the Independent Expert Group. It is proposed that the final SAP will be submitted to DEWHA for approval with the required amendment (use of glass bottles for wet samples) and two additional amendments:

- 24-hour composite sampling regime may be replaced by a grab sample to minimise potential degradation by holding time in transit; and
- An amended strategy to determine temporal variability as described below.

The SAP describes the aims of the ecotoxicity test program, details the samples to be tested, describes pre-testing preparation required, and describes testing methodology and quality assurance measures used to ensure that the project is completed in an efficient and scientifically sound manner.

A comparable overseas mill will be selected to source the effluent samples. For commercial-in-confidence reasons, the identity of the source mill will be communicated to DEWHA under separate cover.

The effluent sampling at the source mill will be undertaken by an appropriately experienced sampling organisation consistent with relevant Australian Standards (particularly AS5667.10-1998). The sample will be taken from the wastewater treatment plant discharge point, equivalent to the effluent monitoring point for the Bell Bay mill.

The individual sample(s) will be representative of effluent quality taken over a period of equal to or less than 24 hours. Samples will be transported to Australia using handling protocols described in the SAP and/or will be analysed by local or international laboratories to standards acceptable for the purpose.

Best endeavours will be made to achieve the minimum practical delivery time — 48 hours is considered to be the shortest achievable period given the significant logistical constraints.

[3] Ecotox (April 2008) Toxicity assessment of an overseas pulp mill effluent for the proposed Tasmanian pulp mill – working draft sample and analysis plan

Prior to the toxicity testing the effluent will be subjected to chemical analysis and will be adjusted to a salinity of 35.5 ppt.

The proposed whole effluent toxicity (WET) testing will comprise:

- Microtox assay using the marine bacterium *Vibrio fischeri*
- 72-h micro-algal growth inhibition test using *Nitzschia closterium*
- 72-h macro-algal germination assay using *Hormosira banksii*
- Sea urchin fertilisation success using *Heliocidaris tuberculata*
- 72-h larval development using the sea urchin *Heliocidaris tuberculata*
- 48-h larval development using the doughboy scallop *Mimachlamys asperrima*
- 96-h survival of the juvenile amphipod *Allorchestes compressa*
- 96-h larval fish imbalance test using the striped trumpeter *Latris lineata*.

All ecotoxicology tests will be performed at the Ecotox Services Australasia laboratory in Lane Cove, NSW, with the possible exception of the Microtox and *Nitzschia* micro-algal growth inhibition tests, which may be performed by the CSIRO Centre for Environmental Contaminants Research at the Lucas Heights Research Laboratories, NSW, subject to availability of CSIRO to undertake tests on the day of the arrival of the samples.

At least 6 concentrations of the pulp mill effluent will be performed for each WET test: 0, D95, 6, 12.5, 25, 50 and 100% plus filtered seawater control and artificial seawater control, where D95 is a dilution representing the 95%ile dilution expected at the edge of the mixing zone (to be determined from the further hydrodynamic modelling). A further 1% treatment will be included to represent the edge of a 1 in 100 mixing zone.

The SAP includes detailed descriptions of each of these tests.

Additional samples will be taken at the same time as the WET samples for chemical analysis of determinands that are relevant to the interpretation of toxicity tests. The suite of determinands is extensive and is based on, but in some cases goes beyond, the pollutant parameters defined under the State permit for routine monitoring of the effluent, as described in the C-BOMP (Module M). Determinands that are not generally associated with toxicity, such as biological indicators and therefore not able to provide useful information for interpretation of toxicity tests have been excluded from the analytical suite.

In addition to the chemical analysis of the effluent itself, chemical analysis of any flocculants formed by the effluent when exposed to seawater will be undertaken to determine the partitioning proportions of chlorate, dioxins, chloroacetic acids and colour in dissolved and flocculated form (colour is of interest as a possible tracer of the dissolved fraction). This information will be inputted to the hydrodynamic model together with the results of the particulate settling tests described in section 4b to ensure that the model reflects the different fates of dissolved and flocculated forms of these contaminants in the receiving environment. Resin acids will not be able to be tested in this way because the source mill for the overseas effluent does not process pine.

The majority of chemical analysis will be conducted by the National Measurement Institute (NMI) Laboratories on return to Australia. Some specialised analysis for groups of compounds such as resin and fatty acids and/or chlorinated phenolics were considered for consignment to a suitable North American laboratory where these analytical suites are commonly undertaken for regulatory purposes to traceable standards. However, it is proposed now that the CSIRO Forest Bioscience Laboratories in Australia is engaged for this particular task using in-house methods. This CSIRO laboratory has been providing analytical services and consultation to NMI/Gunns for similar work on this project. A table detailing the SAP for the physico-chemical tests that will be undertaken in parallel to the WET SAP described above is attached as Appendix C. The table includes preservation techniques.

The preservation procedure and other logistical considerations are complex and subject to ongoing review to minimise the amount of material transported. In addition, some preservation procedures (eg the application of nitric acid) may not be possible due to airline transit policies, while others (eg freezing after collection) may not be practicable.

The source mill has a historical record of effluent toxicity test results and also has an ongoing effluent toxicity testing program, using a range of species and protocols similar to those described above. This will allow the temporal variability of pulp mill effluent to be described by calibrating the toxicity testing required by approval condition 34 with the source mill's own effluent testing program. A sample of effluent from the source mill will be obtained and brought back to Australia as close as is practicable to the same time as the source mill takes its own regular sample for toxicity testing. The Australian toxicity testing end points can then be calibrated to the source mill's toxicity testing end points on its simultaneous effluent sample. Once calibrated, the temporal variability of pulp mill effluent toxicity on the Australian test species will be able to be inferred from the historical records of temporal variability of toxicity on the comparable overseas test species. Additional toxicity information is also available from the two rounds of toxicity testing that have already been undertaken for the Bell Bay project since 2005 (described in Volume 17 of the DIIS) and from the publicly available toxicity testing results from the Botnia mill in Uruguay.

Following mill commissioning, a comparative toxicity testing program will be implemented, using the Bell Bay pulp mill's effluent and species relevant to the Commonwealth waters in Bass Strait in accordance with condition 41(l) of the approval. The design of this program will be determined by the findings of the Precommissioning program.

4a.3 Risk Quotient reassessment (condition 37)

The risk assessment undertaken for the Preliminary Documentation examined hydrophilic substances. Condition 37 requires a reassessment for hydrophobic substances. Accordingly, Gunns will:

1. Select potentially hydrophobic chemicals from the list of 130 chemicals potentially in the effluent
2. Determine the physicochemical properties of these hydrophobic chemicals,
3. Determine their partitioning coefficients, half-lives etc. (based on the physico-chemical properties)
4. Determine their sediment concentrations (following the corrected procedure to estimate dioxin/furan concentrations in sediments)
5. Determine guideline or end-point values for each of the chemicals that partition to the sediment phase
6. Calculate their RQ values, and
7. Any chemicals with RQ ≥ 1 will be added to the monitoring list if they are not already on the list.

If any chemicals are added to the monitoring list, the Sample and Analysis Plan (SAP) for the monitoring list will be revised accordingly and submitted to DEWHA for approval.

Confirmation of the chemicals present in the wastewater effluent will be undertaken during effluent monitoring. If the analysis shows the existence of any of the hydrophobic chemicals, then calculations will be performed in order to determine if they need to be monitored in biota.

4a.4 Endocrine Disruption Chemical (EDC) testing (condition 41(c))

The term endocrine disruption relates to the ability of certain chemicals to interfere with normal endocrine function. The endocrine system plays an important role in the maintenance of homeostasis and the regulation of key developmental processes and bodily functions. Therefore, an endocrine disrupting chemical is one that can potentially interfere with any of these processes.

In accordance with the requirements of condition 41(c), EDC testing of the Bell Bay pulp mill effluent will be undertaken following the commissioning of the mill. EDC testing examines for chronic effects and therefore may require test biota to be held in the test conditions for extended periods. It is not logistically possible for this to be undertaken on overseas pulp mill effluent due to the volumes of effluent that would be required (nor is it a condition of approval that such testing on overseas effluent be undertaken). The EDC testing will therefore only be undertaken on the Bell Bay effluent as part of the monitoring program and are therefore not relevant to the Precommissioning phase. However, the findings of the whole effluent testing of overseas mill effluent described above will inform the design of the EDC testing. The testing procedures are described in section 5e of Module M.

4b. Studies to establish the properties affecting fate of fine particulate organic matter in effluent

4b.1 Approval requirements

Relevant to this issue, condition 35 of the approval requires:

In accordance with the EIMP, to determine the properties affecting the fate of fine particulate organic matter in effluent, Gunns Limited must undertake laboratory studies, agreed to by the Department, to assess the likely settling and flocculation properties of fine particulate organic materials in equivalent effluent.

4b.2 Studies to be undertaken

An exhaustive international literature search has been undertaken but it found no relevant studies of pulp mill effluent settling and flocculation in marine environments. The proposed scope of works described below has been developed at the request of Gunns by the UNSW Water Research Laboratory (WRL) in response to condition 35 of the approval and relevant sections (principally 1.4.4) of the Chief Scientists Report, based on WRL's experience on flocculation studies for other industries.

The proposed methodology aims to describe the likely transport cycle of flocculated material through laboratory studies.

Task 1: Sample analysis and storage: As an initial task WRL will assess the composition of the organic floc and determine the most appropriate methods for storage and handling. This task will focus on issues associated with handling, preparation, reliable analysis, the quantities required and floc storage. During this task, all AQIS permits would be obtained.

Task 2: Physical and structural analysis: Once obtained, the floc will be tested to determine its physical composition, including particle size analysis and distribution and fractal dimensions. These variables are crucial for subsequent tests and in determining the impact of the sample ageing during storage. These tests will be undertaken using a Malvern Mastersizer E, located at UNSW. These tests will also be run at the end of the study to confirm that the sample composition has not altered.

Task 3: Local condition assessment: The available on-site data will be analysed to determine the ambient environmental conditions related to shear and particle transport that are applicable to the study. The resultant criteria will be applied throughout the physical model testing program and incorporated within the numerical modelling predictions (section 4f).

Task 4: Shear tests: Particles will be subjected to a range of shear tests to determine the impact of pipe shear on particle size distribution. These tests will be undertaken in a customised coquette (ie. rotating cylinder) connected to a Malvern Mastersizer E. The results from these tests are crucial to understanding the floc's characteristics upon being discharged from the diffuser.

Task 5: Settling tests: A range of physical model settling tests will be undertaken to determine the particle's settling velocity under various dilution levels. The settling tests will be undertaken in a specialised settling column fitted with a water bath and particle tracking equipment. The results from these tests will be used to determine the particle settling rates and, if relevant, the change in particle composition when the effluent is mixed with seawater. A statistical distribution of settling rates will be determined for a range of particle sizes. These settling rates will be incorporated within the numerical model, together with the information from the chemical testing described in section 4a.2 on the partitioning of contaminants between their dissolved and flocculated forms.

Task 6: Bed shear tests: A range of bed shear tests will be undertaken to determine the resuspension rate (ie. critical shear) of a flocculant mat. These tests will be based on on-site ambient current and wave conditions. These tests will be undertaken in a recirculating flume equipped with an acoustic doppler velocimeter to measure velocity and turbulence, and an in-line focus beam reflective measurement to calculate particle size and distribution. The results from these tests will provide the critical shear rates necessary to resuspend the settled particles. A range of tests will be undertaken to determine the resuspension rates dependent on time of deposition (ie. consolidation). All physical modelling tests will be undertaken using seawater at full scale. The resultant critical shear rates will be incorporated within the numerical model.

Task 7: Dynamic settling and contaminant transport numerical model: A dynamic settling and contaminant transport numerical model will be developed to incorporate the results from the above physical modelling tests and the near-field mixing results into a predictive tool for assessing particle transport and concentrations at a range of locations. The model will incorporate all of the the above findings to track the floc within its transport cycle (shown schematically in Figure 2). The model will be able to be used to determine the distribution of particles along the seabed with distance along the near-field zone. In conjunction with the hydrodynamic modelling (section 4f), which will provide estimates of bed shear stress, the model will be designed to predict deposition and resuspension zones. Results from the model will be used to inform refinements to the design of the long-term monitoring program.

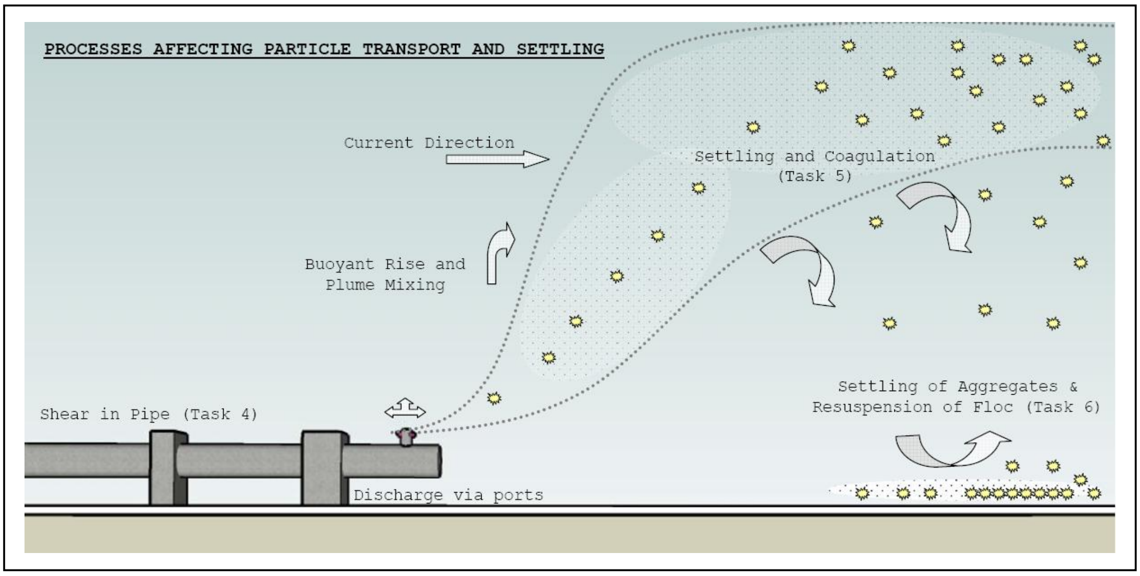


Figure 2: Schematic relationship of processes affecting particle transport and settling and their relationship to the tasks described above (source: UNSW WRL)

4c. Establish maximum limits and trigger levels of pollutants in effluent, receiving environment and sentinel biota

4c.1 Approval requirements

Relevant to this issue, condition 32 of the approval requires:

Gunns Limited must sample the effluent discharge from the operation of the pulp mill for the parameters in the tables below on at least a daily basis. The pulp mill must not operate if the monthly average effluent concentrations from the pulp mill exceed the maximum limits provided in the tables below. These limits may be revised in the final EIMP if agreed by the Independent Expert Group and approved by the Minister as a result of further studies. Maximum limits and trigger levels on additional effluent contaminants (for example, nitrate, resin acid and colour) will also be developed in the EIMP in accordance with Schedule 2.

Parameter	*Monthly average effluent concentration*	
	Trigger level	*Maximum limit*
Dioxins and furans	*2.0 pg TEQ/L*	*3.4 pg TEQ/L*
Chlorate (ClO_3^-)	*1.9 mg/L*	*3.7 mg/L*
Total chloroacetic acids	*237 µg/L*	*237 µg/L*

Parameter	*Monthly average effluent concentration Maximum limit*
Total nitrogen	*2.5 mg/L*
Total phosphorus	*0.8 mg/L*
Total suspended solids	*20 mg/L*
Biological oxygen demand	*11 mg/L*

Also relevant to this issue, condition 33 of the approval requires:

Prior to commissioning, trigger levels for effluent discharge for all phases of development must be included in the EIMP together with agreed response strategies and timeframes if trigger levels are exceeded or maximum limits reached.

Also relevant to this issue, condition 41 of the approval requires:

In accordance with the EIMP, Gunns Limited must prepare and have approved by the Minister, prior to commencement of mill commissioning, strategies for monitoring the impacts of the mill effluent on the marine environment. These strategies must include but not necessarily be limited to:

> *(a) Appropriate early warning of reaching trigger levels in Commonwealth waters.*
> ...
> *g) Effluent monitoring must be undertaken on weekly composites of the daily samples*
> ...

4c.2 Report prepared

In response to the approval requirements, Gunns commissioned Pöyry to prepare a report: *Bell Bay pulp mill project: Trigger levels and maximum limits for effluent concentrations (August 2008)*. A copy of this report is provided in Appendix E.

Pöyry is a global consulting and engineering firm and is a world leader in forest industry engineering and implementation services. Pöyry advised Gunns during its preparation of the pulp mill project's DIIS and the Preliminary Documentation and Response to Submissions documentation.

Of particular relevance to this module, Mr Hannu Jäppinen of Pöyry provided advice on effluent treatment and emissions and Mr Jäppinen also led the preparation of the report in Appendix E.

Mr Jäppinen's area of expertise is in pulp and paper mill process engineering, with a particular emphasis on pollution control planning, environmental pollution control technology, and waste water treatment technology. He holds the degree of Master of Science from the University of Helsinki (1967) and a Diploma in Environmental Science and Technology from the Delft University of Technology (1973). Mr Jäppinen has worked as a process engineer in the pulp industry since he joined Pöyry Forest Industry in 1974. From 1984 to 1992 he was the Manager of Pöyry's Environment Protection Department, and from 1992 to 1997 he was the Director of Environmental Projects in the Asia-Pacific Region in Pöyry's Office in Thailand. Since then Mr Jäppinen has worked as a Senior Consultant in Pöyry's Singapore office with the same responsibility. Prior to joining Pöyry he worked with the Finnish National Water Board and at the Technical and Environmental Research Laboratory of Oy Kaukas Ab (presently part of UPM-Kymmene), where he was responsible for monitoring and reporting the environmental performance of the Kaukas sulphate and sulphite pulp mills in Finland.

The following sections are derived from the report provided in Appendix E, which also references previous material prepared and submitted as part of the approval process, in particular Mr Jäppinen's Expert Witness Statement (available at http://www.gunnspulpmill.com.au/iis/supp/hannu_jappinen_ews.pdf), and are supplemented by further studies of mill performance, including an examination of recent performance data from overseas mills.

4c.3 Mill phase terminology

A number of important terms are used in the following sections:

Water runs: These are undertaken prior to start-up and involve the testing of circuits, pumps and so on using clean water. Only clean water will be used and there will be no contamination sources, so no effluent will be produced. Only clean water would be discharged from the mill.

Start-up: This will be the first input of chips to the digester, or if earlier trials of the pulp drier with purchased fibre are undertaken the first of such trials. In either of these cases effluent will or could be produced (in the latter case although no processing of chips occurs there could be minor contamination due to loss of fibre). The approval defines start-up to constitute the commencement of commissioning. Start-up does not include mill restarts following any mill shutdowns that occur after commissioning, that is during normal operations.

Ramp-up: This follows start-up and involves the ramping up of production levels until they reach the design level. Typically, the ramp-up period is 18 to 24 months, and an 18 month ramp-up is expected for the Bell Bay pulp mill. After ramp-up, the mill enters the "normal operations" phase.

Normal operations: This follows the completion of ramp-up, when production levels have reached design level. Normal operations include mill restarts following mill any shutdowns that occur for maintenance.

4c.4 Statistical terminology

The statistical terminology used for describing the environmental performance of pulp mills (and industrial processes generally) can be confusing and it is important to understand what key terms mean.

To demonstrate the terminology, a hypothetical year long time series of weekly sampling values is shown in Figure 3. The actual concentration values are not pertinent to this demonstration, and have been omitted to avoid suggestions that they are real data. Although Figure 3 is not real data from an actual mill, real data do show these sorts of variability patterns.

The hypothetical time series is based on weekly monitoring values. Weekly monitoring is required for the Bell Bay pulp mill by condition 41(g) of the approval. Condition 32 of the approval, however, sets effluent triggers levels and maximum limits on a monthly basis. In addition to the weekly values, monthly values are therefore also provided in the time series. For simplicity in this demonstration, it is assumed that each month comprises 4 weeks (in practice this will not be the case, because months are not exactly 4 weeks long and true monthly values will contain either 4 or 5 weekly values, depending on how the different cycles line up at any given month end date).

In the graph, each monthly value is the average of the 4 weekly values that fall within that month. As is evident from the graph, variability over the shorter weekly period is much greater than it is for the longer monthly period. Averaging over the longer period smooths out the data.

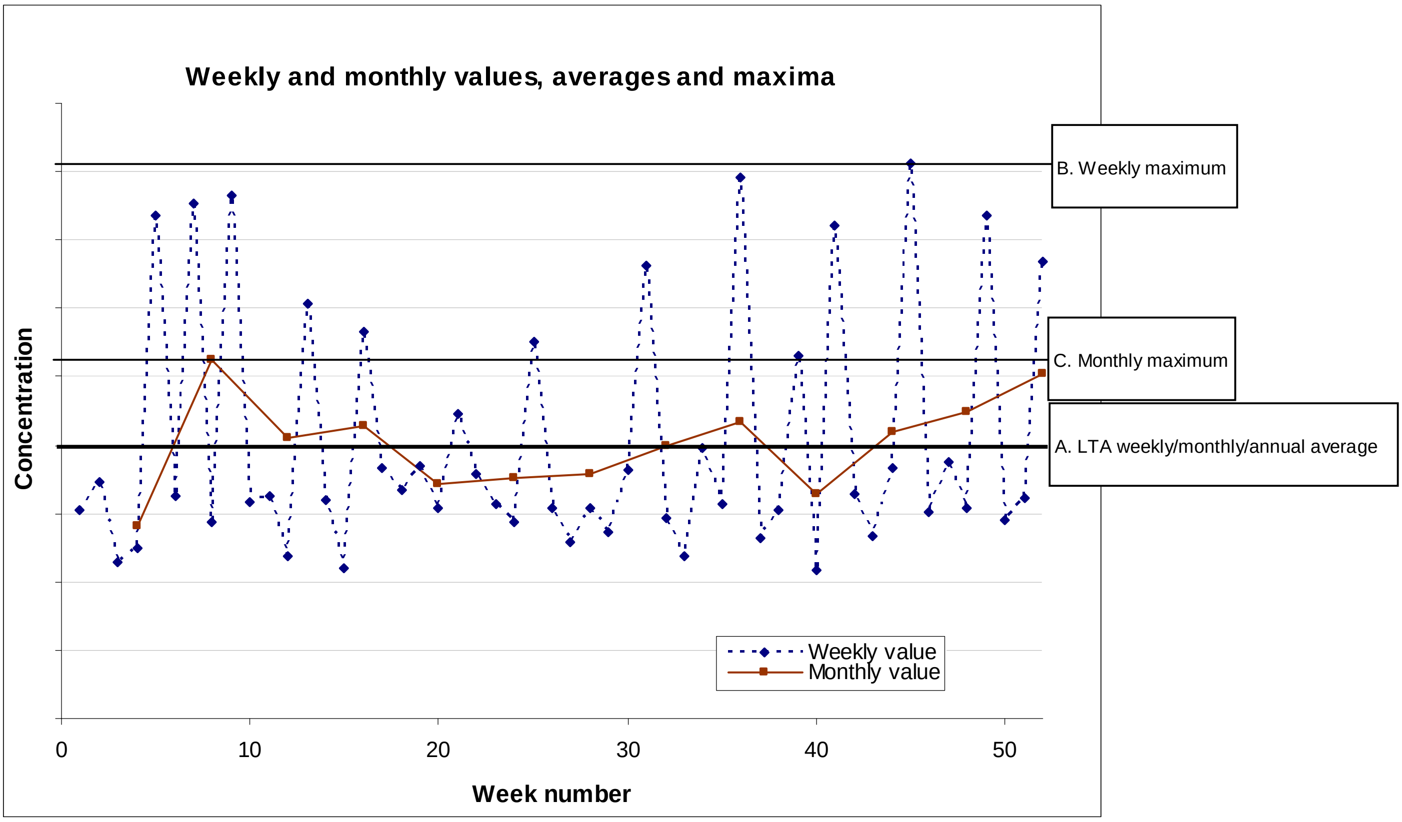


Figure 3: Statistical terminology used for describing pulp mill performance

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Three key statistics are shown in Figure 3:

A. Long Term Average weekly/monthly/annual average – this is the Long Term Average (LTA) of the weekly values over a year, which is the same as the monthly and annual average. The weekly average, monthly average and annual average are identical (they are derived from the same data and the length of the averaging period does not change the average).
B. Weekly maximum – this is the maximum weekly value reached over the year
C. Monthly maximum – this is the maximum monthly value reached over the year. This is lower than the weekly maximum because the monthly period smooths out the weekly peaks - each monthly value is the average of 4 or 5 (depending on the calendar month cycle) weekly values.

Condition 32 of the approval sets a "monthly average maximum limit" for the Bell Bay pulp mill operations. In this term, "average" is taken to be the average of the individual sample values within that month. It is different to the LTA monthly average in A. The monthly maximum C is taken to be the statistic referred to in approval condition 32. This means that there is a maximum limit to which the monthly maximum (C in Figure 3) can rise during normal operations.

Because the LTA monthly average is calculated over a year, each month it is calculated as a 12-month rolling average (the average of that month's and the 11 preceding monthly values). In any given month, the monthly value may be higher than the LTA monthly average but over the 12-month averaging period, the LTA monthly average is achieved.

In any given week, the weekly value may be higher than the weekly average and it may also be higher than the monthly value of the month that it belongs to and higher than the monthly average.

Another important term is "percentiles". Percentiles are used to describe the ranking of a range of values. For example, the weekly 90th percentile (90%ile) is the value that is greater than 90% of weekly values. Similarly, the monthly 90th percentile is the value that is greater than 90% of monthly values. In the hypothetical Figure 3, the weekly 90%ile is approximately the fifth highest weekly value (approximately 90% of the 52 values are lower than the fifth highest) and the monthly 90%ile is approximately the highest monthly value (approximately 90% of the 12 monthly values are lower than it). Percentiles become more precisely determined over periods longer than the single year shown in the hypothetical example.

95 and 95%iles are used in the following sections to develop trigger values. These values are close to the upper end of the normal operating range, and therefore provide a valuable indication of when performance may be trending outside that normal range, a circumstance that would require appropriate response measures to be implemented.

4c.5 Approach taken

Condition 32 of the approval specifies monthly trigger levels (for toxicants) and maximum limits (for all parameters) in terms of concentrations.

Concentration(s) (mass per sample volume) of various determinands are common metrics in environmental monitoring. However, other than for the case of persistent bio-accumulative pollutants — which are not expected to be expressed in modern pulp mill effluent due to the very low concentrations of such contaminants — concentration alone does not infer potential or actual impact of the effluent on the environment. Potential environmental impact is related to contaminant load emitted to the environment over time, which is a combination of concentration and discharge volume over a specified time period (mass per time).

The contemporary practice of industrial regulators in Europe and North America and Australia is to set mass per time (e.g. kg per month) and/or mass per production (e.g. kg per air dried tonne) limits to regulate potential environmental impacts. This is comprehensively described in Beca Amec's (August 2004) *Study report for independent advice on the development of environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania*, which was the basis for the Resource Planning and Development Commission's 2004 *Recommended environmental emission guidelines for any new bleached eucalyptus Kraft pulp mill in Tasmania*. These guidelines were referenced by DEWHA's Recommendation Report to the Minister and also by the Chief Scientist's Report.

The purpose of the Commonwealth approval's trigger levels and maximum limits is to protect the environment, specifically matters of National Environmental Significance. This is made clear by the definitions provided in the approval:

- Maximum limits are levels of specified parameters in a specified medium (such as effluent discharge or benthic sediment) that must not be exceeded in order to ensure protection of the matters of National Environmental Significance defined as controlling provisions for this action under the *Environment Protection and Biodiversity Conservation Act 1999*.
- Trigger levels are levels of specified parameters that, when reached, require the implementation of a response strategy within a specified timeframe as agreed by the Minister. Trigger levels will be below any maximum limits that are relevant to the trigger levels in question.

To best protect the environment, trigger levels and maximum limits must be developed fundamentally in terms of mass emissions, ie. pollutant load discharged in the effluent to the environment over time, and load accumulation in the receiving environment over time. To reflect the approval's use of concentration limits rather than mass emission limits, the trigger levels and maximum limits then need to be converted to their equivalent concentrations.

Pulp mills typically measure pollutant concentrations in effluent in 24-hour composite samples. The daily composite sample concentrations are multiplied by the corresponding daily effluent flow to calculate daily mass emissions. Over a year, depending on the determinant, a pulp mill will typically produce up to 365 individual daily data points of mass emissions which can be analysed statistically[4].

For the purpose of performance predictions made in the DIIS and the Preliminary Documentation, the expected daily effluent "samples" were calculated by converting the planned annual production into average and design daily productions based on the process designs and experiences with mills elsewhere. The results of these calculations were estimates for various analytes of the specific effluent loads per tonne of pulp produced. Empirical statistical coefficients were then applied to simulate the likely short and long term variability of the loads, thereby producing estimates of, for example, 90th percentile and 95th percentile performance for daily values.

Until the mill is operating and real data is obtained, the above approach is the only feasible method of estimating performance and performance variability.

The same approach has therefore been the basis of determining trigger levels. The estimates have also been benchmarked against the performance records of existing similar mills to confirm that the estimates of load patterns and variability are reliable and realistic.

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[4] For the Bell Bay pulp mill, however, approval condition 41(g) stipulates that effluent monitoring must be undertaken on weekly composites of daily samples (i.e. a 7-day average). Over the course of each year a set of 7-day data points for each determinand will be obtained and these data can be subjected to statistical analysis. The dataset will be able to be used to calculate 7-day averages and standard deviations, for example. Condition 32 refers to monthly averages. Because months have 30 or 31 days (apart from February), which are not whole multiples of 7, the requirement for monitoring to be based on 7-day composites will mean that in any given month calculation of monthly averages and standard deviations will be based on either four or five 7-day data points.

The parameters for which trigger levels and maximum limits have been developed are those identified in the tables of condition 32 of the approval, together with the additional parameters contemplated by condition 32 and the further addition of chemical oxygen demand (COD). Together with flow, COD is the principal process control parameter for overall mill performance. The design operating ranges of the other parameters are set as direct or secondary ratios of COD.

The key steps of the approach are:

- Estimate raw (influent to the wastewater treatment plant before treatment) and final (at the wastewater treatment plant outlet after treatment) effluent loads as annual averages

- Estimate raw and final effluent loads as monthly averages and variability about those averages, based on Best Available Technology (BAT) level industry benchmarks

- Estimate raw and final effluent loads as 24-hour averages and variability about those averages based on BAT level industry benchmarks

- Apply the estimates of variability to determine the key percentiles for effluent loads during normal operation (effluent amounts and loads as mass/unit of time)

- Determine appropriate trigger levels using the percentiles where those trigger levels represent effluent loads at the upper limit of the normal expected operating range, therefore signalling that response measures may be necessary

    - 7-day and monthly trigger levels will be developed in terms of mass per unit of time produced on a 7-day basis and monthly basis respectively

    - To reflect the approval's use of concentrations rather than loads, the load based trigger levels will then be converted to equivalent concentration trigger levels, which will be based on expected Long Term Average performance.

- To reflect the approval's "monthly average maximum limit" being taken to be the maximum value that the monthly average can reach in any month (rather than being a rolling average over 12 months), describe how management measures will reduce the monthly variability to ensure that the approval concentration limits are not exceeded.

7-day and monthly trigger levels are derived from the same set of pulp mill daily Long Term Average performance data. 7-day and monthly triggers are therefore fundamentally related because they describe the same mill performance, simply viewed through windows of different periods (weekly or monthly).

Consequently, monthly triggers could not be exceeded without one or more weekly triggers being exceeded. If weekly triggers are exceeded, response measures will be implemented. By responding on a weekly rather than a monthly basis, more responsive actions will be implemented than are contemplated by the approval, which only specifies monthly trigger levels and monthly limits.

The calculations have used mill-wide water balance (MWWB) models. These are interactive Excel spreadsheet models that calculate the water balances and raw effluent loads in steady state production conditions for the following annual production capacities:

- BEKP (bleached eucalypt pulp) production: 1.1 million ADt/yr at available annual production days of 350 days/yr (actual days will be less any softwood days, ie. total production days will be 350 and eucalypt days will be 350 minus up to 49 softwood days)
- BSKP (bleached softwood pulp) production: 100,000 ADt/yr at available annual production days of up to 49 days/yr. Note that the initial mill construction configuration will not allow softwood processing and if and when it is so configured, the maximum length of any single softwood run is likely to be only 8 days.

4c.6 Interaction of approval conditions 32 and 33

Condition 32 sets trigger levels and maximum limits for the mill's operation but provides for the maximum limits specified in the condition 32 tables to be revised in the EIMP as a result of further studies.

Condition 33 recognises that during some phases of the mill's development, trigger levels different to those in the condition 32 tables may be appropriate.

While conditions 32 and 33 necessarily interrelate, the wordings of those conditions do not explicitly refer to each other. Nevertheless, read together the two conditions provide for the determination of trigger levels and maximum limits appropriate to different stages of development, and further provide that those trigger levels and maximum limits may be different to those specified in the condition 32 tables.

A detailed examination of pulp mill performance is reported in Appendix E of this module. The conclusions of that report are summarised below, together with proposed trigger levels and maximum limits during the operating phase (section 4c.7) and the commissioning and ramp-up phase (section 4c.8).

Note that while condition 32 specifies trigger levels and maximum limits in terms of monthly averages, condition 41(g) requires that monitoring is based on 7-day composite samples. This means that monthly trigger levels and maximum limits need to be supplemented with 7-day values. In the following discussion, monthly values are therefore presented, followed by 7-day values.

4c.7 Effluent trigger levels and maximum limits during operations (condition 32)

The estimated final effluent LTA average loads after the waste water treatment plant under normal mill operation (that is, after the commissioning and mill ramp-up phase have been completed), are shown in Table 4, expressed on an annual, monthly, weekly (7-day) and daily basis. The calculations are based on a 350 day operating year, meaning that monthly values are annual divided by 12, weekly values are annual divided by 50 and daily values are annual divided by 350.

Table 4: Estimated final effluent loads and their concentration equivalents for the Bell Bay pulp mill

Parameter	Specific loads		Long Term Average (LTA) loads					LTA concentration	
	Units	Units/ADt	Units	Units per annum	Units per month	Units per week	Units per day	Units	Units per litre
Flow	m^3	20.3	ML	22,348	1862	447	64		
TSS	kg	0.41	tonnes	446	37.2	8.9	1.27	mg	20
BOD5 (total)	kg	0.23	tonnes	257	21.4	5.1	0.73	mg	11
COD (total)	kg	9.45	tonnes	10,395	866	208	29.7	mg	466
Chlorate	kg	0.063	tonnes	69	5.7	1.4	0.20	mg	3.1
Colour	kg	10	tonnes	11,000	917	220	31.4	mg	493
Total N	kg	0.051	tonnes	56	4.66	1.12	0.160	mg	2.5
Total P	kg	0.011	tonnes	12.3	1.02	0.25	0.035	mg	0.6
Nitrate (as N)	kg	0.03	tonnes	29	2.43	0.58	0.083	mg	1.3

The values in Table 4 are Long Term Averages (LTA). LTA are the values expected on average for the time period of interest (eg. day, month or year). Being an LTA, the equivalent concentration is the same regardless of the time period. For TSS, for example, 446 t/22315 ML = 37.2 t/1860 ML = 8.9 t/447 ML = 1.27 t/64 ML = 20 mg/L.

There is variability about those averages. The subject of variability of effluent loads has been described in various documents relating to the Bell Bay pulp mill. These documents are:

- RPDC Guidelines Draft Main Report, Volume 1, Section 5.8.1, titled "Emissions to the marine environment", page 144, sub-section (b), Variability Factors.
- Study report for "Independent advice on the development of environmental guidelines for any new bleached eucalypt kraft pulp mill in Tasmania" by Beca AMEC, Aug 2004, Section 4.7, page 143, Effluent Variability Factors.
- DIIS documentation, Volume 7, Annex 5 "Effluent Load and Treatment Plant Design"
- Expert Witness Statement of Hannu Jappinen section 6.1.3, Attachment 3, Appendix i.

The documentation submitted by Gunns for the DIIS, Expert Witness statements, and for the assessment under the EPBC Act, all presented Long Term Average effluent quality and also the variability about those averages, expressed as LTA minimum and maximum values.

Expected monthly performance

In setting the monthly maximum value, it is necessary to take into account the normal variability of the emissions that occur on a month to month basis. This is the procedure that is used in international practice for defining permit limits and providing for the normal operation of the mill while not compromising environmental protection.

An example of such month to month variability is shown in Figure 4, which presents the actual monthly data for Total Suspended Solids (TSS) from a modern pulp mill in Germany. The values have been calculated based on the reported effluent flow, production and measured emission from the pulp mill corrected to the expected effluent flow of the Bell Bay pulp mill.

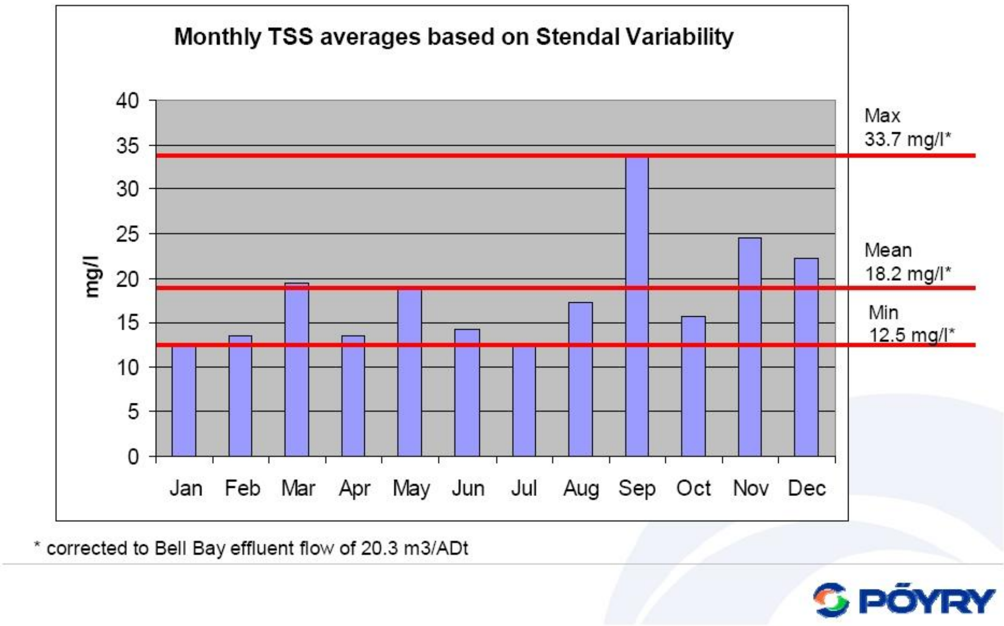

Figure 4: Monthly averages for TSS in the effluent from a pulp mill in Germany

The expected monthly average emissions for the Bell Bay pulp mill were based on Long Term Average (LTA) data. For example, they describe the LTA load of TSS in a typical (average) tonne of pulp. For the example mill shown in Figure 4, this is the line drawn as the mean (average[5]) of 18.2 mg/litre in that graph. The expected LTA average monthly emissions therefore represent what is expected in an average month, ie. 12 monthly values averaged over the 12 month year.

The expected monthly values described in Table 6.1 of the Preliminary Documentation were calculated in this manner. Those values are therefore the values expected in an average month, ie. they are the sum of 12 monthly data points divided by 12. In any particular month of a year, the monthly value may be higher or lower than the expected LTA monthly average but over a year the average month will be the value presented in Table 6.1 of the Preliminary Documentation.

Table 6.1 values (with the addition of some parameters) were carried into DEWHA's assessment document as item 17 (page 5) of that report[6]. Table 6.1 values (with the additional parameters) were in turn also presented in the Chief Scientists Report (pages 39 and 53). The origins of the condition 32 values can therefore be traced directly back to Table 6.1 of the Preliminary Documentation. However, in approval condition 32 the values are taken to be the values achieved in any given month, rather than being LTA monthly values. This means that the mill will need to be operated with lower variability than was contemplated in Table 6.1 of the Preliminary Documentation.

Over a year there will be a range of values above and below the LTA average month's value. This variability is shown in the Figure 4 example as monthly values that lie above and below the average (mean) of 18.2 mg/litre in that graph.

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[5] Note that in this module, for consistency with the approval's terminology, the term "average" will henceforth be used rather than its synonym "mean".

[6] Note that Table 6.1 contained an error in the average chlorate value, which was stated to be 1.9 mg/L. This error was corrected in the Witness Statement of Hannu Jappinen but was not picked up in the Preliminary Documentation. The value of 1.9 mg/L for chlorate was amended through the approval to be 3.7 mg/L.

Note that the distribution of values in Figure 4 is a Poisson distribution, which is a skewed distribution with more than half the values lying below the mean and fewer values lying above the mean. This is typical of pulp mill effluent characteristics. In the Figure 4 example, 3 out of 12 monthly values lie above the mean and 9 out of 12 monthly values lie below the mean.

With LTA averages there will be a few months in the year when the individual monthly value will be higher than the LTA average. However, these will be balanced by the greater number of months when the values are lower than the LTA average. Over a given year of operations, the LTA average will be achieved.

Monthly averages will be calculated on a rolling 12-month basis, to produce a trend of LTA monthly averages over time, which will describe changes in the performance of the mill.

Although effluent loads and concentrations follow a Poisson distribution, for simplicity and convenience effluent variability has been assumed to be a normal (Gaussian, ie. symmetrically bell shaped) distribution for the purpose of developing trigger levels. This is a conservative assumption and leads to a more stringent emission regime because it pushes the mean towards lower values.

The values presented in Table 4 are Long Term Averages and the monthly values are what are expected in an average month.

However, there is an expected variability of the monthly effluent load which is mostly caused by the variability of the monthly average production. In addition to the production throughput variability, variability of in-plant and external effluent control systems also occurs. The total effect of the production variability and control system variability has been estimated based on a statistical analysis of monthly averages of daily monitoring data from existing pulp mills with accepted modern technology. The referenced mills had been under operation for some time and the data do not include commissioning or ramp-up data.

The referenced monthly data show the coefficient of variation (CV) for the final effluent which is the standard deviation expressed as a percentage of the mean (average) value. The CVs of various parameters are shown in Table 5.

Table 5: Monthly effluent coefficient of variation (or standard deviation %) of monthly averages of daily final effluent loads

Parameter	Coefficient of variation, CV (%)
Flow	5
TSS	30
BOD5 (total)	20
COD (total)	10
Chlorate	13
Colour	10
Total N	15
Total P	35
Nitrate (as N)	15

The monthly average data has been analysed and estimates of the 90 and 95 percentiles calculated using the respective standard deviation multiplier factors shown in Table 6, assuming a normal distribution.

Table 6: Monthly standard deviation multipliers

Percentile	Standard Deviation Multiplier, SDM
90	1.313
95	1.645

Multiplying the monthly average final effluent load (in column 3 of Table 7) by (1+(CV/100) x SDM) for each of the percentiles gives the expected variability of effluent loads, expressed as 90 and 95 percentiles. These percentiles are shown in Table 7 for both loads and their equivalent concentrations, which are calculated by dividing the percentile monthly load by the equivalent percentile monthly flow.

Table 7: Monthly final effluent variability

	Variability of monthly loads				Variability of monthly concentrations			
Parameter		**Average**	**90%-ile**	**95%-ile**		Average	**90 %-ile**	**95 %-ile**
	Units	Units/d	Units/d	Units/d	Units	Units/litre	Units/litre	Units/litre
Flow	ML	63.9	68.0	69.1				
TSS	tonnes	1.27	1.78	1.90	mg	20	26	28
BOD5 (total)	tonnes	0.73	0.93	0.97	mg	11	14	14
COD (total)	tonnes	29.7	33.6	34.6	mg	465	494	500
Chlorate	tonnes	0.20	0.23	0.24	mg	3.1	3.4	3.5
Colour	tonnes	31	36	37	mg	492	523	530
Total N	tonnes	0.160	0.191	0.199	mg	2.5	2.8	2.9
Total P	tonnes	0.035	0.051	0.055	mg	0.6	0.8	0.8
Nitrate (as N)	tonnes	0.083	0.100	0.104	mg	1.3	1.5	1.5

The values shown in Table 7 are based on world's best practice LTA averages and variability. However, further reductions in variability will be achieved at the Bell Bay pulp mill to meet the condition 32 limits, thereby establishing new world benchmarks. These variability reductions will be achieved by using flocculation in the treatment plant to remove organic matter and by the use of the spill basin to buffer flows into the treatment plant.

The potential for the spill basin to be used in this manner without compromising its primary emergency role is described in the technical report in Appendix F, and is summarised as follows.

The spill basin can be used to reduce the variability of effluent quality by providing a buffer against spills and process upsets in the pulp mill and against process upsets in the effluent treatment plant.

The spill basin volume of 100,000 m^3 is 38% oversized for the size of the pulp mill. However, the State permit requires that 90% of this full volume is available 95% of the time over a year. This restriction corresponds to the spill basin being available for off-limit effluent for an average volume of 10,000 m^3 for 347 days per year and beyond 10,000 m^3 for 18 days per year.

Use of the spill basin to reduce variability due to spills and process upsets in the pulp mill could be required on up to 15 days per year. The maximum volume expected to be required for diversion to the spill basin in these circumstances is estimated to be 3000 kL/hour. Operational management procedures typically would have the incident under control within up to 4 to 6 hours, requiring up to a 12,000 to 18,000 kL diversion to the spill basin for up to those 15 days. This is within the restrictions set by the State permit.

Use of the spill basin to reduce variability due to process upsets in the effluent treatment could be required up to 20% of the operating time per annum as an absolute maximum. This will typically be due to periodic surges in TSS in the final effluent due to the inherently dynamic nature of activated sludge in variable growth conditions. Surges in TSS concentrations cause correlated surges in other effluent parameters, notably BOD, N and P. The frequency of these TSS surges is in the order of 1 to 2 weeks and their duration is typically 1 to 4 days.

On average, the frequency of occurrence will be about 10 days. The required diversion to the spill basin would be returned to the effluent treatment plant over the intervening 10 day period, amounting to an average daily occupancy of the spill basin of between approximately 1600 and 3200 kL per day over this period. This is well within the restrictions set by the State permit.

Although considered unlikely, it is possible that a combination of a daily volume discharge spike and extraordinary conditions in the receiving environment, such as an unusual combination of extreme temperature stratification and slack tide, might lead to a less than optimum near field dilution at the diffuser. The likelihood of this occurring and the spatial extent of the initial dilution zone in these circumstances will be determined by the hydrodynamic modelling and diffuser performance confirmation studies. If these studies suggest that such circumstances warrant mitigation action, the spill basin could be used to buffer discharge flows during these periods to reduce impacts on the performance of the diffuser. These diversions would by intent only be in the order of 2 hours, and the impacts on the availability of the basin would be negligible.

In the situation of a pulp mill spill or process upset coinciding with an effluent treatment plant process upset, the combined diversion requirements would be up to approximately 21,000 kL per day on 15 days of the year. This is still within the restrictions set by the State permit.

In summary, the spill basin volume is sufficient to allow it to be used to achieve the further reductions in effluent variability necessary to satisfy the approval conditions while not exceeding the availability restrictions set by the State permit.

These further variability reduction measures will reduce the final effluent variability to that shown in Table 8 (compared with that shown in Table 5).

Table 8: Monthly effluent coefficient of variation (or standard deviation %) to meet approval limits

Parameter	Coefficient of variation, CV (%)
Flow	2
TSS	12
BOD5 (total)	15
COD (total)	10
Chlorate	12.5
Colour	10
Total N	13
Total P	35
Nitrate (as N)	13

The standard deviation multipliers will remain unchanged from those shown in Table 6.

The resultant final effluent variability is shown in Table 9.

Table 9: Monthly final effluent variability

	Variability of monthly loads				Variability of monthly concentrations			
Parameter		**Average**	**90%-ile**	**95%-ile**		Average	**90 %-ile**	**95 %-ile**
	Units	Units/d	Units/d	Units/d	Units	Units/litre	**Units/litre**	**Units/litre**
Flow	ML	62.0	63.5	63.9				
TSS	tonnes	1.1	1.3	1.3	mg	18	**20**	**20**
BOD5 (total)	tonnes	0.6	0.7	0.7	mg	9	**11**	**11**
COD (total)	tonnes	27.2	30.8	31.7	mg	439	**485**	**496**
Chlorate	tonnes	0.19	0.22	0.23	mg	3.1	**3.5**	**3.6**
Colour	tonnes	31	35	36	mg	493	**545**	**558**
Total N	tonnes	0.13	0.16	0.16	mg	2.2	**2.5**	**2.5**
Total P	tonnes	0.03	0.05	0.05	mg	0.5	**0.7**	**0.8**
Nitrate (as N)	tonnes	0.07	0.08	0.08	mg	1.1	**1.3**	**1.3**

As can be seen from Table 9, the restriction in variability has brought the 90 and 95%iles very close together (with decimal rounding, in some cases to the point of equivalence).

The 95%iles in Table 9 are the maximum values that are expected to occur in an operating year (95% of 12 months is 11.4 months, which is the annual operating period allowing for maintenance shutdowns). Comparison of Table 9 with the maximum limits specified in condition 32 shows that those maximum limits will be achieved.

For chlorate and also dioxins & furans and chloroacetic acids, the monthly trigger levels from condition 32 are adopted. Condition 32 does not require monthly trigger levels to be specified for non-toxicants.

For those parameters (COD, colour, nitrate) for which condition 32 does not specify a maximum limit the 95%ile values (in blue bold) are carried through as maximum limits to the summary table of maximum limits and trigger levels in Table 23 in section 4c.9. For the other parameters (dioxins & furans, chlorate, chloroacetic acids, total N, total P, TSS and BOD), the specified condition 32 limits will apply.

Expected 7-day performance

The monthly period used in Table 7 reflects the monthly period used by the approval conditions 32 and 33. However, approval condition 41(g) requires monitoring to be based on 7-day composites. To satisfy this condition (while also satisfying 32 and 33), mill management decisions in relation to compliance with the approval conditions will be based on 7-day composite monitoring results[7]. The mill's trigger values, which are management decision determiners, must therefore also be 7-day values.

Based on the experience of numerous operating mills, the average weekly load is known to be approximately 90% of the average maximum weekly load. The expected 7-day average maximum weekly load was therefore determined by taking the average weekly loads shown in Table 4 and dividing by 0.9.

Table 10 shows the resultant 7-day average maximum loads for final effluent.

[7] This 7-day period reflects the approval requirements and decisions necessary to meet the approval conditions. However, the day to day practical management of the mill will be based on real time in-line monitoring data that is fed to a centralised control room. The mill controls are continually monitored and adjusted as necessary to maintain the mill's performance within its design range.

Table 10: 7-day (week) average maximum final effluent loads

Parameter	Units	Final effluent weekly average	Final effluent weekly average maximum
Flow	ML/week	447	496
TSS	tonnes/ week	8.9	9.9
BOD5 (total)	tonnes/week	5.1	5.7
COD (total)	tonnes/week	208	231
Chlorate	tonnes/week	1.4	1.5
Colour	tonnes/week	220	244
Total N	tonnes/week	1.1	1.2
Total P	tonnes/week	0.25	0.27
Nitrate (as N)	tonnes/week	0.6	0.6

Table 10 values are for an average 7-day (week) period. As with the monthly loads, there will be variability about this average. On a week to week basis, values will be above or below this LTA average.

As was done earlier for the monthly values, a 7-day coefficient of variation (CV) for the final effluent was then applied to the average maximum values in Table 10. The CVs of the various parameters are shown in Table 11.

Table 11: 7-day effluent coefficient of variation (or standard deviation %) of final effluent

Parameter	Coefficient of variation, CV (%)
Flow	6
TSS	35
BOD5 (total)	25
COD (total)	15
Chlorate	15
Colour	20
Total N	35
Total P	70
Nitrate (as N)	35

The 7-day average maximum data were used to calculate estimates of the 90 and 95 percentiles using the respective standard deviation multiplier factors shown in Table 12, assuming for simplicity and conservativeness a normal distribution.

Table 12: 7-day standard deviation multipliers

Percentile	Standard Deviation Multiplier, SDM
90	1.313
95	1.645

Multiplying the 7-day average maximum final effluent load (in Table 10) by (1+(CV/100) x SDM) for each of the percentiles gives the expected variability of maximum effluent loads, expressed as 90 and 95 percentiles. These percentiles are shown in Table 13 for both loads and their equivalent concentrations, which are calculated by dividing the percentile 7-day loads by the average weekly flow.

The average weekly flow (447 ML) is used as the divisor, rather than the percentile flow as was used for the monthly calculations, because flow variations on a week to week basis are slight during normal operations and because the maximum loads and maximum effluent volumes do not necessarily coincide.

(Note that in this table the average maximum flow (496 ML/week) and the average weekly flow (447 ML/week) are different statistics.)

Table 13: 7-day final effluent variability

	Variability of 7-day maximum loads				Variability of 7-day maximum concentrations*			
Parameter		**Average**	**90%-ile**	**95%-ile**		**Average**	**90%-ile**	**95%-ile**
	Units	Units/wk	Units/wk	Units/wk	Units	Units/litre	Units/litre	Units/litre
Flow	ML	497	536	546				
TSS	tonnes	9.92	14.47	15.62	mg	22.2	32.4	35.0
BOD5 (total)	tonnes	5.70	7.57	8.05	mg	12.8	16.9	18.0
COD (total)	tonnes	231	276.5	288.0	mg	517	619	644
Chlorate	tonnes	1.53	1.83	1.91	mg	3.4	4.1	4.3
Colour	tonnes	244	309	325	mg	547	690	727
Total N	tonnes	1.24	1.81	1.96	mg	2.78	4.06	4.38
Total P	tonnes	0.27	0.52	0.59	mg	0.61	1.17	1.32
Nitrate (as N)	tonnes	0.65	0.94	1.02	mg	1.45	2.11	2.28

*Concentration flow basis = average weekly flow = 447 ML/week

The reduction in variability shown in Table 9, which is necessary to meet the condition 32 monthly limits, reduces the average weekly flow from 447 ML/week to 434 ML/week and there is a corresponding change in the 7-day concentrations, as shown in Table 14.

(Note that in this table the average maximum flow (482 ML/week) and the average weekly flow (434 ML/week) are different statistics.)

Table 14: 7-day final effluent variability after monthly variability reduction

	Variability of 7-day maximum loads				Variability of 7-day maximum concentrations*			
Parameter		**Average**	**90%-ile**	**95%-ile**		**Average**	**90%-ile**	**95%-ile**
	Units	Units/wk	Units/wk	Units/wk	Units	Units/litre	**Units/litre**	**Units/litre**
Flow	ML	482	520	530				
TSS	tonnes	8.50	12.40	13.39	mg	20	**29**	**31**
BOD5 (total)	tonnes	4.58	6.08	6.46	mg	11	**14**	**15**
COD (total)	tonnes	212	253.3	263.8	mg	487	**583**	**608**
Chlorate	tonnes	1.49	1.78	1.86	mg	3.4	**4.1**	**4.3**
Colour	tonnes	238	300	316	mg	548	**691**	**728**
Total N	tonnes	1.04	1.52	1.64	mg	2.40	**3.50**	**3.78**
Total P	tonnes	0.24	0.46	0.52	mg	0.56	**1.07**	**1.20**
Nitrate (as N)	tonnes	0.53	0.78	0.84	mg	1.23	**1.79**	**1.93**

*Concentration flow basis = average weekly flow = 434 ML/week

The 90 and 95%ile concentrations (in blue bold) in Table 13 will be used as two-tiered trigger values relevant to approval condition 32 for the mill operating under normal conditions (ie. after the commissioning and ramp-up phase). These trigger values are carried through to the summary table of maximum limits and trigger levels in Table 23 in section 4c.9.

If tier one triggers (90%ile) are reached in any 7-day sample, the cause(s) will be assessed and the appropriate response measure(s) will be determined and implemented. If tier two (95%ile) triggers are nevertheless reached in a subsequent 7-day sample (ie. despite the response measures) production levels will be decreased so that the monthly average maximum concentration limits in the condition 32 tables will not be exceeded.

No revision of the condition 32 monthly trigger levels and maximum limits for dioxins and furans and total chloroacetic acids is proposed.

The addition of a 7-day trigger level for resin acids is proposed.

Because of the inconsistency of the input of softwood into the pulping stream and the short-term campaigns (in the order of a week only), a monthly trigger level is not appropriate. A resin acid occurs in the effluent only during the pine pulp production and for a few days after the bleached softwood production campaign is finished.

However, a monthly limit of 80 µg/L has been adopted. This is based on data described in the Preliminary Documentation, specifically *Annex X Pinus radiata production* of Volume 7 of the DIIS. As shown in Figure 3/1 of that document, resin acids increase during a softwood run to a maximum of approximately 200 µg/L then reduce to zero again at the end of a run. Spread over a monthly averaging period, the average concentration of resin acids will be approximately 55 µg/L. Allowing a 50% variability factor leads to a maximum expected monthly resin acids concentration of 80 µg/L. This has been adopted as the monthly average maximum limit in Table 23 in section 4c.9.

The total extractives in the raw effluent (before the effluent treatment process) have been estimated at about 0.26 kg/ADt or about 10.8 mg/L. The share of resin acids of the total is about 45%, or 0.117 kg/ADt and 4.9 mg/L in the raw effluent. The maximum expected length of any pine pulp production campaign is 8 days. After the effluent treatment process the discharge effluent is estimated to have a resin concentration of approximately 0.25 mg/L.

Therefore the variability of the resin acids formed fluctuates from 0 (based on the production periods with eucalyptus only) to the 0.25 mg/L value in the final effluent stated above. This concentration has been adopted as the 7-day trigger value.

4c.8 Effluent trigger levels and maximum limits during commissioning and ramp up (condition 33)

Approval condition 33 recognises that there will be some phases of the mill's development when the levels and limits set by condition 32 for the normal operation of the mill do not apply.

While conditions 32 and 33 necessarily interrelate, the wordings of those conditions do not explicitly refer to each other. Nevertheless, read together the two conditions provide for the determination of trigger levels and maximum limits appropriate to different stages of development, and further provide that those trigger levels and maximum limits may be different to those specified in the condition 32 tables.

As with all industrial processes, pulp mills have a commissioning and ramp-up phase during which process controls are fine tuned and optimised until the process settles to a steady state operation. International practice for pulp mills recognises that the commissioning and ramp-up phase extends for approximately 18 to 24 months after initial start up. Performance during this period is demonstrated by the Orion (Botnia) Pulp Mill in Uruguay, which recently released an independent performance review of its early operations (EcoMetrix (July 2008) *Orion Pulp Mill, Uruguay: Independent Performance Monitoring as required by the International Finance Corporation: Phase 2: Six-Month Environment Performance Review*, available at www.ifc.org/ifcext/lac.nsf/Content/ Uruguay_Pulp_Mills). The Orion Pulp Mill uses similar technology to that proposed for Bell Bay, it processes eucalypts and it is of a similar size.

An appropriate commissioning and ramp-up phase set of limits would be based on the projected monthly maximum emission values being realised as annual averages. Further, the concentration limits for some of the main parameters are not considered appropriate during the commissioning and ramp-up period, which is characterised by frequent start-ups and shut downs. Therefore, it is more appropriate to regulate by environmental loads rather than concentrations during this period, apart from dioxins and furans and chloroacetic acids, for which concentration limits should still apply.

Examples of the ranges of effluent performance are provided in the study report in Appendix E. A particularly relevant example is the Botnia mill at Frey Bentos in Uruguay. This mill is of a similar design and capacity (1 million ADt/annum) to the proposed Bell Bay mill and it also utilises eucalyptus as its raw material. Although there are some differences between the two mills the raw effluent load to the waste water treatment plant can be considered to be quite similar. The performance statistics of the Botnia mill are publicly available (on the mill's web site (www.metsabotnia.com) and are described in detail in the report in Appendix E.

The variability of performance and the higher loads and concentrations that occur following start-up until the mill's operation settles down mean that measuring environmental performance by effluent loads rather than concentrations is the most effective approach, although dioxins and furans and chloroacetic acids would still be managed by concentrations.

The maximum annualised loads permitted by the approval condition 32 limits are shown in Table 15, other than for dioxins and furans and chloroacetic acids, for which the concentration limits will be adopted. These loads have been calculated by taking the permitted concentration multiplying by 64 ML/d (the annual average effluent flow) and multiplying by 365 days per year.

Table 15: Maximum annualised loads permitted by approval condition 32

Parameter	Concentration (mg/L)	Equivalent annualised load limit (tonnes/annum)
TSS	20	467
BOD5 (total)	11	257
Chlorate	3.7	86
Total N	2.5	58
Total P	0.8	19

The Botnia data demonstrate the variability in performance that occurs during the commissioning and start-up phase. Because mill performance during this phase can vary significantly, it is appropriate to use the weekly variability as the basis for determining maximum limits and trigger values.

The 7-day effluent load variability has been provided in Table 13. Table 16 shows the average maximum 7-day load expressed as specific loads (load per unit production).

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Table 16: 7-day maximum final effluent specific loads

Parameter	Units	Average
Flow	kL/ADt	20.29
TSS	kg/ADt	0.41
BOD5 (total)	kg/ADt	0.23
COD (total)	kg/ADt	9.45
Chlorate	kg/ADt	0.06
Colour	kg/ADt	10.00
Total N	kg/ADt	0.05
Total P	kg/ADt	0.01
Nitrate (as N)	kg/ADt	0.03

As was done earlier for the normal operation, a 7-day coefficient of variation (CV) for the final effluent was then applied to the average values in Table 16. These CVs have been previously provided in Table 11 and are shown again in Table 17.

Table 17: 7-day effluent coefficient of variation (or standard deviation %) of final effluent data

Parameter	Coefficient of variation, CV (%)
Flow	6
TSS	35
BOD5 (total)	25
COD (total)	15
Chlorate	15
Colour	20
Total N	35
Total P	70
Nitrate (as N)	35

The 7-day average maximum data in Table 16 were used to calculate estimates of the 84, 90, and 95 percentiles[8] using the respective standard deviation multiplier factors shown in Table 18, assuming for simplicity and conservativeness a normal distribution.

Table 18: 7-day standard deviation multipliers

Percentile	Standard Deviation Multiplier, SDM
84	1.000
90	1.313
95	1.645

Multiplying the 7-day final effluent load (in Table 16) by (1+(CV/100) x SDM) for each of the percentiles gives the expected variability of maximum effluent loads, expressed as 84, 90 and 95 percentiles. These percentiles are shown in Table 19.

[8] The 84%ile is the average plus half a standard deviation

Table 19: 7-day maximum final effluent variability

Parameter	Units	Average	84%-ile	90%-ile	95%-ile
Flow	kL/ADt	20.29	21.50	21.88	22.29
TSS	kg/ADt	0.41	0.55	0.59	0.64
BOD5 (total)	kg/ADt	0.23	0.29	0.31	0.33
COD (total)	kg/ADt	9.45	10.87	11.31	11.78
Chlorate	kg/ADt	0.06	0.07	0.07	0.08
Colour	kg/ADt	10.00	12.00	12.63	13.29
Total N	kg/ADt	0.05	0.07	0.07	0.08
Total P	kg/ADt	0.01	0.02	0.02	0.02
Nitrate (as N)	kg/ADt	0.03	0.04	0.04	0.04

A typical ramp up curve for a similar, modern pulp mill is shown in Figure 5.

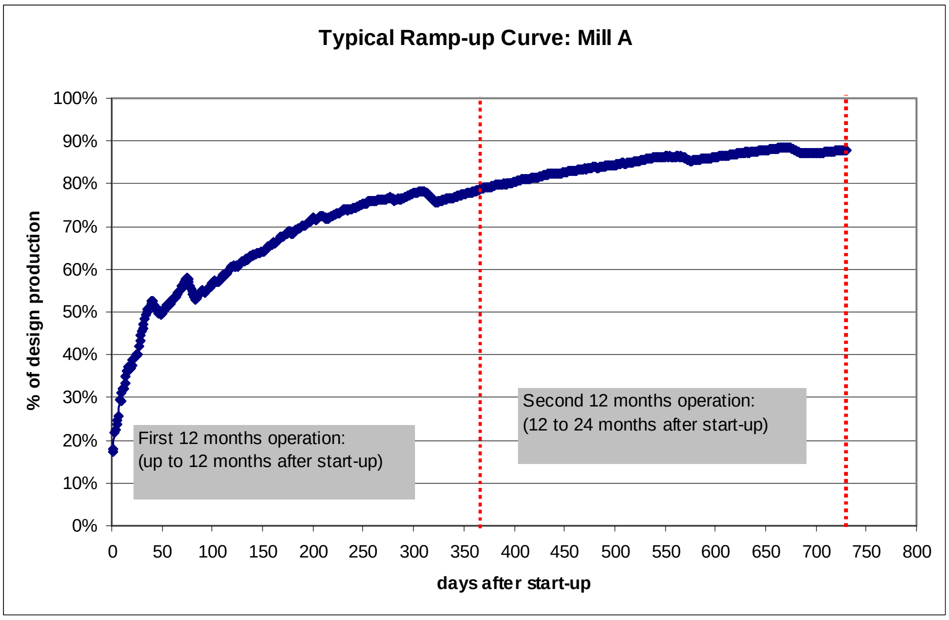

Figure 5: Typical ramp up curve for a similar mill

To reflect the decreasing variability of performance with time over the 18 month commissioning and ramp-up phase, the 18 months is divided into three 6 month periods. Progressively lower percentiles are then applied to the succession of phases, as shown in Table 20. Table 20 also shows the assumed production rates over these phases, as a percentage of full production.

Table 20: Applicable percentiles over commissioning and ramp-up phases

Period	Commissioning and ramp-up		
Months	0 – 6	7 – 12	13 –18
Percentile	95	90	84
Production rate	75-80%	75-80%	~90%

The effluent load produced in each phase is calculated by multiplying the effluent specific load by the respective production for that phase, and the cumulative load can then be calculated. The results of these calculations are shown in Table 21 together with the annualised load limits from Table 15. Because there will be no contamination sources during the water runs that precede start-up (see section 4c.3), these limits would not apply to that phase.

Table 21: Annualised loads during the commissioning and ramp-up phases

Parameter	Units	**Annualised load limit** (from Table 15)	**Total load** **0 to 12 months after start-up**	**Load** **12 to 18 months after start-up**	**Load*** **18 to 24 months after start-up**	**Total load** **12 to 24 months after start-up**
TSS	tonnes/annum	**467**	462	252	187	438
BOD5 (total)	tonnes/annum	**257**	240	134	107	241
Chlorate	tonnes/annum	86	57	33	29	62
Total N	tonnes/annum	**58**	58	32	23	55
Total P	tonnes/annum	**19**	17	9	5	14

*In this period, the commissioning and ramp-up phase has ended and the mill is operating with the normal variability shown in Table 9

The annualised limits shown in Table 21 (in blue bold) are carried through to the summary table of maximum limits and trigger levels in Table 24 in section 4c.9. Note that the annualised limit for chlorate is not carried through in this way. The commissioning and ramp-up phase limit for chlorate will be a maximum load emission of 7 tonnes in any month (86 tonnes per year divided by 12 months = 7 tonnes per month, with rounding).

These limits will only apply to the first 12 months after start-up (thereafter the normal operating limits will apply). During this first year, on a monthly basis these limits will be applied by calculating the year-to-date limit in any particular month number M by multiplying the annual limit by (M/12).

As shown in Table 21, the annualised loads during the commissioning and ramp-up phases will be below the annualised load limits corresponding to the condition 32 concentration limits.

TSS is the value which is closest to the equivalent annual load. TSS is the most difficult parameter to control consistently in an activated sludge plant, since it is influenced by many process variables and the dynamic variability of the biomass population in the activated sludge. The relative share of filamentous bacteria in the population would be kept under control, but they can never be completely eliminated. It takes a long time before the plant operation can be stabilized reasonably well and even then filaments are causing occasional problems due, for instance, to variable oxygen concentration, COD-nutrient ratios, pH, temperature, etc. in aeration basin. Because such variability is higher during the ramp-up phase, this phase is much more vulnerable to bulking sludge phenomena than the normal operation phase.

One of the main driving forces in the development of modern selector type activated sludge plants was an improved control of filaments and sludge bulking, but so far it has been impossible to completely eliminate the bulking especially during the ramp-up phase. It should be noted that the type of effluent treatment plant that Gunns has selected is the best available, but still no guarantees to completely eliminate sludge bulking can be given. It is for this reason that the maximum limit TSS load should be considered higher in the first 12 months after start-up. The unavoidable variability of TSS also causes the variability of nutrient, BOD, and to a lesser extent COD-loads in the final effluent.

Trigger levels have also been developed for the commissioning and ramp-up phases, based on the projected production and loads expected during the commissioning and ramp-up phase. The annual specific effluent flows have been used in conjunction with the maximum annual loads from Table 21 in order to calculate the respective annual trigger values as concentrations for the first 12 months after the initial mill start-up.

These values have been further reviewed against the Botnia mill's experience in Uruguay (described in Appendix E) and the capabilities of modern efficient effluent treatment plants.

The proposed trigger values for the commissioning phase and for ramp-up after start-up are given in Table 22.

Table 22: Weekly trigger values for commissioning and ramp-up phases

Parameter	Units	0 to 12 months from start-up
Dioxins and furans	pg TEQ/L	**2**
Total chloroacetic acids	µg/L	**237**
TSS	mg/L	**100**
BOD5 (total)	mg/L	**25**
Chlorate	mg/L	10
Total N	mg/L	**8.0**
Total P	mg/L	**0.8**

The trigger values (in **blue bold**) in Table 22 are carried through to the summary table of maximum limits and trigger levels in Table 24 in section 4c.9. Note that the trigger level for chlorate is not carried through in this way. The trigger level for chlorate will be the same as for normal operations, 1.9 mg/L.

4c.9 Summary of effluent trigger levels and maximum limits

In accordance with conditions 32 and 33, and based on the preceding discussion (and the detailed analysis provided in Appendix E), the proposed trigger levels and maximum limits for the Bell Bay pulp mill are summarised in Table 23 for normal operations and Table 24 for the commissioning and ramp up phase.

The mill will not operate if the monthly average effluent concentrations exceed the maximum limits specified in Table 23.

Table 23: Trigger levels and maximum limits for the Bell Bay pulp mill during normal operations

Parameter	Units	7-day trigger level Tier 1 (from condition 32 and Table 14)	7-day trigger level Tier 2 (from condition 32 and Table 14)	Units	Monthly trigger value (from condition 32 and Table 9)	Monthly average maximum limit (from condition 32 and Table 9)
Dioxins & furans	pg TEQ/L	2	2	pg TEQ/L	2.0	3.4
Total chloroacetic acids	µg/L	237	237	µg/L	237	237
Total resin acids	mg/L	0.25	0.25	mg/L	N/A	0.08
TSS	mg/L	29	31	mg/L	(Not required)	20
BOD5 (total)	mg/L	14	15	mg/L	(Not required)	11
COD (total)	mg/L	583	608	mg/L	(Not required)	496
Chlorate	mg/L	4.1	4.3	mg/L	1.9	3.7
Colour	mg/L	691	728	mg/L	(Not required)	558
Total N	mg/L	3.50	3.78	mg/L	(Not required)	2.5
Total P	mg/L	1.07	1.20	mg/L	(Not required)	0.8
Nitrate (as N)	mg/L	1.79	1.93	mg/L	(Not required)	1.3

Table 24: Weekly trigger levels and maximum limits for the Bell Bay pulp mill during commissioning and ramp-up phases

Parameter	Units	Concentration limit or load limit*	Units	Trigger level 0 to 12 months from start-up
Dioxins and furans	pg TEQ/L	3.4	pg TEQ/L	2
Total chloroacetic acids	µg/L	237	µg/L	237
TSS	t/a	467	mg/L	100
BOD5 (total)	t/a	257	mg/L	25
Chlorate	t/month	7	mg/L	1.9
Total N	t/a	58	mg/L	8.0
Total P	t/a	19	mg/L	0.8

* Apart from dioxins and furans, chloroacetic acids and chlorate, at any particular month number M, the year-to-date limit will be calculated by multiplying the annual limit by (M/12). For chlorate, the monthly load limit applies in any month.

4c.10 Risk management and responses to trigger levels being exceeded and maximum limits being approached or exceeded

The mill will have a very sophisticated, integrated control system where performance is continually monitored and controlled in real time. This system includes real-time, in-line measurement of indicator parameters (including temperature, pH, electrical conductivity, TSS, BOD and COD) and mill operators will adjust controls as necessary to maintain performance within acceptable operating ranges.

The potential for concentration spikes of chlorate (and other toxics) to occur in effluent will be managed by careful control of the chlorine dioxide charge in the mill itself. Continuous monitoring of the redox potential in the chlorate removal stage of the effluent treatment plant will provide a real time indication of any potential for the generation of excess chlorate.

These real time observations will be supplemented with laboratory measurements. These measurements will be different to those used for compliance assessment against the condition 32 limits. As required by the approval, the compliance measurements must be 7-day composites, meaning that the turn around time from first sample to laboratory result will be in the order of 10 days, which is too great for operational management. The chlorate measurements for operational management will need a more rapid turnaround time, which will be achieved using a local laboratory (or an in-house laboratory). The expectation is that an ion chromatography technique will be used.

Chlorate production will be minimised by:

- minimising the chlorine dioxide charge to that appropriate for the darkness of the pulp - both pulp darkness and chlorine dioxide charge will be monitored continually and alarms will alert operators to excess charges;
- maintaining sufficiently high chlorate reducing biomass concentration in anoxic conditions in the presence of readily biodegradable dissolved organic matter; and
- maintaining the redox potential in the reactor between -200 and -300 mV.

If measurements of the redox potential indicate that chlorate reduction is not being effectively maintained, control measures will be:

- In the pulp mill:
  - Modify cooking and oxygen delignification parameters – lower cooking kappa number;
  - Modify cooking and oxygen delignification parameters – lower post-oxygen delignification kappa number;
  - Modify bleach plant parameters – check/adjust pH in D0, D1 and D2 bleaching stages; lower chlorine dioxide charge, increase hydrogen peroxide charge;
  - Reduce the production level of bleached pulp;
- In the effluent treatment plant:
  - Improve DO control in the chlorate reactor towards more anoxic conditions;
  - Increase the MLSS concentration in the chlorate reactor;
  - Check micronutrient (ferro ion) level in the raw effluent, adjusting if required;
  - Adjust DO in the MBB selector and final aeration stage;
  - Direct part of effluent flow to emergency basin (recycling part of the effluent in the treatment plant).

With real time process control and in-line monitoring of pulp mill performance, the 7-day effluent monitoring is a compliance assessment protocol using validated methods and a back-up alert system rather than the primary decision making tool. It will provide a valuable second line of defence measure against the mill's performance or in-line measurement systems drifting outside of control ranges.

The 7-day trigger values will be used for weekly checks on mill performance. If these trigger levels are exceeded, that will be an indication that the monthly average limits may not be achieved (the 7-day trigger concentrations are higher than the monthly limits because of the greater variability when measured over a shorter time period; over a month, the 7-day variability will average out to below the monthly limit if the mill is operating correctly).

Exceedence of the 7-day triggers will initiate response measures to bring the mil's performance back into line with the monthly limit expectations. The actual response measures will depend on the cause of the performance drift and it is not possible to anticipate specific response measures – these will be determined at the time of the event.

As a general principle, however, the response measures due to performance drift during normal operations will be:

1. Respond to any drift of real-time, in-line monitoring variables outside of control ranges by adjusting controls as necessary;
2. If the first tier 7-day trigger levels are exceeded, determine causes and implement remedial measures;
3. Continue to monitor real-time, in-line variables to confirm that they move back into control ranges;
4. If the second tier 7-day trigger levels are exceeded, reduce production until real-time, in-line variables return to within control ranges, and inform DEWHA of the second tier trigger exceedence and of the action taken;
5. If the above response measures fail to bring performance back to within control ranges and the monthly limit is exceeded, the ultimate response will be to cease production until the cause has been determined and rectified. A report on the problem and action taken will be provided to DEWHA.

Similarly, as a general principle the response measures to performance drift during the commissioning and start-up phase will be:

1. Respond to any drift of real-time, in-line monitoring variables outside of control ranges by adjusting controls as necessary;
2. If the 7-day or monthly trigger levels are exceeded, determine causes and implement remedial measures;
3. Continue to monitor real-time, in-line variables to confirm that they move back into control ranges;
4. If the above response measures fail to bring performance back to within control ranges, reduce production until real-time, in-line variables return to within control ranges, and inform DEWHA of the second tier trigger exceedence and of the action taken;
5. If the above response measures fail to bring performance back to within control ranges, the ultimate response will be to cease production until the cause has been determined and rectified. A report on the problem and action taken will be provided to DEWHA.

The response measures to the various trigger levels and maximum limits are summarised in Table 33.

For effluent triggers, the primary response will be initiated within 24 hours of a trigger level being exceeded. If a subsequent (either weekly or monthly) result shows that the trigger level is still exceeded, the secondary response will be initiated within 24 hours of that subsequent result.

For receiving environment triggers, the primary response will be initiated within 1 month of a trigger level being exceeded. If a subsequent sampling round shows that the trigger level is still exceeded, the secondary response will be initiated within 1 month of that subsequent result.

The above response measures relate to performance drift events. In the event of more precipitous performance downturns or spills, effluent will be directed to the 100,000 m^3 spill basin, which can hold up to a day and a half's effluent at the mill's full production rate. This diversion will allow rectification action to be undertaken, following which the stored effluent will be bled back into the treatment plant for treatment.

The investigation of the cause of a trigger level being exceeded or a spill occurring will follow a formal process in accordance with the principles of Root Cause Analysis (RCA). RCA is a method of "drilling down" to investigate adverse events to identify any system flaws that may not be apparent at a cursory investigation level.

An RCA generates causal statements through event mapping and an investigation of causative links between context, events, actions and outcomes. The RCA response to trigger levels being reached will include:

- a focus on systems and process
- a review of expert knowledge from other mill experience
- an examination of events to uncover underlying contributing factors
- causal statements describing the cause(s) and effect(s) of the event
- an identification of any needs for procedural and/or system change and/or the introduction of a new process to prevent reoccurrence.

If a problem persists despite system and process responses identified through the RCA, an engineering solution may be required. The need for an engineering solution would be determined following a Failure Analysis. A Failure Analysis is an engineering approach to determining what equipment or component has failed and how and why the failure occurred, so as to take the necessary rectifying action and prevent similar failures in the future.

The required detailed action to revert the production process into normal operation depends on the mill department causing an environmental problem.

The department in question must be identified in the root cause analysis. This can be achieved quickly and precisely with the modern internal environmental control and monitoring system, including the spill control systems. Such a system is an integral part of the mill wide distributed control system (DCS). The normal problem in many older mills, lacking such systems, has been that without a clear proof of the root cause, various mill departments start disputing who is responsible and valuable time to rectify the problem is lost.

The mill departments (the digester plant, brown stock washing and screening, oxygen delignification, bleach plant and secondary cleaning, drying machine, evaporator plant, recovery boiler, recausticizing plant, lime kiln, power boiler, turbine, chemical plant, demineralisation plant, water treatment plant, and the effluent treatment plant) feature widely variable unit operations and environmental risk areas. Departments will have their own individual action plans.

The key environmental issues, risks, and control principles at the departments have already been identified in the technical descriptions published in the DIIS of the Bell Bay Mill (section 4.8 “Mitigation of Environmental Risks”, Volume 6.

However, the detailed action plans can be prepared only as part of the departmental operating instructions (OI’s) for the operator training phase (preliminary OI’s) and the start-up and commissioning phases of the mill (final OI’s). This is because the plans must identify many environmentally critical position numbers of main machines and equipment, pumps, tanks, pipelines, and process control equipment in the various mill departments. Such data will be available only when the final approved process instrumentation (PI) diagrams and detailed machine layout drawings are ready for installation.

Another important consideration is the details of the mill’s environmental management organisation and system. This will define the information flow, responsibilities, and command routes in any remedial action required. The detailed environmental action plans to control the environmental performance of mill operations will therefore be developed only when the preliminary operating instructions prepared for the training of the mill engineers, superintendents, and operators are available.

The principles upon which these operating instructions will be based are described below, together with examples of response measures that might be implemented. It is important to note that these are examples only and the actual response measures used will be whatever is appropriate for the particular circumstances at the time.

4c.10.1 Risk identification

The key environmental issues, risks, and control principles at the departments have already been identified in the technical descriptions published in the DIIS of the Bell Bay Mill.

The types of waste water environmental risks associated with the pulp mill operations are as follows:

- Accidental spills of process and auxiliary chemicals from the storage tanks, process equipment, and mobile equipment;
- Accidental spills of fuel oil from mobile equipment;
- Accidental spills of fibres, black liquor, and other hazardous process liquids and gases to the drain or to the atmosphere due to breakdown or malfunctioning of the equipment, or due to operational errors.

4c.10.2 Pre-start-up requirements

The mill will be put into operation only after all the pre-start-up requirements have been fulfilled. These are required to reduce any risk of a poorly managed start-up. The pre-start-up requirements are extensive and include such items as:

- Detailed engineering completed with the relevant HAZOP (or similar) studies performed for start-up, shutdown, emergency and maintenance issues
- Mill operational plan in place
- Mill environmental management plan in place
- Mill maintenance plan in place
- Mill emergency plan procedures in place
- Training of the operational and maintenance personnel undertaken
- Installation and check out of all equipment according to the required design
- Emergency diesel generators and main power distribution system available
- Process control system available
- Equipment spare parts and consumables available on site
- Raw materials available on site.

The Mill Common Systems (Water Supply and Treatment, Compressed Air, Effluent Treatment, and Discharge, etc) are planned to be ready for operation well before the main process areas such as the Boilers, Wood handling, Drying Machine or the Fibre Line are started, in order to have them tuned and functioning correctly before the production will start.

When the Water Treatment Plant is completed and the water flushing of the other subsystems is ready to start, the Effluent Treatment Plant will be ready to receive the flushing waters. The proper test run of the Effluent Treatment will not be able to start before the process areas produce contaminated water.

The NCG Boilers will be started with natural gas on time to produce 12 bar steam which is needed during the construction period (i.e. steam blows etc). The complete NCG Collection System including the scrubbing system will be completed later, when the Recovery Boiler starts and the odorous gases are available for collection. However the system can be run on air before the recovery boiler is started.

The Power Boiler will be started when 100 bar steam is needed. The filling of the Biofuel Storage will start some weeks earlier to be ready when the fuel is needed for the boiler. When the commissioning of the main areas is ongoing and the demand of power grows, the Turbogenerator will be put into operation.

The Drying and Baling Area will be started a month in advance of the new fibre line, with purchased pulp, to be able to do the test run before the new Fibre Line produces its own pulp.

The first chips will be conveyed to the digester only after all the other areas (Evaporation, Re-causticizing, Lime Kiln, Chemical Plant) have been completed, tested and tuned with water, and ready for commissioning with pulp.

The mill start-up phase is the most demanding in terms of varying production levels and hence air and water emissions. This can be due to some individual departments having to start-up and shut down during this phase. The individual departments are designed with in-plant measures such as spill recovery systems, designated gas scrubbers, precipitators, bunded areas for tanks, odorous gas collection system, tank storage, etc, to minimise any risk of emissions. The odorous gas system will be functional to collect any gases when the mill is shut for maintenance. The emergency spill basin is a back up for the in-plant measures.

4c.10.3 Control of accidental spills of process chemicals

The most important environmental hazards are associated with accidental spills of process chemicals. The main process chemicals used at the pulp mill are:

- Caustic soda
- Oxygen
- Hydrogen peroxide
- Sulphuric acid
- Chlorine dioxide
- Sodium bisulphite
- Methanol.

Due to the size of the operation, the pulp mill (ie. the chemical plant component) will be classified as a Major Hazard Facility in accordance with the guidance material of the Safety, Rehabilitation, and Compensation (SRC) Commission of the Australian Government.

In order to eliminate the environmental and occupational safety risks associated with the storage and handling of the hazardous chemicals the pulp mill operations must comply with the SRC protocol defined for any Major Hazard Facility.

The main components of the Protocol are:

- Identification of Major Hazard Facility by the Operator
- Recording the Identification Process
- Undertaking and Documenting the Hazard Identification and Risk Assessment Process
- Controlling the Risk
- Establishing, Implementing, and Maintaining a Documented Safety Management System
- Preparation and Review of Safety Reports, including:
    - Training and Education of Employees and Contractors
    - Preparation and Review of On-site and Off-site Emergency Plans
    - Investigating, Reporting, and Recording Major Accidents and Near Misses
    - Responsibilities of Employees and Employee Representatives
    - Security
    - Confidentiality of Information.

The chemical plant will have bunds and spill containment to recover any spills of chemicals. Recovered chemicals will be returned to the chemical plant and will not report to the effluent treatment plant.

4c.10.4 Prevention, containment and recovery of fibre, black liquor and other hazardous spills

The mill will be provided with a spill monitoring, collection, containment and recovery system. To ensure spill recovery the evaporator plant has a 10% excess capacity, based on the design conditions of the liquor recovery circuit, to be able to process the collected contaminated effluents.

Provision of large buffer tanks has been made for storage of spilled cooking and recovery liquors and dirty condensates to prevent sudden peaks of loading and occasional upsets in the external effluent treatment plant.

Spillage of fibres and black liquor may occur in the digestion plant, screening plant and during washing. There may also be spills from the evaporation plant and from tank farms. Spillage of white liquor, weak liquor, lime etc. may occur in the causticising and lime kiln area. All spills, contaminated sealing waters and floor washings in the recovery area will be collected in special floor canal sumps and pumped either directly or via an intermediate tank to be recycled using a 4000 m^3 spill tank in the evaporation plant as buffer volume.

The conductivity and/or pH of individual effluent drains are continuously monitored in order to select which streams must be recycled in the process and which are directed to waste water treatment plant. The calibration and maintenance of the conductivity and pH probes will be carried on a regular and scheduled basis since they are crucial to the performance of the spill prevention system. Clean water, such as rain, cooling and sealing water, is piped off separately.

Spill monitoring is used to ensure spill recovery resulting from process upsets, tank overflows, mechanical breakdowns, operator errors and construction activities.

All critical process areas will be bunded to avoid concentrated or harmful streams entering the external effluent treatment plant or contaminating storm water drains. The bunded tank farm areas include:

- Liquor and washing liquor tanks in the unbleached fibre line area
- Evaporator tank farm
- Causticising tank farm
- Recovery boiler
- Evaporator plant.

4c.10.5 Tertiary treatment

Condition 4 of the approval requires that if maximum limits are likely to be exceeded but response strategies are unable to achieve their objective to reverse any undesirable impacts, then the mill must cease to operate until a tertiary treatment solution satisfactory to the Minister has been installed.

Exceedence will be determined on the basis of a validated laboratory measurement made in accordance with the approval requirements, the EIMP and the C-BOMP.

If the mill is unable to operate without a likelihood of condition 32 maximum limits being exceeded, it will not do so until the cause of the failure has been determined to the satisfaction of the Minister. If the failure cannot be rectified without tertiary treatment the mill will remain shut down until a tertiary treatment solution satisfactory to the Minister has been installed.

Undesirable impacts could also arise if maximum limits established under the EIMP for water quality, sediment quality and/or biota are exceeded.

If this circumstance arises, Gunns will submit a report to DEWHA within 2 months on the ecological significance of the observed effect(s), including where possible an assessment of cause and options available to mitigate the effect(s) if they can reasonably be attributed to the mill. The report will include an assessment of the potential efficacy of implementing tertiary treatment to resolve the issue, and where relevant a timetable for remediation of any undesirable impacts on matters of National Environmental Significance.

4c.10.6 Examples of response measures

The exceedence of trigger levels or maximum limits will only occur if the mill's performance moves outside its normal operating range. These problems will be addressed through management responses. Examples of events that might lead to parameters exceeding trigger levels or, in the worst case, approaching or exceeding maximum limits are provided in Table 25, together with likely response measures. The actual response measures will depend on the detailed cause of the performance problem and must be determined at the time of the event.

Table 25: Examples of events that may cause trigger levels to be exceeded or maximum limits to be approached or exceeded, and likely response measures

Event	Response	Responsible department
TSS		
Too high hydraulic loading of secondary clarifiers	Reduce water consumption at the mill	Pulp mill departments
	Direct part of effluent to emergency spill basin	Effluent treatment plant
Poor quality of biomass (bulking)	Mitigate/Eliminate bulking sludge by: Controlling the variability of raw effluent quality Controlling COD-nutrient ratios Controlling oxygen concentration in the aeration Controlling of sludge age by controlling excess sludge flow Using polymers in secondary clarifier inflow	Effluent treatment plant
Too high sludge level in the secondary clarifier	Increase the return sludge flow and excess sludge flow	Effluent treatment plant
BOD5 and COD		
Too high BOD /COD load to aeration	Check and eliminate the possible spills at the mill	Pulp mill departments
	Direct part of effluent to emergency spill basin	Effluent treatment plant
High TSS in the effluent	TSS in the effluent increases the BOD as well, therefore reduce effluent TSS	See responses for TSS
Poor quality of biomass (bulking)	Mitigate/Eliminate bulking sludge by: Controlling the variability of raw effluent quality Controlling COD-nutrient ratios Controlling oxygen concentration in the aeration Controlling of sludge age by controlling excess sludge flow Using polymers in secondary clarifier inflow	Effluent treatment plant
Toxicity in effluent	Determine reason for toxicity and reduce it	Pulp mill departments
	If biomass activity has decreased decrease the load to the treatment plant by directing part of the effluent to the emergency spill basin to allow the biomass to recover	Effluent treatment plant
Too high raw effluent temperature	Eliminate the reason for high temperature	Pulp mill departments
	Decrease the load to the treatment plant to allow the treatment plant to recover. Methods are:	Pulp mill departments
	Operate reserve effluent heat exchanger	Pulp mill departments
	Direct part of effluent to emergency spill basin	Effluent treatment plant
Shortage of nutrients	Adjust the nutrient dose	Effluent treatment plant
Shortage of oxygen	Adjust the oxygen content in aeration	Effluent treatment plant
Excess use of defoaming agents	Defoaming agents reduce oxygen uptake and oxygen shortage may result, reduce defoaming agent use	Effluent treatment plant
Chlorate		
Too high chlorate at raw effluent	Lower the effluent load. Methods are:	
	Modify cooking and oxygen delignification parameters Modify bleach plant parameters	Pulp mill departments
	Direct part of effluent to emergency basin	Effluent treatment plant
	Improve oxygen control, in the chlorate removal stage and MBB stage	
	Check micronutrient (ferro ion) level in the raw effluent, adjust if required	
Poor quality of biomass	Revive biomass quality with lower load, check nutrient and oxygen dose	Effluent treatment plant

Event	Response	Responsible department
Total N		
Too high total N in raw effluent	Check and eliminate the reason at the pulp mill and at the effluent treatment plant	All departments
Too high total N at effluent treatment plant	Correct the dose at effluent treatment plant	Effluent treatment plant
	Can be part of TSS – reduce TSS	See responses for TSS
Total P		
Too high total P in raw effluent	Check and eliminate the reason at the pulp mill and at the ETP	All departments
Too high total P at effluent treatment plant	Correct the dose at effluent treatment plant	Effluent treatment plant
	Change sludge age through recycling rate	Effluent treatment plant
	Can be part of TSS – reduce TSS	See responses for TSS

4c.11 Water quality trigger levels and maximum limits in Commonwealth waters

Water quality trigger levels for the Commonwealth waters receiving environment have been developed in accordance with the ANZECC/ARMCANZ (2000) *Guidelines for Fresh and Marine Water Quality*. These guidelines specify guideline trigger values for a number of toxicants and chemical stressors in marine waters. Reference has also been made to the water quality objectives established under the State permit.

For chemical toxicants, the ANZECC guideline trigger values are preferentially derived from a mathematical fit of all available toxicity data in a species sensitivity distribution. The derived trigger values are relevant to different levels of ecosystem protection. Commonwealth waters are considered to be pristine and of high conservation value, so a 99% species protection applies. If there are insufficient species for this statistical approach, an alternative (less reliable) method is to apply a factor to the lowest "no observed effect concentration" (NOEC).

For chemical stressors, the ANZECC guidelines provide default trigger values for various regions of Australia, based on the 80th percentile of background data for the region. Data and default values for south-east Australia are applicable to Bass Strait.

The proposed toxicant trigger values for water quality in Commonwealth waters are described in Table 26, together with their DV_{100}/TV ratios, where DV_{100} is the concentration at the conservative minimum dilution factor (100 times) assumed in the DIIS and Preliminary Documentation and TV is the trigger value concentration. Ratios greater than 1 indicate chemicals of potential concern. The DV_{100} is adopted as the maximum limit for toxicants in Commonwealth waters. The design basis of the diffuser will be to ensure that these limits are not exceeded outside the State permit's mixing zone.

The proposed non-toxicant trigger values for water quality in Commonwealth waters are described in Table 27, together with their DV_{100}/TV ratios. These trigger levels are adopted as the medium level effect trigger level for stressors in Commonwealth waters.

Once sufficient background monitoring data are available, the default trigger values for stressors shown in Table 27 may be replaced by 80th percentile background data values, subject to the approval of DEWHA.

Chlorate is expected to remain the determining parameter for effluent dilution due to its concentration in the effluent relative to its potential toxicity on any local brown algae. The chlorate water quality objective (WQO) would therefore determine the dilution to be achieved at the edge of the mixing zone.

The DIIS (Toxikos 2007 *Marine impact assessment – Bell Bay pulp mill effluent.* Toxikos Report TR101006RJF) recommended a water quality objective (WQO) for chlorate of 8 µg/L.

This WQO value was developed through an analysis of available data, which included that for a fucoid brown algae (*Fucus vesiculosus*) from the Baltic Sea due to an absence of data for local fucoid species. The 8 µg/L value was adopted as the chlorate WQO in the State permit. The DIIS report proposed that a reassessment of the WQO be undertaken when further information for local fucoid algae species became available.

The findings of further toxicity testing using the local *Ecklonia radiata* fucoid species became available during the Commonwealth assessment period and the report on this testing (Toxikos 2007a *Chlorate Impact Assessment Summary.* Toxikos report no. TR170707-RF1) formed part of the Preliminary Documentation. This further report's assessment included the *Ecklonia radiata* data and therefore appropriately excluded the Baltic Sea data. This revised assessment recommended a chlorate WQO of 50-60 µg/L (the Baltic Sea *Fucus vesiculosus* is considerably more sensitive to chlorate than the local *Ecklonia radiata*). This EIMP proposes that a conservatively lower WQO value of 30 µg/L is appropriate and this value is accordingly adopted.

The Tasmanian EPA has acknowledged the further assessment undertaken by Toxikos and formally advised Gunns (18 August 2008) that the chlorate WQO will be reviewed as part of an overall review of all WQOs for State waters that will be undertaken near the close of baseline monitoring. Pending the outcome of that review, the current State chlorate WQO of 8 µg/L remains lower than the adopted WQO of 30 µg/L (see Table 26).

Using the State permit water quality objective for chlorate, the required dilution ranges from 500 fold for a background chlorate concentration of zero to 673 fold for the conservative DIIS assumption of a background concentration of 2.5 µg/L.

A zero background concentration for chlorate is expected to be the most likely scenario because as reported in the DIIS a literature review could not identify any publications reporting the natural occurrence of chlorate in the environment and there are no anthropogenic sources of chlorate in the vicinity of the outfall or in the industries present in the area[9]. Following recent improvements in analytical techniques undertaken by the National Measurement Institute (NMI) in support of this project, analysis has failed to detect chlorate at a 2 µg/L Limit of Reporting (LOR) with a Method Detection Limit (MDL) of 0.5 µg/L, supporting the expectation that background chlorate concentrations are zero.

Response measures to toxicant trigger levels being exceeded will be based on the premise that effective responses to trigger levels being exceeded at Impact Locations, which are close to the edge of the mixing zone, will prevent adverse impacts in the more distant Commonwealth waters.

[9] http://www.gunnspulpmill.com.au/iis/supp/veronique_levy_ews.pdf

Table 26: Water quality trigger levels and maximum limits for toxicants in Commonwealth waters

Chemical	Trigger value (TV) µg/L	Estimated maximum concentration at DV_{100} µg/L	Maximum limit µg/L	Ratio DV_{100}/TV	Notes
Aluminium	0.5	11	11	22	A low reliability marine guideline value of 0.5 µg/L was derived using the assessment factor approach. There are only three trophic levels represented in the ANZECC database and there is an insufficient spread of data to derive a 99% value. Speciation considerations are relevant with aluminium. Much of the aluminium will be colloidal and therefore biologically unavailable, while complexation with dissolved organics will also be appreciable. Bioavailable aluminium is likely to be much lower than the assumed concentration.
Chlorate	30	37	37	1.2	Using all available toxicity data for chlorate, the 99% species protection value is 3 µg/L but the reference data are biased by the inclusion of a NOEC of 5 µg/L for the European *Fucus vesiculosus*, a macroalgal species not found in Bass Strait. Excluding this species from the calculation gives a Bass Strait specific trigger value guideline of 30 µg/L.
Monochloroacetic acid (a chloroacetic acid)	0.58	0.74	0.74	1.3	A value of 0.58 µg/L is listed in the European Union risk assessment of monochloroacetic acid (EU 2005). Few marine toxicity data are available.
Trichloroacetic acid (a chloroacetic acid)	3	0.74	0.74	0.25	A value of 3 µg/L based on a freshwater test is shown in the Ontario 1994 guidelines.
Resin acids excluding dehydroabietic acid	52	2.5	2.5	0.05	From softwoods (pine) only. The only published guideline value 52 µg/L is based on freshwater species (Ontario 1994). It includes resin acids other than dehydroabietic acid.
Dehydroabietic acid (a resin acid)	13	0.5	0.5	0.04	From softwoods (pine) only. The Ontario 1994 value is 13 µg/L and is for freshwater species. No marine data are available but chronic NOEC values for freshwaters include a crustacean Daphnia magna (200 µg/L), rainbow trout (130 µg/L) and fathead minnow (240 µg/L) (Kamaya et al 2005). Using an assessment factor of 10 on the lowest NOEC yields the low reliability value of 13 µg/L.
Chlorophenols	2	0.05	0.05	0.025	Few marine data are available and guideline values were calculated using the application factor method. Low reliability values are based on freshwater data and are from 2 to 340 µg/L, depending on the compound.
Dioxins/furans	2 pg/L	0.034 pg/L	0.034 pg/L	0.017	Undetectable by current techniques which have a limit of reporting (LOR) of approximately 1 to 2 pg/L. The adopted trigger value is the current LOR.

Table 27: Water quality trigger levels for stressors in Commonwealth waters

Chemical	Trigger value (TV) µg/L	Estimated maximum concentration at DV_{100} µg/L	Ratio DV_{100}/TV	Notes
Total nitrogen (N)	25	25	1	The trigger values are the default ANZECC values for marine waters in south-east Australia. Subject to DEWHA approval, these trigger values may be replaced by the 80th percentiles of the background data values once sufficient background data are available. The DV_{100} are based on the maximum limits in Table 23.
Total phosphorus (P)	120	8	0.07	
Nitrate (as N)	5	13	2.6	

4c.12 Sediment trigger levels and maximum limits in Commonwealth waters

The determination of trigger levels for contaminants other than dioxins and furans in sediments in Commonwealth waters will be dependent on the results of the baseline monitoring required by condition 36(b) of the approval. This monitoring is described in Module M.

At least a full 12 months of monitoring data is considered to be required. Once that data is available, proposed trigger levels and maximum limits will be determined and submitted to DEWHA for approval, prior to mill commissioning.

For dioxins and furans, condition 42 sets a maximum concentration limit in sediments in Commonwealth waters of 850 pg TEQ/kg.

The approval does not specify a trigger level for dioxin and furan concentrations in sediments. The ANZECC *Guidelines for Fresh and Marine Water Quality Management* 2000 note that there are insufficient data to derive a reliable trigger value for dioxins.

However, the National Dioxins Program has undertaken a survey of several thousand sediment cores from around Australia. The findings for marine sediments are summarised in Table D3a of the Department of Environment and Heritage 2004 report *Dioxins in aquatic environments in Australia - Technical Report No. 6*. The data (excluding Cape Grim, which is zero) in that table have been used to create the lognormal plot of the WHO98TEQ lower bound shown in Figure 6.

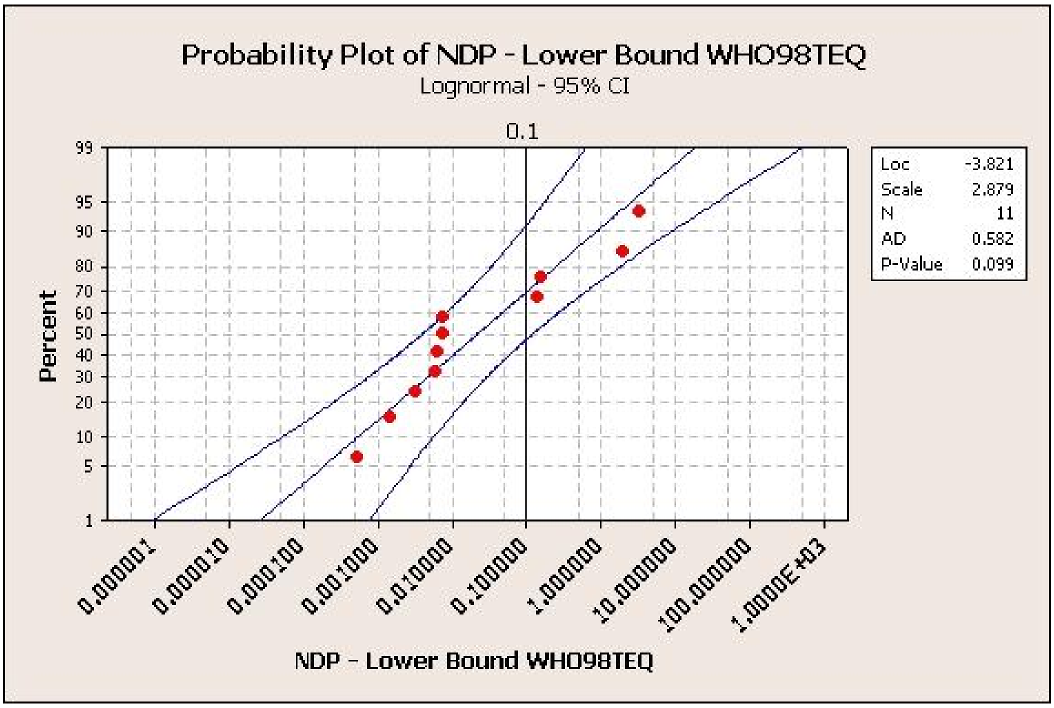

Figure 6: Probability plot of National Dioxin Program concentrations of PCDD/PCDF found in Australian marine sediments

The units in Figure 6 should be multiplied by 1000 to convert pg/g to pg/kg as used by the approval. The reference line is 0.1 pg/g (100 pg/kg). Sites to the right of this include Port Melbourne and Port Pirie, which have considerable sources of contamination. Sites to the left of the reference line are comparatively clean sites.

The 100 pg/kg value therefore represents what is considered to be a reasonable division between relatively uncontaminated and potentially contaminated sites. Accordingly, for dioxins and furans in sediments in Commonwealth waters a trigger level concentration of

100 pg TEQ/kg is adopted. This trigger level will be taken to constitute a low level effect with reference to Table 28 (below) and the associated response strategies described in Table 33 (below).

The mean value of the National Dioxins Program's marine sediment data is 460 pg TEQ/kg. This value is adopted as a medium level effect trigger level concentration for dioxins and furans in sediments in Commonwealth waters. This trigger level will be taken to constitute a medium level effect with reference to Table 28 (below) and the associated response strategies described in Table 33 (below).

It may be appropriate to replace these trigger levels with site specific trigger levels once sufficient baseline data are available from the baseline monitoring program (described in the C-BOMP accompanying Module M). Any proposed site specific trigger levels will be submitted to DEWHA for approval.

Trends in concentrations of samples collected in State and Commonwealth waters will be analysed, and independently reviewed, on a six-monthly basis. As described in Module M, following mill commissioning sediment surveys will be taken quarterly in the first year of operations. Thereafter they will be taken twice annually (spring and autumn) for 3 years unless the findings indicate that quarterly sampling should be continued. The sampling need and sampling frequency will be reviewed after 3 years.

Although site specific numerical trigger levels cannot be determined until sufficient monitoring data are available, an adaptive monitoring approach will be adopted, as described in section 4c.14, and statistical trigger levels are identified in Table 28.

4c.13 Biota trigger levels and maximum limits

A trigger level of 0.7 pg TEQ/g fw and a maximum limit of 7 pg TEQ/g fw for dioxins and furans in fish are adopted, based on the analysis presented in the DIIS (Toxikos 2007 *Marine Impact Assessment – Bell Bay Effluent*). These values were taken from USEPA guidelines.

The trigger level (0.7 pg TEQ/g) is the concentration in fish that represents low risk to piscivorous mammalian wildlife based on the no-effects thresholds for reproductive effects (mortality in embryos and young) in sensitive species. This trigger level will be taken to constitute a medium level effect with reference to Table 28 (below) and the associated response strategies described in Table 33 (below). Trigger levels for seal blubber and penguin eggs will be determined after the baseline sampling.

As described in Toxikos (2007), for sensitive organisms substantial effects on reproduction would be expected at concentrations approximately ten-fold higher than the no-effects thresholds for reproductive effects. The maximum limit (7 pg TEQ/g) is the high risk concentration derived from doses expected to cause 50 to 100% mortality in embryos and young of sensitive species. This maximum limit will also be taken to constitute a high level effect with reference to Table 28 (below) and the associated response strategies described in Table 33 (below).

It may be appropriate to replace the above trigger levels and maximum limit with site specific values once sufficient baseline data are available from the baseline monitoring program (described in the C-BOMP accompanying Module M). Subject to the findings of the baseline monitoring, it may be appropriate to develop trigger levels and maximum limits for other contaminants also.

At least two years of field monitoring data is considered to be required, using the approved sampling protocol (top 2 cm of sediment). Once all baseline data are available, proposed trigger levels and maximum limits will be determined and submitted to DEWHA for approval, prior to mill commissioning.

Although site specific trigger levels cannot be determined until sufficient monitoring data are available, an adaptive monitoring approach will be adopted, as described in section 4c.14, and statistical trigger levels are identified in Table 28.

4c.14 Adaptive management approach

While significant contamination of water, sediment and biota by the mill effluent is not expected, an adaptive management approach will nevertheless be adopted so that any unexpected findings can be appropriately assessed and responded to.

Adaptive management is a cyclical process of plan, monitor, review, revise plan, monitor and so on. Implicit in an adaptive management process is that where monitoring intensity is required to intensify, it does so, and where objective evidence exists that no effects are apparent, monitoring intensity can also be reduced with no elevation of risk to the environment.

Figure 7 presents a schematic description of the approach that will be followed and shows adaptive management for both the monitoring regime and the response options.

As shown in Figure 7, if monitoring finds no detectable change, routine monitoring will continue and no response actions will be necessary, although as a matter of course the design of the monitoring plan will continually be evaluated to ensure that it is appropriate.

If effects are detected by the monitoring, the monitoring program will be reviewed and amended as necessary to target the effects, so as to ensure that those effects are adequately tracked. A risk characterisation will be undertaken to identify response options available to mitigate those effects. These options will then be evaluated and implemented as appropriate to the situation. The monitoring program may also need to be adjusted to measure the success of those responses.

Risk characterisation and response options will be determined by the significance of the impact detected.

Adaptive decision making will be triggered by low, moderate and high level impact effects. Table 28 identifies the effect trigger levels for ecological indicators, being water chemistry, sediment chemistry, and invertebrate and algae abundance. Trigger levels for biological indicators (as measured through seal blubber and penguin egg sampling) will be determined after the baseline sampling.

The triggers in Table 28 (and if necessary also the triggers in Table 26 and Table 27) would be reviewed and revised if the results of the hydrodynamic modelling indicate that this is warranted. Revisions may include additional triggers and/or may be based on continuous monitoring if this is appropriate, subject to the findings of the modelling. Any proposed revisions would be submitted to DEWHA for approval.

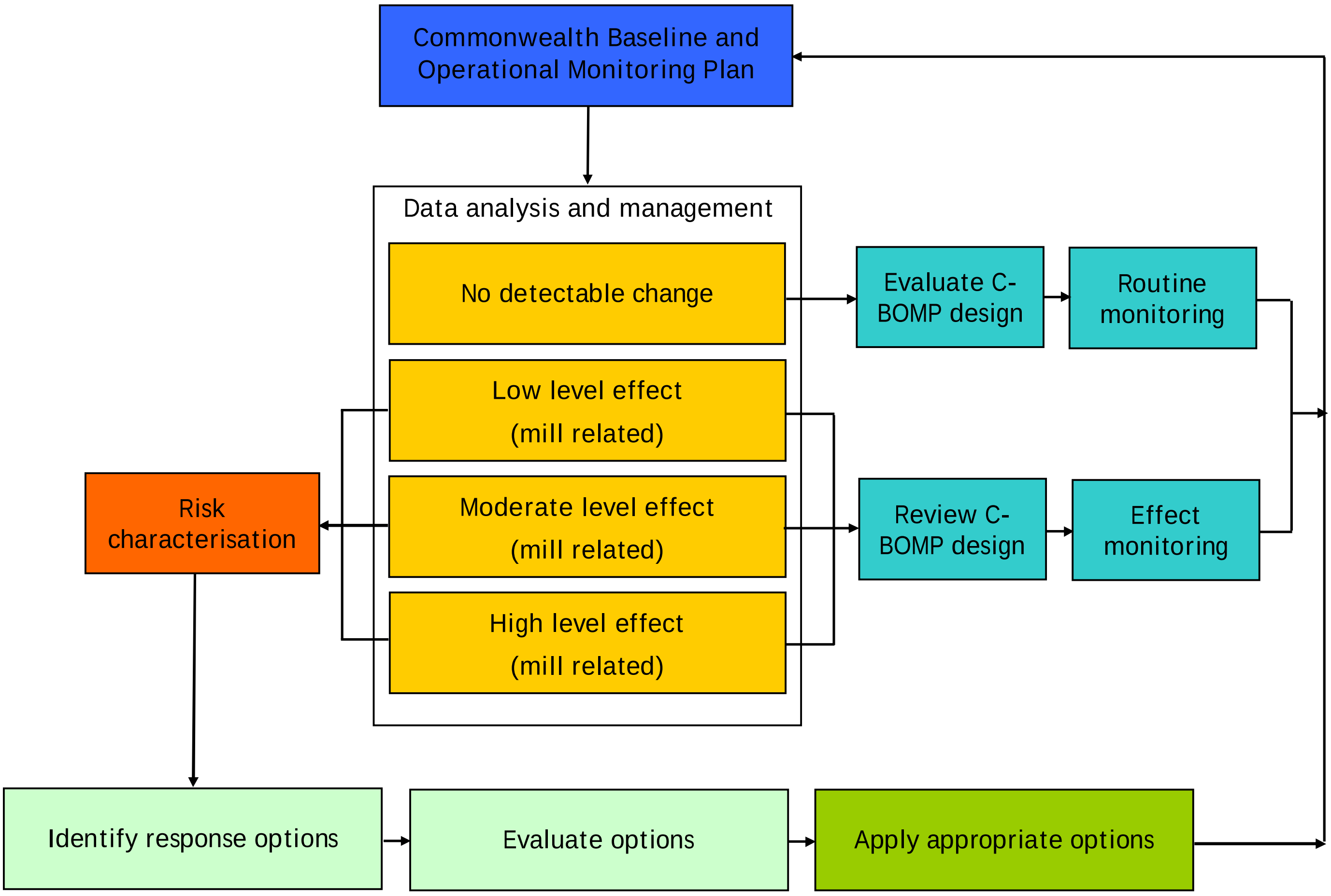

Figure 7: Adaptive environmental management response approach to observed mill related effects on the Commonwealth marine environment

Table 28: Effect trigger levels for water chemistry, sediment chemistry, biota and ecological community indicators

	Trigger levels		
	Water chemistry	Sediment chemistry	Biota and ecological communities
Low level effect	• The time series trend of a toxicant at any Impact Location indicates that it is trending upward and may breach the applicable trigger value in Table 26.	• Statistically significant change in a tracer (total organic carbon, total nitrogen or carbon to nitrogen ratio) at any Location; or • Dioxin and furan concentrations in consecutive independent serial samples exceed 100 pg TEQ/kg at any Location in Commonwealth waters.	• Previously unobserved statistical change in fish abundance, algae and infauna abundance or infauna species richness at any Impact Location.
Medium level effect	• The maximum (100%ile) concentration of a toxicant at any Impact Location exceeds its applicable trigger value in Table 26. • Consecutive independent serial samples exceed a non-toxicant trigger value in Table 27 at any location in Commonwealth waters.	• Statistical difference of a toxicant at any Impact Location of more than 1 standard deviation relative to controls; or • Dioxin and furan concentrations in consecutive independent serial samples exceed 460 pg TEQ/kg at any Location in Commonwealth waters; or • Statistical increasing trend predicting dioxin and furan concentrations will exceed 850 pg TEQ/kg at any Location in Commonwealth waters.	• Statistical change (with at least 2 years of data) at any Impact Location as a percentage of control greater than 50% (fish abundance), 75% (algae and infauna abundance) or 25% (infauna species richness); or • Mean dioxin and furan concentration in fish flesh exceeds 0.7 pg TEQ/g fw.
High level effect	• Consecutive independent serial samples exceed a toxicant trigger value in Table 26 at any Impact Location.	• Statistical difference of a toxicant at any Impact Location of more than 2 standard deviations relative to controls; or • Statistical difference of a toxicant at any Location (other than Impact) of more than 1 standard deviation relative to controls; or • Dioxin and furan concentrations in consecutive independent serial samples exceed 850 pg TEQ/kg at any Location in Commonwealth waters.	• Statistical change (with at least 2 years of data) at any Location (other than Impact) as a percentage of control greater than 50% (fish abundance), 75% (algae and infauna abundance) or 25% (infauna species richness); or • Fish condition index exceeds critical effect size; or • Mean dioxin and furan concentration in fish flesh exceeds 7 pg TEQ/g fw.

Note: In this table, "Location" and "Impact Location" have the meanings described in the C-BOMP (EIMP Module M). Critical effect sizes for fish condition indices are also described in that document. "Independent serial samples" means samples taken in a temporal sequence but which are not autocorrelated – they may or may not be able to be sequential samples depending on the degree of temporal correlation.

4d. Measurement of background contaminants in sediments and biota

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

4e. Background ecological surveys

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

4f. Improved modelling (hydrodynamic and sediment) of fate and impact of effluent

4f.1 Approval requirements

Relevant to this issue, condition 38 of the approval requires:

Additional modelling must be carried out in relation to the fate of effluent, as part of the EIMP, prior to the commencement of commissioning of the mill. The details of the modelling to be commissioned and the organisation responsible for performing the modelling must be approved by the Department. The modelling to be commissioned must include, but not be limited to:

a) The inclusion of a sediment transport component.
b) The use of three-dimensional models for all levels of spatial resolution.
c) Increased vertical resolution for the high resolution model used in the water quality analysis.
d) Forcing from all mechanisms that may potentially influence residual or diurnal dynamics, including background sea level gradients, low frequency sea level oscillations, surface heat flux, sea level, temperature and salinity open boundary and initial conditions which capture mesoscale variability and wave enhanced bottom friction.
e) The execution of long term simulations that capture seasonal variability, and evidence of the model achieving pseudo-steady state in the regional (Bass Strait) field.
f) The calibration of model tracers (e.g. temperature or salinity) and velocity to data derived from moored instruments (for temporal comparisons) and measured profiles (for spatial comparisons) over the period the model is simulated. This will involve a supplementary field program designed specifically for model calibration (i.e. implemented over an annual cycle). Detailed evidence of satisfactory calibration must be supplied, including correlation between phase and amplitude of calibration variables.
g) Sensitivity analysis for key model parameters, particularly horizontal diffusion.
h) The use of appropriate simulation lengths for generating plume statistics.
i) The use of data (modelled or measured) that captures the three-dimensional nature of the water column and seasonal variability for use in the near-field model.

Also relevant to this issue, condition 39 of the approval requires:

In accordance with the EIMP, if the results of the modelling resulting from condition 38 indicate that effluent hydrodynamics and deposition will result in chemicals reaching trigger levels, Gunns Limited must implement approved response strategies, including, if necessary, changing the design and operation of the effluent pipeline and diffuser.

4f.2 Background

The proposed pulp mill outfall is a diffuser pipe that will discharge up to 64 megalitres/day (64 million litres/day) of treated effluent 2.7 km offshore from Five Mile Bluff to the east of Low Head. The diffuser will be in a water depth of approximately 26 m. The tidal range there varies between approximately 2 and 3 m.

The diffuser will be designed to achieve a dilution that meets the Water Quality Objective for all toxicants before the edge of the mixing zone set under the State permit. The State permit sets an interim mixing zone boundary at a distance of 500 m from the diffuser. Achievement of this required dilution will be a fundamental property of the diffuser design.

Chlorate is expected to remain the determining parameter for dilution due to its concentration in the effluent relative to its potential toxicity on any local brown algae. The chlorate water quality objective (WQO) would therefore determine the dilution to be achieved at the edge of the mixing zone (see discussion in section 4c.11).

Approval condition 3 requires that the EIMP includes trigger points and maximum limits in relation to effluent discharge and that an operational objective of the pulp mill shall be that these are not reached during the operation of the pulp mill. In relation to the wastewater effluent discharge, the contaminants of concern are stated in condition 32 to be dioxins and furans, chlorate, total chloroacetic acids, total nitrogen, total phosphorous, total suspended solids (TSS) and biological oxygen demand (BOD). The studies described here, together with information about the composition and likely settling and flocculation properties of the fine organic materials in the effluent will provide predictions of the fate and likely concentration levels (above background) in both the receiving waters and the sediments.

Condition 38 states that additional modelling must be carried out in relation to the fate of effluent, prior to the commencement of commissioning of the mill, and that DEWHA must approve the details of the modelling to be commissioned and the organisation responsible for performing the modelling. The Tasmanian authorities also require additional hydrodynamic modelling with details specified in Schedule EM1 of the State permit.

Considerable hydrodynamic modelling has already been undertaken in relation to the fate and transport of the effluent (Gunns Pulp Mill IIS, Hydrodynamic Modelling, 2006). The hydrodynamic and water quality modelling had some deficiencies, according to the Chief Scientist's Report.

These were the inappropriate use of 2-D models, neglect of background stratification, insufficient vertical resolution, high horizontal eddy diffusion, omission of low frequency forcing, inadequate calibration and short run times. In view of these deficiencies the Chief Scientist stated that the effluent dilutions predicted by the model are open to question and that the modelling study may have over-estimated minimum dilution rates and under-estimated maximum tracer concentrations away from the outfall. The Chief Scientist concluded that there is sufficient uncertainty in the modelling carried out to date that it cannot be guaranteed that the proposed water quality objectives for contaminants such as chlorate and colour will be met at all times in Commonwealth waters.

Section MZ 4.1-4.4 of Schedule EM1 of the State permit also pointed to a number of weaknesses in the hydrodynamic modelling, most notably the lack of field data for model verification and calibration. A key outcome is the requirement for a revised definition of the mixing zone to ensure the State's water quality objectives are likely to be achieved.

4f.3 Components of additional hydrodynamic modelling

The Chief Scientist recommended that improved hydrodynamic and sediment modelling of the fate and impact of effluent be undertaken that considers both dissolved and particulate contaminants. This will provide critical information on the expected concentration levels in the receiving waters and the sediments, and assist in the design of the monitoring program.

Condition 38 identifies the following requirements for the hydrodynamic modelling:

- The inclusion of a sediment transport component.
- The use of three-dimensional models for all levels of spatial resolution.
- Increased vertical resolution for the high-resolution model used in the water quality analysis.
- Forcing from all mechanisms that may potentially influence residual or diurnal dynamics, including background sea level gradients, low frequency sea level oscillations, surface heat flux, sea level, temperature and salinity open boundary and initial conditions which capture mesoscale variability and wave enhanced bottom friction
- The execution of long term simulations that capture seasonal variability, and evidence of the model achieving pseudo-steady state in the regional (Bass Strait) field.
- The calibration of model tracers (e.g. temperature or salinity) and velocity to data derived from moored instruments (for temporal comparisons) and measured vertical profiles over the period the model is simulated. This will involve a supplementary field program designed specifically for model calibration (ie. implemented over an annual cycle). Detailed evidence of satisfactory calibration must be supplied, including correlation between phase and amplitude of calibration variables.
- Sensitivity analysis for key model parameters, particularly horizontal diffusion.
- The use of sufficiently long simulation periods for generating plume statistics.
- The use of data (modelled or measured) that captures the three-dimensional nature of the water column and seasonal variability for use in the near-field model.

In response to the condition 38 requirements, the proposed scope of work has been developed for approval by DEWHA. The scope of work is provided in Appendix D.

4f.4 Diffuser design

Further work on the diffuser design has been undertaken since the original concept design of the diffuser was presented in the Preliminary Documentation (DIIS). The current design is expected to achieve a 500 fold dilution within a few tens of metres of the diffuser, significantly better than the original concept design.

Design refinement will continue as a precursor to the hydrodynamic modelling study. The final diffuser design report will be submitted to the IEG and DEWHA for review and approval prior to the hydrodynamic modelling commencing.

The expected dilution achievable by the diffuser will be an input into the hydrodynamic model and will be an important determinant of the modelled near field dilution rates. The near field dilutions will in turn be coupled to the far field modelling to predict the overall dilution rate and the spatial and temporal behaviour of the effluent plume.

A dilution of 1:500 will achieve the Water Quality Objectives for all effluent contaminants (chlorate is the contaminant that requires the greatest dilution).

The State permit sets an interim mixing zone of 500 m radius. Based on the current conceptual design of the diffuser, the size of the likely actual mixing zone could be an order of magnitude smaller than the interim mixing zone. The diffuser is more than 2.5 km from Commonwealth waters, over 50 to 100 times the distance at which a 1:500 times dilution is expected to be achieved. The potential for Water Quality Objectives being exceeded in Commonwealth waters is negligible. This expectation will be examined by the hydrodynamic modelling study.

The actual performance of the diffuser will be confirmed by the continuous plume monitoring program (described in the C-BOMP, Module M) once the mill is operational. A report on the diffuser performance will be submitted to DEWHA after 12 months of discharge monitoring.

Although considered unlikely, it is possible that a combination of a daily volume discharge spike and extraordinary conditions in the receiving environment, such as an unusual combination of extreme temperature stratification and slack tide, might lead to a less than optimum near field dilution. The likelihood of this occurring and the spatial extent of the initial dilution zone in these circumstances will be determined by the hydrodynamic modelling and diffuser performance confirmation studies. If these studies suggest that such circumstances warrant mitigation action, the spill basin could be used to buffer discharge flows during these periods to reduce impacts on the performance of the diffuser. These diversions would by intent only be in the order of 2 hours, and the impacts on the availability of the basin would be negligible. The capability of using of the spill basin for this purpose is described in the technical report attached as Appendix F.

4g. Design of the monitoring program for marine effluent

The monitoring program has been described in Module M. A Commonwealth Baseline and Operational Monitoring Plan (C-BOMP) was submitted with Module M for approval by the Minister.

The C-BOMP will be implemented once approved. Some components of the monitoring are already underway, having commenced more than 2 years ago. Other components are scheduled to commence up to and in some cases after financial close for the project. Monitoring activities will continue while the studies and investigations described in the current Module L are being undertaken.

The findings of these studies and investigations may lead to the monitoring program being refined. For example, the hydrodynamic modelling may identify better locations for monitoring stations, such as locations that better focus on particulate deposition areas. The findings of the studies and investigations will be reviewed in consultation with the IEG and DEWHA and any necessary changes to the monitoring program's design and/or implementation will be implemented, following their approval by the Department.

As described in Module M, refinements to the C-BOMP will be implemented by updating it and submitting it to DEWHA for approval.

4h. Response strategies to outcomes of modelling

A number of possible outcome scenarios have been identified for the hydrodynamic modelling study and response strategies for each of those outcomes have also been developed in accordance with approval condition 39. The scenarios and response strategies are described in Table 29.

If the results of the hydrodynamic modelling suggest that these responses should be revised and/or that additional response strategies should be developed, those revised and/or additional strategies will be submitted to DEWHA for approval.

Table 29: Response strategies for a range of possible hydrodynamic modelling outcome scenarios

	Hydrodynamic modelling outcome scenario	Response strategy
1	Modelling predicts that the 95 percentile water concentration isopleth of a toxicant, or median water concentration isopleth of a non-toxicant, exceeds its applicable water quality objective in Commonwealth waters (commensurate with the water chemistry high level effect criterion defined in Table 28). These 95 and 50 percentile statistics are computed seasonally for annual simulations, or for the length of the simulation (e.g. monthly) for shorter simulations only capturing high or low energy conditions.	Redesign diffuser and/or develop a release regime linked to tides and/or temperature stratification (using the spill basin as volume buffer). If not successfully resolved by reiteration of modelling, establish a water quality monitoring site at the predicted exceedence location(s) and maintain ongoing monitoring. Subject to the findings of that monitoring, develop additional response strategies to the satisfaction of DEWHA.
2	Modelling predicts that the water concentration isopleth of a toxicant exceeds its applicable water quality objective in Commonwealth waters at any time during the simulation (commensurate with the water chemistry medium level effect criterion defined in Table 28).	Redesign diffuser and/or develop a release regime linked to tides and/or temperature stratification (using the spill basin as volume buffer). If not successfully resolved by reiteration of modelling, develop an engineering solution, which may include reduced production and/or tertiary treatment, to the satisfaction of DEWHA. Implement this solution if 6 months of operational monitoring confirms the predictions of the modelling.
3	Modelling predicts that over a 12 month period the maximum water concentration isopleth of chlorate will exceed its applicable water quality objective outside of the State permit's defined mixing zone within 1 metre of the seabed in any area where brown algae is present (commensurate with the biota medium level effect criterion described in Table 28).	Redesign diffuser and/or develop a release regime linked to tides and/or temperature stratification (using spill basin as volume buffer). If not successfully resolved by reiteration of modelling, establish a brown algae monitoring site at the predicted exceedence location(s) and maintain ongoing monitoring. Subject to the findings of that monitoring, develop additional response strategies to the satisfaction of DEWHA.
4	Modelling predicts a depositional zone(s) in Commonwealth waters at which the accumulation of particulates from the mill's effluent discharge over a 12 month period will cause a statistical difference of a toxicant concentration of more than one standard deviation relative to background (commensurate with the sediment chemistry medium level effect criterion defined in Table 28).	Establish a sediment and ecological monitoring site(s) at the predicted deposition zone(s). Maintain ongoing monitoring to confirm that the sediment concentration build-up or effects on biota do not exceed a medium level effect. Subject to the findings of that monitoring, develop additional response strategies to the satisfaction of DEWHA.
5	Modelling predicts a depositional zone(s) in Commonwealth waters at which the accumulation of particulates from the mill's effluent discharge over a 12 month modelling period will cause a statistical difference of a toxicant concentration of more than two standard deviations relative to background (commensurate with the sediment chemistry high level effect criterion defined in Table 28).	Establish a sediment and ecological monitoring site(s) at the predicted deposition zone(s). Develop an engineering solution, which may include reduced production and/or particulate removal by flocculation, to the satisfaction of DEWHA. Implement this solution if 12 months of operational monitoring confirms the predictions of the modelling of sediment concentration build up or 24 months of ecological monitoring confirms a high level effect on biota.
6	Modelling predicts a depositional zone(s) in Commonwealth waters at which the accumulation of particulates from the mill's effluent discharge over the life of the mill will cause the condition 42 sediment quality limit for dioxins and furans (850 pg TEQ/kg) to be exceeded (commensurate with the sediment chemistry high level effect criterion defined in Table 28).	Develop and implement an engineering solution, which may include reduced production and/or tertiary treatment, to the satisfaction of DEWHA within a timeframe agreed to by DEWHA.
7	Modelling identifies that a monitoring location(s) is not fit for purpose, which may include (but not be limited to) an Impact Location(s) not being located in the vicinity of predicted maximum concentrations or a Control Location(s) being exposed to predicted concentrations from the discharge above the laboratory detection limit.	Revise monitoring locations to the satisfaction of DEWHA.

5. ONGOING MONITORING

5a. Effluent monitoring

Monitoring of effluent quantity and quality is addressed in Module M. The results of that monitoring will be compared against the flow limit of 64 ML/day set by condition 31 and the trigger levels and maximum limits established under condition 32 and provided in Table 23 and Table 24, and subject to the following.

In addition to treated effluent from the mill's operations, the effluent discharged from the mill's wastewater treatment plant will include treated stormwater from the mill site and stormwater and wash water from the adjacent chip mill site, which will be redirected to the treatment plant (it currently discharges from the chip mill site to irrigation areas and subject to evaporation rates potentially then to drainage lines that lead to the Tamar Estuary).

The condition 31 volume limit and the condition 32 concentration limits do not relate to these non-mill sources. The non-mill source flows and concentrations will therefore need to be discounted from the measured flows and concentrations to allow comparison against the approval limits (and trigger values).

The flows from non-mill sources will be variable (although maximum flows will be in the order of only 1 or 2% of the total flow through the ETP) and flows will therefore be measured at least weekly. Concentrations from non-mill sources are expected to be relatively constant and once concentrations have been characterised they will able to be assumed, with occasional validation measurements.

The discounting procedure will be as follows, which describes discounting based on average daily flows from the chip mill, taken from Mr Hannu Jäppinen's Expert Witness Statement (available at http://www.gunspulpmill.com.au/iis/supp/hannu_jappinen_ews.pdf). The actual values used for the calculations will vary from period to period as they are measured by the monitoring program.

Contaminant load contributions from the chip mill for the example are provided in Table 30.

Table 30: Example calculations of contaminant contributions from the chip mill

Parameter	Daily chip mill load to ETP*	Reduction coefficient in ETP	Net final chip mill effluent load from ETP	Net final chip mill concentration contribution from ETP***
TSS	0.66 t/d	97.5 %	16.5 kg/d	0.25 mg/L
BOD	0.35 t/d	98.8 %	4.2 kg/d	0.06 mg/L
COD	1.05 t/d	79.9 %	211.1 kg/d	3.23 mg/L
Colour	2.16 t/d**	0 %	2160 kg/d	33.00 mg/L
N	0.09 t/d	79.7 %	3.6 kg/d	0.06 mg/L
P	0.02 t/d	87.8 %	0.4 kg/d	0.01 mg/L

*Pulp mill effluent treatment plant
**Estimate assuming 1500 mg/L
***Assuming combined average monthly flow from chip mill of 1440 kL/day and pulp mill effluent flow of 64 ML/day

For the actual calculations, the values in the second column (daily load to ETP) will be replaced by the as-measured loads (ie. measured volumetric flow from chip mill multiplied by concentration from chip mill).

The measured volumetric flow from the chip mill in any given period will be discounted from final ETP flow to give the net flow contribution from the pulp mill alone. The calculated concentrations in the final column will be discounted each period from the concentrations measured in the final ETP effluent to give the concentration contribution from the pulp mill alone.

The resultant pulp mill flow and concentrations will then be used to calculate the weekly and monthly averages for comparison to the relevant pulp mill effluent quality against the trigger levels and maximum limits in Table 23 and Table 24.

Similar discounting calculations will be done for stormwater if and when there is a stormwater flow.

5b. Continuous monitoring of the effluent plume and its dispersion

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

5c. Sediment quality monitoring

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

5d. Sentinel biota monitoring

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

5e. Ecological surveys

This issue is addressed in Module M and is not directly relevant to this module but see item 4g.

6. REMEDIAL AND RESPONSE STRATEGIES

Remedial and response strategies have been developed for each of the matters for which the approval conditions require trigger levels to be developed and these are described in their relevant EIMP modules, which have been identified in Table 9 of the EIMP Module A Overview module, as shown in Table 31 below.

Table 31: Trigger levels and the EIMP modules that will deal with them and their associated remedial and response strategies

Trigger	Module
Concentration of dioxins and furans, chlorate and total chloroacetic acids in effluent	L
Additional effluent contaminants, including nitrate, resin acid and colour	L
Numbers of Tasmanian devils, quolls and Eastern barred bandicoots that may become trapped in pipeline excavation trenches	F-G-H-K
Numbers of listed threatened species that may be victims of roadkill	B, C, C1, I-J
Underwater noise impacts on Australian grayling during pile driving for the construction of the wharf	D
Underwater noise impacts on listed threatened and migratory marine species during construction of the wharf and ocean outfall	D, F-G-H-K

The trigger levels relating to effluent contaminants are relevant to this module. The relevant approval conditions and their triggers are shown in Table 32.

Quantitative trigger levels for effluent (conditions 3, 5, 32 and 33) have been developed in this module and are summarised in Table 23 and Table 24.

Trigger levels for the receiving environment (Schedule 2) have also been developed, and are described in Table 28. These are statistical triggers, which will involve a statistical analysis of data collected under the C-BOMP (Module M).

The trigger levels will be reviewed on the basis of the various studies and investigations described in this module and if amendments or refinements to the trigger levels are required, they will be submitted to DEWHA for approval.

Table 33 presents a summary of the trigger levels and the response strategies that will be implemented in the event that those trigger levels are reached.

Module N provides a collated summary of the trigger levels and response measures to provide a single EIMP reference point. Module N will also be updated if amendments or refinements to the trigger levels are required.

Table 32: Approval conditions relating to trigger levels

Condition	Condition wording
3	The EIMP must include trigger points and maximum limits in relation to effluent discharge from the operation of the pulp mill as well as specific remedial management responses to be undertaken by Gunns Limited if trigger points are exceeded or maximum limits are reached. It shall be an operational objective of the pulp mill, and reflected in the EIMP, that trigger points, and maximum limits, are not to be reached.
5	If at any time during the taking of the action the trigger levels for effluent discharge in this approval, or in the EIMP, are exceeded, then Gunns Limited must immediately implement the response strategies in the EIMP, in accordance with stipulated timeframes.
32	…Maximum limits and trigger levels on additional effluent contaminants (for example, nitrate, resin acid and colour) will also be developed in the EIMP in accordance with Schedule 2.
33	Prior to commissioning, trigger levels for effluent discharge for all phases of development must be included in the EIMP together with agreed response strategies and timeframes if trigger levels are exceeded or maximum limits reached.
39	In accordance with the EIMP, if the results of the modelling resulting from condition 38 indicate that effluent hydrodynamics and deposition will result in chemicals reaching trigger levels, Gunns Limited must implement approved response strategies, including, if necessary, changing the design and operation of the effluent pipeline and diffuser.
Schedule 2	In addition, the EIMP must detail the arrangements for environmental management once the pulp mill is operational. These include: a. Ongoing monitoring; and b. The development of remedial and response strategies if monitoring shows trigger levels are likely to be exceeded or maximum target levels are to be reached.
	The plan must include but not necessarily be limited to: … e. Identification of, and commitment to, agreed trigger or response levels for key indicators; and f. Identification of specific remedial management responses to be undertaken when trigger point levels are exceeded, so as to ensure environmental targets and objectives will be achieved.
	The EIMP must address the management of all issues associated with protection of the Commonwealth marine environment, including: … c. Establish both maximum limits and trigger levels of pollutants in effluent discharge, in the receiving environment and in sentinel biota;
	The EIMP must establish the design and measures to implement an appropriate monitoring program to ensure there are no unacceptable impacts on matters of National Environmental Significance as a result of the action. The monitoring program must also identify and measure agreed trigger or response levels for key indicators.
	The EIMP must identify specific remedial management responses to be undertaken when trigger levels are exceeded or maximum limits are reached, so as to ensure no unacceptable environmental impacts on matters of National Environmental Significance. If necessary, remedial changes could include retrofitting of new technology, for example tertiary treatment of the effluent. It must be an operational objective of the pulp mill that trigger points, and maximum limits, are not to be reached.

Table 33: Remedial and response measures and response timeframes for effluent and receiving environment trigger levels

Trigger or maximum limit	Reference in this EIMP module for levels	Primary response if exceeded	Timing of primary response initiation	Secondary response if primary response fails	Timing of secondary response initiation
Commissioning and ramp-up phase effluent					
7-day and monthly trigger levels	Table 24	Undertake Root Cause Analysis and implement remedial measures. Continue to monitor real-time using statistical process tools with in-line parameters to confirm that they move back into control ranges.	Within 24 hours of 7-day or monthly result	Modify production until real-time, in-line parameters return to within control ranges. Inform DEWHA of the exceedence and of the action taken within 7 days.	Within 24 hours of subsequent 7-day or monthly result
Monthly maximum limits	Table 24	Undertake Root Cause Analysis and implement remedial measures. Modify production or process variables until subsequent monitoring activities confirms limit is satisfied.	Within 24 hours of monthly result	Modify production until the cause has been determined and rectified. Submit report on the problem and action taken to DEWHA within 14 days. Consider intensification of relevant monitoring activities in the receiving environment.	Within 24 hours of subsequent monthly result
Average monthly maximum volume limit	Condition 31	Reduce production until the daily effluent volumes are below the level that over a month will be less than the average monthly maximum limit.	Within 24 hours of average monthly result	Reduce production until the daily effluent volumes are below the level that over a month will be less than the average monthly maximum limit.	Within 24 hours of average monthly result
Operational phase effluent					
7-day tier 1 trigger	Table 23	Undertake Root Cause Analysis and implement remedial measures. Continue to monitor real-time using statistical process tools with in-line parameters to confirm that they move back into control ranges.	Within 24 hours of 7-day result	Implement tier 2 response.	Within 24 hours of subsequent 7-day result
7-day tier 2 trigger	Table 23	Modify production levels by up to a 50% reduction commensurate with the degree of the trigger level exceedence and/or modify process variables until real-time, in-line parameters return to within control ranges. Inform DEWHA of the second tier trigger exceedence and of the action taken, within 1 week of the exceedence result.	Within 24 hours of 7-day result	Detailed risk assessment. Determine if modifying production or process further will resolve issue if an identifiable cause(s) has not been determined and rectified. Submit report on the problem and action taken to DEWHA within 1 month.	Within 24 hours of subsequent 7-day result
Monthly trigger	Table 23	Undertake Root Cause Analysis and implement remedial measures. Continue to monitor real-time using statistical process tools with in-line parameters to confirm that they move back into control ranges.	Within 24 hours of monthly average result	Detailed risk assessment. Determine if modifying production or process further will resolve issue if an identifiable cause(s) has not been determined and rectified. Submit report on the problem and action taken to DEWHA within 1 month.	Within 24 hours of subsequent monthly average result
Monthly average maximum limit	Table 23	The pulp mill will not operate if the monthly average effluent concentrations exceed the maximum limits. This response will be enacted immediately the monthly monitoring program shows the pulp mill operated above the monthly maximum limits unless the primary cause of the exceedance is a specific event, such as an unexpected spike in concentrations, which occurs during the last weekly monitoring result for the month, and responses have been implemented to the satisfaction of DEWHA. In addition, the maximum limits for the monthly average effluent concentrations will be reduced for the following month in order to fully compensate for the exceedance. The mill will not recommence operating without the Minister's agreement.	Within 24 hours of monthly average result	The mill will not operate if in the month following the monthly exceedance (as a result of a specific event, such as an unexpected spike in concentrations) the exceedance has not been fully compensated. The mill will not operate if the mill exceeds the monthly average maximum limits for three months in any 12 month rolling period. The mill will not recommence operating without the Minister's agreement	Within 24 hours of relevant monthly average result
Average monthly maximum volume limit	Condition 31	Reduce production until the daily effluent volumes are below the level that over a month will be less than the average monthly maximum limit. Adjust measured concentrations of condition 32 parameters by dividing the actual contaminant loads discharged over that month by the average monthly maximum volume limit (64 ML/day), thereby ensuring that any compliance assessment with condition 32 limits is not distorted by dilution from the excess effluent volume.	Within 24 hours of average monthly result	Reduce production until the daily effluent volumes are below the level that over a month will be less than the average monthly maximum limit.	Within 24 hours of average monthly result

<table>
<thead>
<tr><th>Trigger or maximum limit</th><th>Reference in this EIMP module for levels</th><th>Primary response if exceeded</th><th>Timing of primary response initiation</th><th>Secondary response if primary response fails</th><th>Timing of secondary response initiation</th></tr>
</thead>
<tbody>
<tr><td colspan="6">Receiving environment water chemistry, sediment chemistry, biota and ecological communities</td></tr>
<tr><td>Low level effect</td><td>Table 28</td><td>Review C-BOMP design to ensure that effects are monitored.</td><td>For next sampling round</td><td>Continue to monitor.</td><td>Next sampling round</td></tr>
<tr><td rowspan="2">Medium level effect</td><td rowspan="2">Table 28
&
Condition 39</td><td>For all media: Review C-BOMP design to ensure that effects are monitored → Characterise risk → Identify response options → Evaluate options → Advise DEWHA of proposed actions → Implement appropriate options → Monitor effectiveness of response.</td><td>Within 1 month of sampling result</td><td rowspan="2">Submit report to DEWHA on the ecological significance of effects and options available to mitigate impacts, if any, including the design and operation of the effluent pipeline and diffuser within 1 month.</td><td rowspan="2">Within 1 month of subsequent sampling round result</td></tr>
<tr><td>Additionally for water chemistry toxicants: Implement a pulsed discharge regime (using temporary effluent storage in the spill basin) linked to tidal state so as to avoid discharge at slack water and monitor the effectiveness of this at the relevant Impact Location(s) with hourly sampling over at a full tidal cycle. If this does not bring water quality concentrations below trigger values at the following week's sampling, reduce production and hence discharge rates until hourly monitoring over a full tidal cycle confirms that trigger levels are no longer exceeded beyond the edge of the mixing zone.</td><td>Within 48 hours of sampling result</td></tr>
<tr><td rowspan="2">High level effect</td><td rowspan="2">Table 28</td><td>For all media: Review C-BOMP design to ensure that effects are monitored → Characterise risk → Identify response options → Evaluate options → Advise DEWHA of proposed actions → Implement appropriate options → Consider program to identify potential causal agents applicable to operation of the mill. Monitor effectiveness of response for next monitoring cycle(s) or other nominated confirmation period.</td><td>Within 1 month of the next monitoring cycle or a nominated confirmation period.</td><td rowspan="2">Submit report to DEWHA within 1 month on the ecological significance of the observed effect(s), including where possible an assessment of cause (undesirable impacts could arise if maximum limits for water quality, sediment quality and/or biota are exceeded) and options available to mitigate the effect(s) if they can reasonably be attributed to the mill. The report will include an assessment of the potential efficacy of implementing tertiary treatment to resolve the issue, and where relevant a timetable for remediation of any undesirable impacts on matters of National Environmental Significance.</td><td rowspan="2">Within 1 month of subsequent sampling round result</td></tr>
<tr><td>Additionally for water chemistry toxicants: Reduce production and hence discharge rates until hourly monitoring over a full tidal cycle confirms that trigger levels are no longer exceeded beyond the edge of the mixing zone.</td><td>Within 48 hours of sampling result</td></tr>
</tbody>
</table>

Appendix A
Integrated EIMP progress update

Phase		EPBC 2007/3385 Schedule 2 Component	A	B	C	C1	D	E	F	G	H	I	J	K	L	M	N	O
			MODULE															
			EIMP Overview	Vegetation clearing - mill site and wharf access	Mill site bulk earthworks	Mill construction	Wharf construction	Accommod-ation facility construction	Water supply pipeline construction	Shore crossing construction	Ocean outfall construction	Solid waste disposal facility construction	Local reservoir construction	Effluent pipeline construction	Pre-commission management	Monitoring program	Remedial and response strategies	Habitat offsets & reserves
1. Overview	a	A description of the proposal and associated infrastructure	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Not applicable	Not applicable	Not applicable	Not applicable
	b	Identification of clear environmental objectives	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	This module	Other modules	Other modules	Other modules
	c	Identification of environmental indicators, and translation of objectives into agreed targets and performance measures	Not applicable	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	This module	Other modules	Other modules	Other modules
	d	Design and implementation of an appropriate monitoring program	Not applicable	Other modules	Other modules	Other modules	Other modules	Not applicable	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	This module	Other modules	Not applicable	Other modules
	e	Identification of, and commitment to, agreed trigger or response levels for key indicators	Not applicable	Other modules	Other modules	Other modules	Other modules	Not applicable	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	This module	Other modules	Other modules	Not applicable
	f	Identification of specific remedial management responses to be undertaken when trigger point levels are exceeded	Not applicable	Other modules	Other modules	Other modules	Other modules	Not applicable	Other modules	Other modules	Other modules	Other modules	Other modules	Other modules	This module	Other modules	Other modules	Not applicable
EPBC approval condition(s)			1,2,6,7,8,9,10, 11,12,13,20, 44,45,46,47,48	14,15,17, 18,20,23,25,26	14,17, 18,20,23,25,26	14,17, 20,23,25,26	14,27,28,29,30	14,20,23,25	14,19,20,21, 22,23,25	14,20,23,24, 25,27	14,20,26,27, 28,30,38,39	14,17, 20,23,25,26	14,17, 20,23,25,26	14,19,20,21, 22,23,24,25	3, 4, 9, 31, 32, 33, 34, 35, 37,38,39,41,42	3,4,31,32,33, 36,37,40,41, 42,43*	3,4,5,19,26,29, 30,31,32,33,39	15,16,17,18

*For completeness Module M also reiterates monitoring described in other modules relevant to conditions 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 29, 30, 34, 35 and 38

(grey)	Not applicable	(green)	Other modules	(orange)	This module

Phase		EPBC 2007/3385 Schedule 2 Component	A EIMP Overview	B Vegetation clearing - mill site and wharf access	C Mill site bulk earthworks	C1 Mill construction	D Wharf construction	E Accommod-ation facility construction	F Water supply pipeline construction	G Shore crossing construction	H Ocean outfall construction	I Solid waste disposal facility construction	J Local reservoir construction	K Effluent pipeline construction	L Pre-commission management	M Monitoring program	N Remedial and response strategies	O Habitat offsets & reserves
2. Preconstruction	a	Management of impacts on the Wedge-tailed Eagle – Tasmanian		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓		✓
	b	Management of risks to listed flora from plant pathogens		✓	✓	✓		✓	✓	✓		✓	✓	✓				
	c	Management of risks and uncertainties associated with the non-detection of listed flora		✓	✓	✓		✓	✓	✓		✓	✓	✓				
	d	Management of risks associated with the decline of difficult-to-detect listed flora		✓	✓	✓		✓	✓	✓		✓	✓	✓				
	e	Management of risks associated with the decline of Xanthorrhoea aff. bracteata								✓				✓				
	f	Management of risks associated with the amphibian chytrid fungus Batrachochytrium dendrobatidis							✓	✓				✓				
	g	Management of risks associated with trenching				✓			✓	✓				✓				
	h	Mitigation of impacts on the pipeline corridors							✓	✓				✓				
	i	Establishment of baseline surveys for roadkill		✓	✓													
	j	Undertaking appropriate surveys and establishing mitigation measures for impacts on listed migratory birds					✓			✓	✓							
	k	Undertaking appropriate examination of likely impacts of pile-driving noise associated with the wharf construction [or outfall construction noise]					✓				✓							
	l	Establishing baseline levels of vessel strike in the region					✓				✓							
	m	Monitoring the baseline levels of contaminants in listed species														✓		
	n	Developing rehabilitation and offset plans for listed threatened species																✓
	o	Establishing measures for habitat protection		✓	✓	✓						✓	✓					✓
		EPBC approval condition(s)	1,2,6,7,8,9,10, 11,12,13,20, 44,45,46,47,48	14,15,17, 18,20,23,25,26	14,17, 18,20,23,25,26	14,17, 20,23,25,26	14,27,28,29,30	14,20,23,25	14,19,20,21, 22,23,25	14,20,23,24, 25,27	14,20,26,27,28 ,30,38,39	14,17, 20,23,25,26	14,17, 20,23,25,26	14,19,20,21, 22,23,24,25	3, 4, 9, 31, 32, 33, 34, 35, 37,38,39,41,42	3,4,31,32,33, 36,37,40,41, 42,43*	3,4,5,19,26,29, 30,31,32,33,39	15,16,17,18

*For completeness Module M also reiterates monitoring described in other modules relevant to conditions 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 29, 30, 34, 35 and 38

Not applicable | Other modules | This module

		MODULE															
			A	B	C	C1	D	E	F	G	H	I	J	K	L	M	N	O
Phase		EPBC 2007/3385 Schedule 2 Component	EIMP Overview	Vegetation clearing - mill site and wharf access	Mill site bulk earthworks	Mill construction	Wharf construction	Accommod-ation facility construction	Water supply pipeline construction	Shore crossing construction	Ocean outfall construction	Solid waste disposal facility construction	Local reservoir construction	Effluent pipeline construction	Pre-commission management	Monitoring program	Remedial and response strategies	Habitat offsets & reserves
3. Construction	a	Management of risks associated with the amphibian chytrid fungus	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Other modules	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	Not applicable
3. Construction	b	Management of risks associated with roadkill	Not applicable	Other modules	Other modules	Other modules	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Other modules	Other modules	Not applicable	Not applicable	Other modules	Other modules	Not applicable
3. Construction	c	Management of pile-driving noise[or outfall construction noise]	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Other modules	Not applicable
3. Construction	d	Development of strategies to minimise vessel strike	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable
3. Construction	e	Appropriate strategies to minimise impacts on listed migratory birds	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Other modules	Other modules	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable
3. Construction	f	Strategies to ensure no increase in the levels of contaminants in listed species	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	This module	Other modules	Not applicable	Not applicable
3. Construction	g	Management of risks associated with listed crayfish	Not applicable	Other modules	Other modules	Other modules	Not applicable	Other modules	Other modules	Other modules	Not applicable	Other modules	Other modules	Other modules	Not applicable	Not applicable	Not applicable	Not applicable
4. Precommissioning	a	Toxicity testing of Elemental Chlorine Free mill effluents	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	This module	Other modules	Not applicable	Not applicable
4. Precommissioning	b	Studies to establish the properties affecting fate of fine particulate organic matter in effluent	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	This module	Not applicable	Not applicable	Not applicable
4. Precommissioning	c	Establish maximum limits and trigger levels of pollutants in effluent, receiving environment and sentinel biota	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	This module	Other modules	Other modules	Not applicable
4. Precommissioning	d	Measurement of background contaminants in sediments and biota	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable
4. Precommissioning	e	Background ecological surveys	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable
4. Precommissioning	f	Improved modelling (hydrodynamic and sediment) of fate and impact of effluent	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Other modules	Not applicable	Not applicable	Not applicable	This module	Other modules	Not applicable	Not applicable
4. Precommissioning	g	Design of the monitoring program for marine effluent	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	This module	Other modules	Not applicable	Not applicable
		EPBC approval condition(s)	1,2,6,7,8,9,10, 11,12,13,20, 44,45,46,47,48	14,15,17, 18,20,23,25,26	14,17, 18,20,23,25,26	14,17, 20,23,25,26	14,27,28,29,30	14,20,23,25	14,19,20,21, 22,23,25	14,20,23,24, 25,27	14,20,26,27,28 ,30,38,39	14,17, 20,23,25,26	14,17, 20,23,25,26	14,19,20,21, 22,23,24,25	3, 4, 9, 31, 32, 33, 34, 35, 37,38,39,41,42	3,4,31,32,33, 36,37,40,41, 42,43*	3,4,5,19,26,29, 30,31,32,33,39	15,16,17,18

*For completeness Module M also reiterates monitoring described in other modules relevant to conditions 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 29, 30, 34, 35 and 38

(grey)	Not applicable
(green)	Other modules
(orange)	This module

			MODULE															
			A	B	C	C1	D	E	F	G	H	I	J	K	L	M	N	O
Phase		EPBC 2007/3385 Schedule 2 Component	EIMP Overview	Vegetation clearing - mill site and wharf access	Mill site bulk earthworks	Mill construction	Wharf construction	Accommod-ation facility construction	Water supply pipeline construction	Shore crossing construction	Ocean outfall construction	Solid waste disposal facility construction	Local reservoir construction	Effluent pipeline construction	Pre-commission management	Monitoring program	Remedial and response strategies	Habitat offsets & reserves
5. Ongoing monitoring	a	Effluent monitoring																
	b	Continuous monitoring of the effluent plume and its dispersion																
	c	Sediment quality monitoring																
	d	Sentinel biota monitoring																
	e	Ecological surveys																
6. Remedial response	a	Remedial management responses to be undertaken when trigger levels are exceeded or maximum limits are reached																
		EPBC approval condition(s)	1,2,6,7,8,9,10, 11,12,13,20, 44,45,46,47,48	14,15,17, 18,20,23,25,26	14,17, 18,20,23,25,26	14,17, 20,23,25,26	14,27,28,29,30	14,20,23,25	14,19,20,21, 22,23,25	14,20,23,24, 25,27	14,20,26,27,28 ,30,38,39	14,17, 20,23,25,26	14,17, 20,23,25,26	14,19,20,21, 22,23,24,25	3, 4, 9, 31, 32, 33, 34, 35, 37,38,39,41,42	3,4,31,32,33, 36,37,40,41, 42,43*	3,4,5,19,26,29, 30,31,32,33,39	15,16,17,18

*For completeness Module M also reiterates monitoring described in other modules relevant to conditions 15, 16, 17, 18, 19, 20, 22, 25, 26, 27, 29, 30, 34, 35 and 38

	Not applicable		Other modules		This module

Appendix B
Approval conditions, actions, outcomes, management

EPBC 2007/3385 approval conditions addressed by this module, actions taken by Gunns to prepare management measures, action outcomes and resultant environmental management measures

Condition	Issue	Approval requirement addressed by this module	Actions taken to prepare management measures	Findings	Management measures adopted to ensure approval condition is met
3	Trigger levels, maximum limits and response strategies	The EIMP must include trigger points and maximum limits in relation to effluent discharge from the operation of the pulp mill as well as specific remedial management responses to be undertaken by Gunns Limited if trigger points are exceeded or maximum limits are reached. It shall be an operational objective of the pulp mill, and reflected in the EIMP, that trigger points, and maximum limits, are not to be reached.	Trigger levels and maximum limits have been developed in accordance with approval conditions 32 and 33. These are described in section 4c of this module.	Trigger levels and maximum limits for effluent are described in Table 23 and Table 24.	Response strategies are described in Table 33 of this module. These will be implemented if trigger levels are reached.
4	Implementation of response strategies	If at any time during the taking of the action there are reasonable grounds for any of Gunns Limited, the Minister, the Department, the Independent Expert Group or the Independent Supervisor to believe that the maximum limits for effluent discharge in this approval, or in the EIMP, are likely to be exceeded, then that party (if it is not Gunns Limited) shall immediately inform Gunns Limited. Once Gunns Limited has either been so informed or itself believes maximum limits are likely to be exceeded, it must immediately implement the response strategies in the EIMP, in accordance with the stipulated timeframes. If within the stipulated timeframe Gunns Limited is unable to demonstrate to the satisfaction of the Minister that response strategies are achieving their objective as set out in the EIMP to reverse the undesirable impacts, the mill must cease to operate until such time as a tertiary treatment solution satisfactory to the Minister is installed.	Maximum limits have been developed in accordance with approval conditions 32 and 33. These are described in section 4c of this module.	Maximum limits for effluent are described in Table 23 and Table 24.	Response strategies are described in Table 33 of this module. These will be implemented if trigger levels are reached.
9	Commissioning and the EIMP	No commissioning activity is to commence until the final and complete EIMP has been approved by the Minister. Once approved, the EIMP must be implemented.	This module of the EIMP addresses those conditions of the approval that are relevant to precommissioning activities.	The approval defines "*commissioning*" to be "when construction activities of the pulp mill have been concluded and the pulp mill is commencing start-up" (the approval does not define the end of commissioning). "Start-up" is not defined in the approval but it is an accepted industry term marking the first input of chips to the pulp mill's digester. For this project, start-up will also include any trials of the pulp drier using purchased fibre, which could lead fibre to contamination of water that will be discharged from the ocean outfall.	Mill commissioning will not commence until the full EIMP has been approved by the Minister.
31	Effluent discharge volume limit	The volume of wastewater effluent discharged from the operation of the pulp mill to the marine environment must not be more than 64 megalitres per day on an average monthly basis.	This is a set limit (of not more than 64 megalitres per day on an average monthly basis). No action is required.	Effluent volume monitoring has been described in Module M.	The mill will be operated so that the average monthly discharge is less than or equal to 64 megalitres per day.

<table>
<tr><th>Condition</th><th>Issue</th><th>Approval requirement addressed by this module</th><th>Actions taken to prepare management measures</th><th>Findings</th><th>Management measures adopted to ensure approval condition is met</th></tr>
<tr><td>32</td><td>Operational effluent trigger levels and maximum limits</td><td>Gunns Limited must sample the effluent discharge from the operation of the pulp mill for the parameters in the tables below on at least a daily basis. The pulp mill must not operate if the monthly average effluent concentrations from the pulp mill exceed the maximum limits provided in the tables below. These limits may be revised in the final EIMP if agreed by the Independent Expert Group and approved by the Minister as a result of further studies. Maximum limits and trigger levels on additional effluent contaminants (for example, nitrate, resin acid and colour) will also be developed in the EIMP in accordance with Schedule 2.
<table>
<tr><th>Parameter</th><th colspan="2">Monthly average effluent concentrations</th></tr>
<tr><td></td><td>Trigger level</td><td>Maximum limit</td></tr>
<tr><td>Dioxins & furans</td><td>2.0 pg TEQ/L</td><td>3.4 pg TEQ/L</td></tr>
<tr><td>Chlorate (CO3-)</td><td>1.9 mg/L</td><td>3.7 mg/L</td></tr>
<tr><td>Total chloroacetic acids</td><td>237 µg/L</td><td>237 µg/L</td></tr>
</table>
<table>
<tr><th>Parameter</th><th>Monthly average concentration
Maximum limit</th></tr>
<tr><td>Total nitrogen</td><td>2.5 mg/L</td></tr>
<tr><td>Total phosphorus</td><td>0.8 mg/L</td></tr>
<tr><td>Total suspended solids</td><td>20 mg/L</td></tr>
<tr><td>Biological oxygen demand</td><td>11 mg/L</td></tr>
</table>
</td><td>Further studies have been undertaken and are reported in Appendix E of this module.</td><td>The studies have led to trigger levels and maximum limits being proposed for the normal operations of the mill. These are described in Table 23 of this module.</td><td>During normal operations, the mill will be operated so that the maximum limits described in Table 23 are not exceeded. If the trigger levels described in that table are exceeded during normal operations, the response measures identified in that table and described in Table 33 will be implemented.
This Module L also describes additional studies and investigations that will be undertaken to address residual risks and uncertainties identified by the Chief Scientist.
These studies and investigations are intended to further inform understanding of effluent characteristics and the design of the monitoring program. Gunns may also use the results of some of these studies and investigations to contribute to a request to the Minister to revise the trigger levels and maximum limits as provided for under condition 32.
The findings of the completed studies will need to be approved by the Department prior to commissioning commencing.
The results of the approved studies will need to be incorporated into the monitoring program (known as the Commonwealth Baseline and Operational Monitoring Plan, C-BOMP), or other documents as required, to the satisfaction of the Department prior to commissioning commencing. The results of baseline surveys being undertaken to inform the monitoring program will also be incorporated into the monitoring program.
Outputs from the programs will include reports to the Department and at various stages Departmental approval will be required.</td></tr>
<tr><td>33</td><td>Effluent trigger levels and maximum limits for all phases</td><td>Prior to commissioning, trigger levels for effluent discharge for all phases of development must be included in the EIMP together with agreed response strategies and timeframes if trigger levels are exceeded or maximum limits reached.</td><td>Further studies have been undertaken and are reported in Appendix E of this module.</td><td>The studies have led to trigger levels and maximum limits being proposed for the commissioning and ramp-up phases of the mill. These are described in Table 24 of this module.</td><td>During the commissioning and ramp-up phase of the mill development, the mill will be operated so that the maximum limits described in Table 24 are not exceeded. If the trigger levels described in that table are exceeded during these phases, the response measures identified in that table and described in Table 33 will be implemented.</td></tr>
<tr><td>34</td><td>Effluent toxicity testing</td><td>In accordance with the EIMP, Gunns Limited must obtain (from overseas pulp mills already using technologies similar to that proposed) effluent samples, and conduct chemical analyses and whole effluent toxicity testing to identify the key contaminants and their concentrations and the effluent dilutions needed in the mixing zone for the proposed mill. Gunns Limited must report on the temporal variability in both the contaminant concentrations and toxicity in the effluents from</td><td>A toxicity testing sample and analysis plan has been prepared and is described in section 4a of this module.</td><td>The findings of the toxicity testing will be provided to DEWHA when they are available.</td><td>Once approved through the approval of this module, the toxicity testing will be commissioned. The results of this testing will be reported to DEWHA and response strategies will be modified if and as necessary and submitted to DEWHA for approval prior to mill commissioning.</td></tr>
</table>

Condition	Issue	Approval requirement addressed by this module	Actions taken to prepare management measures	Findings	Management measures adopted to ensure approval condition is met
		these mills.			
35	Properties of fine particulate organic matter	In accordance with the EIMP, to determine the properties affecting the fate of fine particulate organic matter in effluent, Gunns Limited must undertake laboratory studies, agreed to by the Department, to assess the likely settling and flocculation properties of fine particulate organic materials in equivalent effluent.	A laboratory study methodology for determining the settling and flocculation properties of fine particulates has been prepared and is described in section 4b of this module.	The findings of the laboratory studies will be provided to DEWHA when they are available.	Once approved through the approval of this module, the laboratory studies will be commissioned. The results of the studies will be reported to DEWHA for approval prior to mills commissioning.
37	Reassessment of risk quotients for hydrophobic substances	Gunns Limited must determine, in accordance with the EIMP, effluent monitoring requirements prior to the commencement of pulp mill commissioning. This must include but not be limited to: a) the parameters described in Condition 32; b) a re-assessment of the Risk Quotients (RQs) for hydrophobic substances, in all media, being taken into account; and c) sampling and analysis protocols and accreditation.	The risk assessment undertaken for the Preliminary Documentation examined hydrophilic substances. Condition 37 requires a reassessment for hydrophobic substances.	Gunns will: 1. Select potentially hydrophobic chemicals from the list of 130 chemicals potentially in the effluent 2. Determine the physicochemical properties of these hydrophobic chemicals, 3. Determine their partitioning coefficients, half-lives etc. (based on the physico-chemical properties) 4. Determine their sediment concentrations (following the corrected procedure to estimate dioxin/furan concentrations in sediments) 5. Determine guideline or end-point values for each of the chemicals that partition to the sediment phase 6. Calculate their RQ values, and 7. Any chemicals with RQ ≥ 1 will be added to the monitoring list if they are not already on the list.	The testing will be undertaken in accordance with the program described in this module.

Condition	Issue	Approval requirement addressed by this module	Actions taken to prepare management measures	Findings	Management measures adopted to ensure approval condition is met
38	Additional hydrodynamic modelling	Additional modelling must be carried out in relation to the fate of effluent, as part of the EIMP, prior to the commencement of commissioning of the mill. The details of the modelling to be commissioned and the organisation responsible for performing the modelling must be approved by the Department. The modelling to be commissioned must include, but not be limited to: a) The inclusion of a sediment transport component. b) The use of three-dimensional models for all levels of spatial resolution. c) Increased vertical resolution for the high resolution model used in the water quality analysis. d) Forcing from all mechanisms that may potentially influence residual or diurnal dynamics, including background sea level gradients, low frequency sea level oscillations, surface heat flux, sea level, temperature and salinity open boundary and initial conditions which capture mesoscale variability and wave enhanced bottom friction. e) The execution of long term simulations that capture seasonal variability, and evidence of the model achieving pseudo-steady state in the regional (Bass Strait) field. f) The calibration of model tracers (e.g. temperature or salinity) and velocity to data derived from moored instruments (for temporal comparisons) and measured profiles (for spatial comparisons) over the period the model is simulated. This will involve a supplementary field program designed specifically for model calibration (i.e. implemented over an annual cycle). Detailed evidence of satisfactory calibration must be supplied, including correlation between phase and amplitude of calibration variables. g) Sensitivity analysis for key model parameters, particularly horizontal diffusion. h) The use of appropriate simulation lengths for generating plume statistics. i) The use of data (modelled or measured) that captures the three-dimensional nature of the water column and seasonal variability for use in the near-field model.	The additional hydrodynamic modelling (condition 36(c)) to be undertaken is described in section 4f.3 and Appendix D of this module. The modelling has been broken up into the following five major components: o Far-field hydrodynamic modelling o Near-field modelling o Sediment transport modelling o Wave modelling o Field measurement program. The laboratory studies for determining the properties of fine organic particulates are described in section 4b.2 of this module.	Following the approval of this module, the additional hydrodynamic modelling and the laboratory studies will be commissioned in accordance with the program described in this module.	Subject to the findings of the additional hydrodynamic modelling and laboratory studies of fine organic particulates, the C-BOMP will be modified as necessary, and then submitted to DEWHA for approval.

Condition	Issue	Approval requirement addressed by this module	Actions taken to prepare management measures	Findings	Management measures adopted to ensure approval condition is met
39	Deposition and trigger levels	In accordance with the EIMP, if the results of the modelling resulting from condition 38 indicate that effluent hydrodynamics and deposition will result in chemicals reaching trigger levels, Gunns Limited must implement approved response strategies, including, if necessary, changing the design and operation of the effluent pipeline and diffuser.	The additional hydrodynamic modelling (condition 36(c)) to be undertaken is described in section 4f.3 and Appendix D of this module. The modelling has been broken up into the following five major components: o Far-field hydrodynamic modelling o Near-field modelling o Sediment transport modelling o Wave modelling o Field measurement program.	Following the approval of this module, the additional hydrodynamic modelling will be commissioned in accordance with the program described in this module.	Subject to the finding of the additional hydrodynamic modelling, any necessary additional response measures will be developed and submitted to DEWHA for approval.
41	Early warning of reaching trigger levels	In accordance with the EIMP, Gunns Limited must prepare and have approved by the Minister, prior to commencement of mill commissioning, strategies for monitoring the impacts of the mill effluent on the marine environment. These strategies must include but not necessarily be limited to: (a) Appropriate early warning of reaching trigger levels in Commonwealth waters. … g) Effluent monitoring must be undertaken on weekly composites of the daily samples	A Commonwealth Baseline and Operating Monitoring Plan (C-BOMP) has been prepared.	The C-BOMP is provided with Module M. Trigger levels are provided in Table 26, Table 27 and Table 28. Effluent sampling will use 7-day composites of daily samples.	The approved C-BOMP will be implemented and any proposed revisions will be submitted to DEWHA for approval.
41	Ecotoxicological testing	In accordance with the EIMP, Gunns Limited must prepare and have approved by the Minister, prior to commencement of mill commissioning, strategies for monitoring the impacts of the mill effluent on the marine environment. These strategies must include but not necessarily be limited to: … c) Chemical and ecotoxicological assessments including assessments of endocrine disrupting ability, and ecological assessments. … l) Whole-effluent toxicity testing using species relevant to Commonwealth waters in Bass Strait. …	The proposed whole effluent toxicity (WET) testing will comprise: • Microtox assay using the marine bacterium *Vibrio fischeri* • 72-h micro-algal growth inhibition test using *Nitzschia closterium* • 72-h macro-algal germination assay using *Hormosira banksii* • Sea urchin fertilisation success using *Heliocidaris tuberculata* • 72-h larval development using the sea urchin *Heliocidaris tuberculata* • 48-h larval development using the doughboy scallop *Mimachlamys asperrima* • 96-h survival of the juvenile amphipod *Allorchestes compressa* • 96-h larval fish imbalance test using the striped trumpeter *Latris lineata*. The strategy for monitoring endocrine disruptive ability of the effluent of the Bell Bay Pulp Mill Project will continue to include the focussed surveillance strategies developed for the Canadian Pulp & Paper Environmental Effects Monitoring (EEM).	WET testing will be undertaken prior to mill commissioning, using overseas mill effluent. The endocrine disruptive ability investigation strategy however, will be reviewed again after construction of the mill has commenced and before commissioning commences. The intent of the review will examine if any other assay(s) potentially with greater ecological relevance than the presently known in vitro assays, such as ER_CALUX have developed from the Canadian project or any other robust source. If there are any such assays, they will be considered for inclusion in later versions of the C-BOMP, with the final strategy subject to approval by DEWHA.	The testing will be undertaken in accordance with the program described in this module.

Condition	Issue	Approval requirement addressed by this module	Actions taken to prepare management measures	Findings	Management measures adopted to ensure approval condition is met
42	Maximum limits of dioxins and furans in sediments	The maximum limit of concentration of dioxins and furans in the benthic sediments in any location within Commonwealth marine waters is 850pg TEQ/kg. To ensure that concentrations do not reach this level, trends in concentrations of samples collected in State and Commonwealth waters, in accordance with the EIMP, must be analysed and independently reviewed on a six-monthly basis.	A Commonwealth Baseline and Operational Monitoring Plan (C-BOMP) has been prepared and submitted for approval with Module M.	The C-BOMP includes monitoring of sediments for dioxins and furans. Trends in concentrations of samples collected in State and Commonwealth waters will be analysed, and independently reviewed, on a six-monthly basis. As described in Module M, following mill commissioning sediment surveys will be taken quarterly in the first year of operations. Thereafter they will be taken twice annually (spring and autumn) for 3 years unless the findings indicate that quarterly sampling should be continued. The sampling need and sampling frequency will be reviewed after 3 years.	Once approved, the C-BOMP will be implemented.

Appendix C
Schedule of physico-chemical tests for overseas effluent

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
Group A - Instrument Measurements	**Continuous**											
Flow	Continuous	Mill equipment TBA	*Insitu* or field instrument	vol/time		Logged	N/A	N/A	N/A	N/A	No	
Dissolved Oxygen	Continuous or spot	Mill TBA or Gunns	*Insitu* or field instrument	mg/l		Logged	N/A	N/A	N/A	N/A	No	
pH	Continuous or spot	Mill TBA or Gunns	*Insitu* or field instrument	pH		Logged	N/A	N/A	N/A	N/A	No	
Temp	Continuous or spot	Mill TBA or Gunns	*Insitu* or field instrument	°C		Logged	N/A	N/A	N/A	N/A	No	
Turbidity	Continuous or spot	Mill TBA or Gunns	*Insitu* or field instrument	NTU		Logged	N/A	N/A	N/A	N/A	No	
Electrical Conductivity	Continuous or spot	Mill TBA or Gunns	*Insitu* or field instrument	uS/cm		Logged	N/A	N/A	N/A	N/A	No	
Group B												
Orthophosphate as P (FRP)	One	NMI	NW_S21	ug/L	5	Grab	Filter on site (0.45 um cellulose acetate membrane and refrigerate)	2d	Plastic	1L B1	Yes	Will violate holding time recommended by NMI
Phosphorus total	One	NMI	NT2_47	ug/L	2	Grab	pH <2 (H_2SO_4) + cool to 4 deg C	28d	Plastic	1L B2	Yes	
Chemical Oxygen Demand COD	One	NMI	NWS3	mg/L	3	Grab	pH <2 (H_2SO_4) + cool to 4 deg C	28d	Plastic	1L B2	Yes	
Total Suspended Solids	One	NMI	NW_S13	mg/L	2	Grab	Cool to 4 deg C	7d	Plastic	1L B3	Yes	
Nitrite-N	One	NMI	NW_B19	mg/L	0.005	Grab	Cool to 4 deg C	2d	Plastic	1L B3	Yes	Will violate holding time recommended by NMI
Nitrate-N	One	NMI	NW_B19	mg/L	0.005	Grab	Freeze	28d	Plastic	1L B4	Yes	May defrost in transit
Nitrogen - total as N	One	NMI	NW_B23	mg/L	0.05	Grab	Freeze	28d	Plastic	1L B4	Yes	May defrost in transit
Ammonia	One	NMI	NWD8_NWB18	mg/L	0.005	Grab	Filter on site (0.45 um cellulose acetate membrane and refrigerate)	1d	Plastic	1L B1	Yes	Will violate holding time recommended by NMI
Total Organic Carbon	One	NMI	NW_S15	mg/L	1	Grab	pH <2 (H_2SO_4) + cool to 4 deg C	28d	Plastic	1L B2	Yes	
Colour True	One	NMI	NWD4	Hazen	2	Grab	Cool to 4 deg C + Dark	2d	Plastic	1L B3	Yes	Will violate holding time recommended by NMI
Group C												
Chlorate	One	NMI	WL119	ug/L	10	Grab	50 mg/L EDA + cool to 4 deg C	28d	Plastic	0.25L C1	Yes	
AOX	One	NMI_sub Levay	SCANW9-89	ug/L	2	Grab	Acidify with nitric acid to pH <2, refrigerate and store in the dark.	3d	Glass	0.25L C2	No	Will violate holding time. Check AQIS permit. HNO_3 may not be permitted in aircraft
Group D												
Sterols												
Campestorol	One	NMI_sub_CSIRO	In - house	ug/L	0.04	Grab	Cool to 4 deg C	14 Days	Glass	2 X 1L D1	No	
Stigmasterol	One	NMI_sub_CSIRO	In - house	ug/L	0.4	Grab	Cool to 4 deg C	14 Days	Glass	2 X 1L D1	No	
β-sitosterol	One	NMI_sub_CSIRO	In - house	ug/L	0.12	Grab	Cool to 4 deg C	14 Days	Glass	2 X 1L D1	No	
Stigmastanol	One	NMI_sub_CSIRO	In - house	ug/L	0.04	Grab	Cool to 4 deg C	14 Days	Glass	2 X 1L D1	No	

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
Fatty acids												
Oleic (C18:1(n-9))	One	NMI_sub_CSIRO	In - house	ug/L	TBA	Grab	4 deg C or 0.5g ascorbic acid plus 2 pellets NaOH	14d	Glass	2 X 1L D1	No	
Stearic (C18:0)	One	NMI_sub_CSIRO	In - house	ug/L	TBA	Grab		14d	Glass	2 X 1L D1	No	
Linoleic (C18:2(n-6))	One	NMI_sub_CSIRO	In - house	ug/L	TBA	Grab		14d	Glass	2 X 1L D1	No	
Palmitic (C16:0)	One	NMI_sub_CSIRO	In - house	ug/L	TBA	Grab		14d	Glass	2 X 1L D1	No	
Group E												
Metals and metaloids - Total												
Aluminium-Total	One	NMI	NT2_47	ug/L	5	Grab	Acidify with nitric acid to pH 1 to 2	6 m	Plastic	0.25L E1	Yes	HNO3 may not be permitted in aircraft
Arsenic-Total	One	NMI	NT2_247_251	ug/L	0.5	Grab		6 m	Plastic	0.25L E1	Yes	
Barium-Total	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L E1	Yes	
Beryllium-Total	One	NMI	NT2_47	ug/L	0.1	Grab		6 m	Plastic	0.25L E1	Yes	
Boron-Total	One	NMI	NT2_47	ug/L	5	Grab	None required	6 m	Plastic	0.25L E1	Yes	
Cadmium-Total	One	NMI	NT2_47	ug/L	0.1	Grab		6 m	Plastic	0.25L E1	Yes	HNO3 may not be permitted in aircraft
Chromium-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L E1	Yes	
Cobalt-Total	One	NMI	NT2_47	ug/L	0.2	Grab	Acidify with nitric acid to pH 1 to 2	6 m	Plastic	0.25L E1	Yes	
Copper-Total	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L E1	Yes	
Iron-Total	One	NMI	NT2_47	ug/L	5	Grab		6 m	Plastic	0.25L E1	Yes	
Lead-Total	One	NMI	NT2_47	ug/L	0.2	Grab		6 m	Plastic	0.25L E1	Yes	
Manganese-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L E1	Yes	
Mercury-Total	One	NMI	NT2_47_244	ug/L	0.1	Grab	Acidify with nitric acid to pH 1 to 2	28d	Plastic	0.25L E2	Yes	note separate vessel, HNO3 may not be permitted in aircraft
Molybdenum-Total	One	NMI	NT2_47	ug/L	0.1	Grab		6 m	Plastic	0.25L E1	Yes	HNO3 may not be permitted in aircraft
Nickel-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L E1	Yes	
Selenium-Total	One	NMI	NT247_251	ug/L	1	Grab	Acidify with nitric acid to pH 1 to 2	6 m	Plastic	0.25L E1	Yes	
Tin-Total	One	NMI	NT2_47	ug/L	2	Grab		6 m	Plastic	0.25L E1	Yes	
Vanadium-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L E1	Yes	
Zinc-Total	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L E1	Yes	
Group F												
Metals and metaloids - Dissolved												
Aluminium-Field filtered	One	NMI	NT2_47	ug/L	5	Grab		6 m	Plastic	0.25L F1	Yes	
Arsenic-Field filtered	One	NMI	NT2_247_251	ug/L	0.5	Grab	Filter + Acidify with nitric acid to pH 1 to 2	6 m	Plastic	0.25L F1	Yes	
Barium-Field filtered	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L F1	Yes	
Beryllium-Field filtered	One	NMI	NT2_47	ug/L	0.1	Grab		6 m	Plastic	0.25L F1	Yes	
Boron-Field filtered	One	NMI	NT2_47	ug/L	5	Grab	Filter + none required	6 m	Plastic	0.25L F1	Yes	
Cadmium-Field filtered	One	NMI	NT2_47	ug/L	0.1	Grab	Filter + Acidify with nitric acid to pH 1 to 2	6 m	Plastic	0.25L F1	Yes	
Chromium-Field filtered	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L F1	Yes	
Cobalt-Field filtered	One	NMI	NT2_47	ug/L	0.2	Grab		6 m	Plastic	0.25L F1	Yes	
Copper-Field filtered	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L F1	Yes	
Iron-Total	One	NMI	NT2_47	ug/L	5	Grab		6 m	Plastic	0.25L F1	Yes	
Lead-Total	One	NMI	NT2_47	ug/L	0.2	Grab		6 m	Plastic	0.25L F1	Yes	
Manganese-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L F1	Yes	
Molybdenum-Total	One	NMI	NT2_47	ug/L	0.1	Grab		6 m	Plastic	0.25L F1	Yes	
Nickel-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L F1	Yes	
Selenium-Total	One	NMI	NT247_251	ug/L	1	Grab		6 m	Plastic	0.25L F1	Yes	
Tin-Total	One	NMI	NT2_47	ug/L	2	Grab		6 m	Plastic	0.25L F1	Yes	
Vanadium-Total	One	NMI	NT2_47	ug/L	0.5	Grab		6 m	Plastic	0.25L F1	Yes	

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
Zinc-Total	One	NMI	NT2_47	ug/L	1	Grab		6 m	Plastic	0.25L F1	Yes	
BTEX												
Benzene	One	NMI	NGCMS_1120	ug/L	1						Yes	
Toluene	One	NMI	NGCMS_1120	ug/L	1	Grab	pH <2 (H2SO4 or HCl) + Cool to 4 deg C	14d	Glass, vials with PTFE faced septum	2 X 0.04L F2	Yes	
Ethylbenzene	One	NMI	NGCMS_1120	ug/L	1						Yes	
Xylenes	One	NMI	NGCMS_1120	ug/L	2						Yes	
Halogenated Aliphatic Hydrocarbons												
Dichloromethane	One	NMI	NGCMS_1120	ug/L	1	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Sulfonated Compounds												
Total Sulfide	One	NMI	NWD16	ug/L	100	Grab	Cool + add 4 drops 2N Zn acetate/100mL	7d	Plastic	0.1L F4	Yes	APHA 4500D
Amines Nitroaromatics & Nitrosamines												
Aniline	One	NMI	NGCMS_1122	ug/L	20	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Other Organics												
Methanol	One	NMI	NGCMS_1130	ug/L	1000	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	No	
Surfactants												
MBAS	One	NMI	NWS6	mg/L	0.05	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Chloropropanes												
1,1-Dichloropropane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
2,2-Dichloropropane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,2-Dichloropropane	One	NMI	NGCMS_1120	ug/L	1	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,3-Dichloropropane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,2,3-Trichloropropane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,2-Dibromo-3-chloropropane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Chlorinated alkenes												
3-chloropropene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Vinyl chloride (aka Chloroethylene)	One	NMI	NGCMS_1120	ug/L	2		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
trans-1,2-Dicloroethene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,1-Dichloroethene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
cis-1,2-Dichloroethene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
1,1-Dichloropropene	One	NMI	NGCMS_1120	ug/L	1	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Trichloroethene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
cis-1,3-Dichloropropene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
trans-1,3-Dichloropropene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Tetrachloroethene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Hexachlorobutadiene	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
Trihalomethanes												
Chloroform	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	14d	Glass		Yes	
Bromodichloromethane	One	NMI	NGCMS_1120	ug/L	1	Grab	Cool to 4 deg C	14d	Glass	2 X 0.04L F2	Yes	
Dibromochloromethane	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	14d	Glass		Yes	
Bromoform	One	NMI	NGCMS_1120	ug/L	1		Cool to 4 deg C	14d	Glass		Yes	
Chloracetic Acids												
Monochloroacetic acids	One	NMI	NGCMS_1120	ug/L	10						No	NATA accreditation in progress
Dichloroacetic acids	One	NMI	NGCMS_1120	ug/L	10	Grab	If residual chlorine is present add 10% thiosulphate	14d	Glass, vials with PTFE faced septum	2 X 0.04L F2	No	NATA accreditation in progress
Trichloroacetic acids	One	NMI	NGCMS_1120	ug/L	10						No	NATA accreditation in progress

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
Phenols including chlorophenols												
Phenol	One	NMI	NGCMS_1111	ug/L	1	Grab	Cool to 4 deg C	7d	Glass	2 X 1L F3	Yes	
2-Chlorophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2-Methylphenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2,4-Dichlorophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
3-& 4-Methylphenols	One	NMI	NGCMS_1111	ug/L	2					2 X 1L F3		
2,4-Dimethyphenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2,6-Dichlorophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2-Nitrophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
4-Chloro-3-methylphenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2,4,6-Trichlorophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
4-Nitrophenol	One	NMI	NGCMS_1111	ug/L	1					2 X 1L F3		
2,4,5-Trichlorophenol	One	NMI	NGCMS_1111	ug/L	2					2 X 1L F3		
2,3,4,6-Tetrachlorophenol	One	NMI	NGCMS_1111	ug/L	2					2 X 1L F3		
Pentachlorophenol	One	NMI	NGCMS_1111	ug/L	2					2 X 1L F3		
3-chlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04	Grab	If residual chlorine is present add 10% thiosulphate	21d	Glass	2 X 1L D1	No	
4-chlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,4,6-trichloroanisole	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,5 or 3,5-dichlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,4-dichlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,3-dichlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
3,4-dichlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,4,6-trichlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
4,5-dichloroveratrole	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
4,5-dichloroguaiacol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
4,6-dichloroguaiacol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
3,4,5-trichloroveratrole	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
4,5-dichlorocatechol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
6-chlorovanillin	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
5-chlorovanillin	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
3,4,5-trichloroguaiacol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,3,4,6-tetrachlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
3,4,6-trichlorocatechol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
4,5,6-trichloroguaiacol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
trichlorosyringol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2-chlorosyringaldehyde	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
tetrachloroguaiacol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
5,6-dichlorovanillin	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
pentachlorophenol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
2,6-dichlorosyrigealdehyde	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
tetrachlorocatechol	One	NMI_sub_CSIRO	In - house	ug/L	0.04					2 X 1L D1		
Group H												
PCDD/PCDF/PCB						Grab	Cool to 4 deg C + 0.008% Na2S203	30 d	Glass		Yes	
2,3,7,8-TCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
2,3,7,8-TCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
2,3,7,8-TCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
2,3,7,8-TCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
1,2,3,7,8-PeCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
2,3,4,7,8-PeCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,7,8-PeCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,4,7,8-HxCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,6,7,8-HxCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
2,3,4,6,7,8-HxCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,7,8,9-HxCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,4,7,8-HxCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,6,7,8-HxCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,7,8,9-HxCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,4,6,7,8-HpCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,4,7,8,9-HpCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
1,2,3,4,6,7,8-HpCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
OCDF	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
OCDD	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 77	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 81	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 126	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 169	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 105	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 114	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 118	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 123	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 156	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 157	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
PCB 167	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		

Grouping	Frequency	Measurement Organisation	Methodology	Units	LOR	Type	Preservation Procedure	Holding Time	Vessel	Vessel ID	NATA Certification	Notes
PCB 189	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total TCDF isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total TCDD isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total PeCDF isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total PeCDD isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total HxCDF isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total HxCDD isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total HpCDF isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Total HpCDD isomers	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Sum of PCDD and PCDF congeners excluding LOD values	One	NMI	AUTL_01	pg/L	Various					2 X 1L Glass H1		
Dioxin/furan/PCB (Low)	One	NMI	AUTL_01	pg/L WHO05-TEQDFP	Various					2 X 1L Glass H1		
Dioxin/furan/PCB (Mid)	One	NMI	AUTL_01	pg/L WHO05-TEQDFP	Various					2 X 1L Glass H1		
Dioxin/furan (Low)	One	NMI	AUTL_01	pg/L WHO05-TEQDF	Various					2 X 1L Glass H1		
Dioxin/furan (Mid)	One	NMI	AUTL_01	pg/L WHO05-TEQDF	Various					2 X 1L Glass H1		

Appendix D
Hydrodynamic modelling scope

Appendix E
Trigger level and maximum limit determination (study report)

Pöyry (October 2008)
Bell Bay pulp mill project: Trigger levels and maximum limits for effluent concentration.
Report prepared for Gunns Limited.

Gunns LIMITED ABN 29 009 478 148

Appendix F
Use of spill basin to further reduce final effluent quality - report

Pőyry (November 2008)
Use of the emergency basin to further reduce the variability of final effluent quality. Report prepared for Gunns Limited.