

**ENVIRONMENTAL MANAGEMENT PLAN FOR MACQUARIE HARBOUR SALMONID
AQUACULTURE – WASTE MANAGEMENT INCL. DISINFECTION
Rev 5.d – November 15th 2017**

PART A – PROPONENT INFORMATION

Tassal is a publicly listed fish farming company established in Tasmania in 1986, and is the proponent for this activity. Tassal's company registered address is:

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The contact person for this project is:

Mark Ryan
MD and CEO

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Tassal is a publicly listed company on the Australian Stock Exchange and formally releases financial results every six months. The most recent financial results published were for the six months ended 30 June 2017 and can be obtained from the ASX web address www.asx.com.au.

PART B – PROPOSAL/PROJECT INFORMATION

1.0 Objective of the Project

The objectives for treatment of under pen fish waste are:

1. Separation of under pen waste sludge into solid waste & filtrate;
2. Solid waste will be managed in line with waste management hierarchy at the Dulverton Organic Recycling Facility (DORF);
3. Treat and disinfect filtrate so that it is suitable for co-disposal via Taswater's Pardoe WWTP outfall or GTS treatment plant; and
4. Minimize all risk to the environment, salmon stock and stakeholders

Tassal have previous approval under EPN No 9702/1 for capture and collection of under pen waste from marine farming leases within Macquarie Harbor. Waste capture has been successfully implemented since June 2017.

EPN No 9706/1 was issued on Oct 3rd 2017 for treatment of raw waste sludge, onboard a dedicated vessel. The waste treatment is aimed at separating the raw sludge for composting and reuse or some other approved management method. The treatment also aims to reduce nutrient concentration and disinfect the filtrate.

Updated EMP (Versions 4.1 & 4.2) were previously submitted to cover minor amendments of the treatment process and disposal of the solid waste.

The EPA has granted Tassal a Regulation 12 approval (No. 9777/1) on 13th November to co-dispose filtrate through Taswater's Pardoe outfall. Taswater have granted Tassal a Tankered Trade Waste Consent for Pardoe WWTP.

This further updated EMP now covers off the additional treatment processes required to prepare the filtrate for co-disposal through Taswater's Pardoe WWTP's outfall.

2.0 Waste Volumes

The final volumes will be dependent on several variables including fish growth rates & harvesting activities. However, based on waste collection achieved to date, and current biomass projections, a forward estimate of monthly volumes has been included in Table 1 below:

Month	Total Projected Closing Biomass (t)	Number of Liners Required (Calculation on % of 49 Cages)	Average Daily Estimated Extraction Amount (kL)	Total Estimated Monthly Extraction Amount (kL)	Average Daily Solids Estimate (m ³)	Average Daily Filtrate Estimate (kL)
Jul-17	4029.5	6	6	192	#	
Aug-17	4462.1	11	13	400	#	
Sep-17	4935.2	16	21	642	#	
Oct-17	5511.8	22	20	640	1.5	56
Nov-17	5695	27	32	1102	2.3	36.7
Dec-17	6139	32	42	1445	2.9	46.6
Jan-18	5903	32	50	1726	3.5	55.7
Feb-18	4491	29	44	1362	3.0	48.6
Mar-18	1814	4	6	236	0.5	8.40
Grand Total				7745		
Biomass Cap (t)						
Estimated average % Solids on extraction						7%

Table1: Revised waste volume projection. #Note: solids separation did not commence until Oct.

If additional liners are employed in Macquarie Harbour, and their contents bough to the Wallaby for treatment, the above volumes will increase proportionately.

3.0 Dedicated Treatment & Storage Vessel – The Wallaby

The proposed treatment process will occur onboard a dedicated vessel – the Wallaby.



Figure 1: Dedicated waste treatment vessel - The Wallaby



Figure 2: Foredeck of Wallaby, showing centrifuge, solids conveying and raw waste storage tanks

The Wallaby is a 38m ex-navy water/fuel lighter. The vessel was specifically built to transport & deliver to other vessels diesel fuel oil, fresh water & demineralized water and to receive and hold oily bilge water and sullage from other ships. It is self-propelled, with propulsion units forward & aft making it highly maneuverable, particularly at low speeds. The vessel is constructed from 10mm thick corrugated steel plate.

Refer to **Attachment 1** for a General Arrangement of the Wallaby (as used by the Navy)

Tassal will use the Wallaby for:

- Separation of raw waste sludge into solid waste & filtrate
- Storage for both waste streams until they can be offloaded/discharged
- Further treatment and disinfection of filtrate so it is suitable for disposal

The Wallaby will remain within Macquarie Harbor for the duration of the EPA approved waste treatment. Once approvals are in place, the Wallaby will typically moor at the farm site and receive waste sludge from a collection vessel the Sea Hauler. The Sea Hauler will travel to each of the pens fitted with waste capture liners & once its 14 kL holding tank is at capacity it will then deliver the contents to the Wallaby for treatment.

3.1 Deck Bunding:

Due to its previous use as a fuel lighter, the working deck of the Wallaby is fully bunded to capture any spillage. All spills are directed to the Backwater Ballast hold. For the proposed waste treatment process, any spills of either raw sludge, solid waste or filtrate will be contained on board the vessel, within the deck bund. In addition, a wash down regime will be implemented to ensure there is no buildup of solid waste on the working deck to eliminate any risk of these wastes drying and becoming airborne. Once again, the wash water will be directed to the Backwater Ballast hold. Effective containment of all materials ensures there will be no impacts to the broader environment, from the waste treatment process on board the Wallaby.

Whilst the Backwater Ballast hold has a capacity of 80 kL. The backwater ballast hold level will be checked at least once a shift and as needed the contents will be directed to the above deck holding tanks, for inclusion in the waste treatment process, such that there is always sufficient capacity to receive input from the deck bund including a holding tank spill.

3.2 Wallaby Holding Capacity:

The hull of the Wallaby is divided into a series of eleven service tanks as follows:

- Four diesel fuel tanks – combined capacity of 680 kL
- Two fresh water tanks – 100 kL
- Two demineralized water tanks – 100 kL
- Two sullage tanks – 110 kL
- One backwater ballast tank – 80 kL

- Total capacity 1,060 kL

3.3 Arrangement of Processing Equipment:

The treatment process will require installation of the following major items of equipment onto the deck of the Wallaby:

- 2 x 11kL above deck holding tanks



- Solid waste storage

Refer figure 2 below for the arrangement of treatment equipment on the deck of the Wallaby.

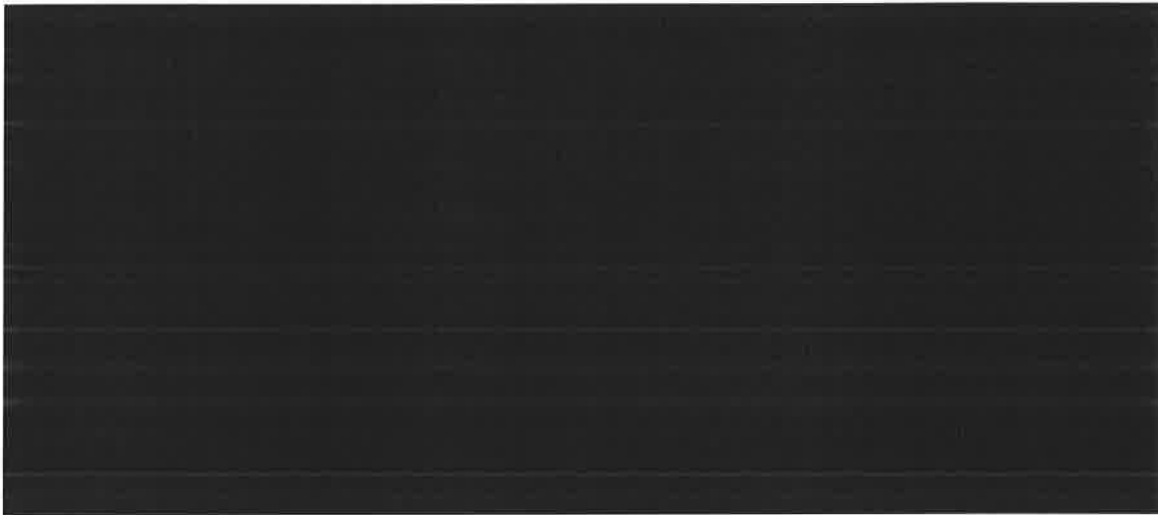


Figure 2: Arrangement of treatment equipment onboard the Wallaby

3.4 Raw Sludge Holding Tanks:

In addition to the below deck holds, the Wallaby has been fitted with two new above deck 11 kL poly holding tanks, which will receive the raw waste sludge from the extraction vessel(s) (eg Sea Hauler). The two holding tanks will be interconnected to act as a single holding vessel, however there will be operational flexibility to operate from either holding tank individually depending on daily requirements.

Unless an unplanned event requires the holding tanks to be emptied, the waste sludge will remain above deck in the holding tanks until treatment in the centrifuge. If the holding tanks are required to be emptied, the contents will be directed to one of the available below deck holds.

In the event of an overflow, or spillage, or failure of the holding tanks, the contents will be contained within the bunded deck of the Wallaby and directed to the backwater ballast hold. The capacity of the backwater ballast hold is 80 kL, which provides adequate safety margin to contain the full 22 kL volume of the holding tanks.

The two holding tanks will be connected to a circulating pump. This pump will be used as needed to assist with agitation of the raw sludge to prevent settlement of solids in the holding tank.

3.5 Filtrate Storage:

The intention is to store filtrate in the four "Dieso Tank" holds, which have a combined capacity of 680 kL.

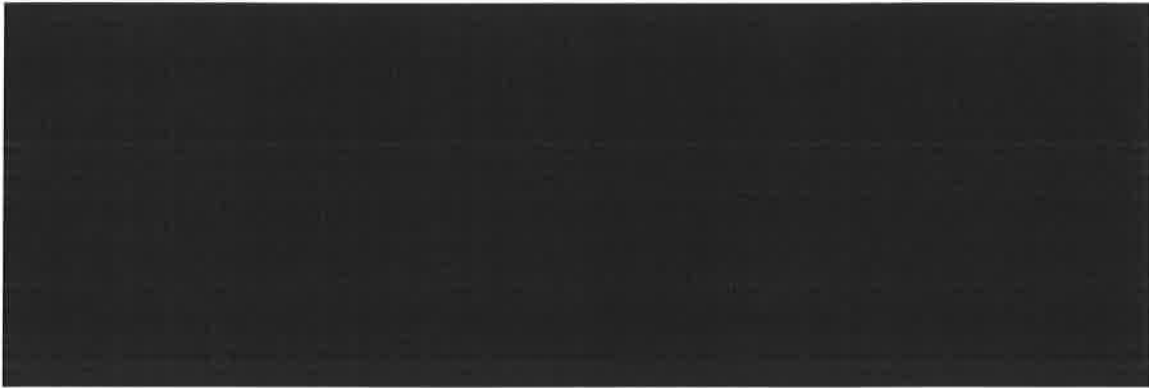


Figure 3: Filtrate storage holds

As needed, the filtrate can be transferred from one hold to another via the existing piping network & pumps. If the capacity of the diesel hold is exceeded the filtrate will overflow to the starboard side sullage tank.

3.6 Backwater Ballast Hold:

The Wallaby has a backwater ballast hold. This hold has a capacity of 80 kL and will be used:

- To receive spillage from the deck of the vessel
- As emergency storage of raw sludge in the event the above deck holding tanks need to be emptied



Figure 4: Backwater Ballast hold

3.7 Sullage Holds:

The Wallaby has two below deck sullage holds, one each side of the centerline of the vessel, with a capacity of 50 kL .

The sullage hold will be used for disinfection of filtrate prior to removal from the Wallaby.

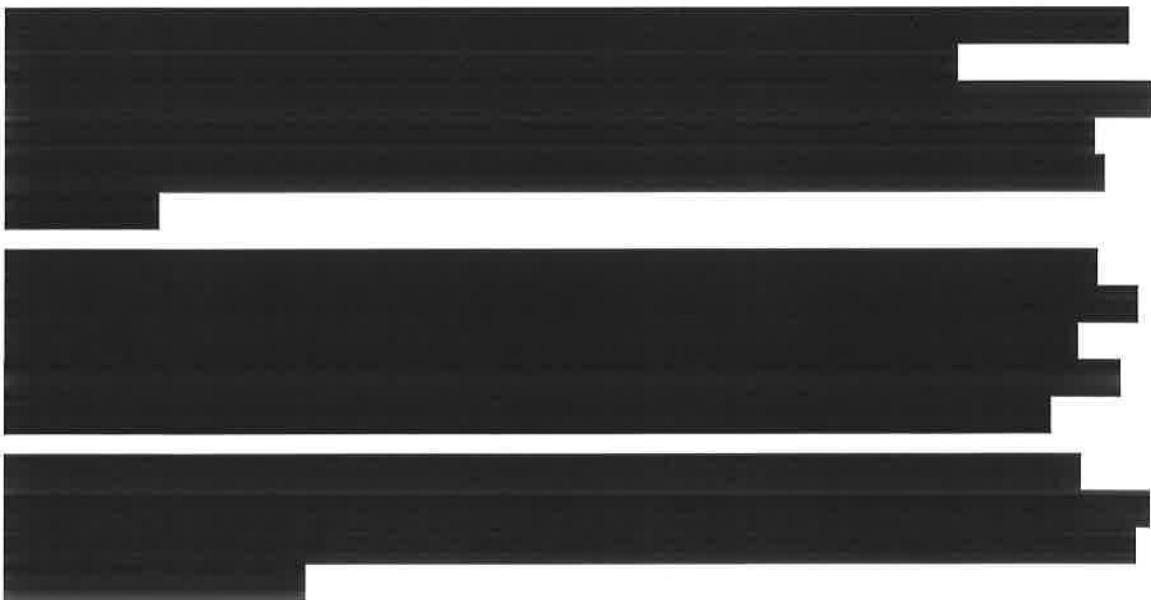
4.0 Waste Treatment Process

4.1 Solids Separation

The initial waste treatment process is to separate solids from the liquid phase in the raw extract. A single stage process using a centrifuge for separation of the raw sludge into a waste solids & a filtrate is used as follows:-



Figure 5: Process Flow Diagram



[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

4.2 Disinfection

Tassal are proposing to disinfect filtrate prior to discharge by dosing with Sodium Hypochlorite (NaClO).

Disinfection will occur on-board in one of the Sullage holds, in batches up to 50kL. The proposed dose rate is 50mg/L with a contact time of 2 hours. The final dose rate will be proven by in the field testing and laboratory analysis, prior to implementation.

Following the required contact time, any residual free chlorine in the disinfected filtrate will be neutralized by addition of Sodium Bisulphite (SBS).

4.3 Flows and Buffer Capacity

During peak production, daily waste capture & treatment volumes could be in excess of 50 kL. For 50kL per day:

- Will typically require 3-4 transfers of waste onto the Wallaby.
- For a treatment rate of 5 kL/hr the centrifuge will need to operate for 10 hrs on a continuous basis.
- With 680 kL of storage capacity in the filtrate holds (ex diesel holds,) at 50 kL per day there is in excess of 13 days storage capacity on board the Wallaby.
- Typically, 41 kL of filtrate will be unloaded from the Wallaby each day, with the capacity to increase this to 60kL per day as needed.

5.0 Hours of Operation:

The intent is for waste to be treated the same day it is collected from the pen.

Based on the daily volumes of under pen waste captured to date and with consideration of biomass increases for the remainder of the project, waste processing will likely peak in January. At peak volumes, it is expected the centrifuge will be required to operate up to 10 hours per day*.

**Note: This is on the basis the centrifuge will treat raw sludge at 5 kL/hr, which is typical of processing rates achieved to date.*

Daily durations for operating the centrifuge on board the Wallaby, have been summarized by month in *Table 3* below.

Month	Total (marine) waste vol [kL/day]	centrifuge treatment rate [kL/hr]	daily centrifuge operating time [hrs]
Oct	21.3	5	4.3
Nov	32.4	5	6.5
Dec	41.6	5	8.32
Jan	50.1	5	10.0
Feb	43.5	5	8.7
Mar	6.0	5	1.2

Table 2: Waste treatment plant daily operating duration

With consideration of the above table, night time operations of the centrifuge will not be typical but may occur if driven by waste collection constraints and /or other components of the treatment process. In the event biological treatment is needed in the form of a sequenced activated sludge process, then aeration will continue through the night as will normal bilge pumping and associated operations.

6.0 Filtrate Limits

In accordance with the EPA Regulation 12 approval (No. 9777/1) issued on 13th November, for disposal of filtrate via the Pardoe outfall, the following parameters apply:

- BOD5: 2850mg/L;
- Suspended solids: 1,500mg/L;
- Ammonia nitrogen: 40mg/L;
- Total Phosphorus: 80mg/L;
- Oil and Grease: 100mg/L;
- Thermotolerant coliforms: 1000cfu/100ml;
- pH: 9;
- Total residual chlorine: 1mg/L

7.0 Waste Disposal:

The two waste streams that will be generated from the treatment process described in this EMP are:

- filtrate,
- waste solids

Filtrate disposal will primarily occur through the Taswater Pardoe WWTP outfall, in accordance with EPA approval (no. 9777/1). In the event filtrate cannot be disposed of at Pardoe, then it will be disposed of via George Town Seafoods (GTS.)

Following consultation with the Chief Veterinary Officer at Tas Biosecurity & EPA approval, waste solids are being disposed of at the Dulverton composting facility in Latrobe.

Prior to transport, bulka bags are emptied at the Aquaculture hub into a 15 m3 hook bin fitted with a rain cover and a water seal on the tail gate. The empty bulka bags which have been contaminated, will be placed into a separate waste bin and disposed of as land fill.

Composting at Dulverton is a controlled process which is regulated by EPA Tasmania. All composting activities are fully compliant with AS4454 – 2012 Composts, soil conditioners & mulches. This includes:

- monitoring of temp & oxygen levels during the composting process
- achieving a temperature of 55 degrees C for a minimum of 3 days to pasteurize the compost and remove target pathogens
- testing for heavy metals & pesticides prior to distribution

8.0 Monitoring:

8.1 Characterization of Waste Solids & Filtrate:

Tassal will continue to analyze filtrate & waste solids on a weekly basis, in accordance with all EPA approvals, and to monitor and improve treatment plant performance.

8.2 Traceability / Flow Measurement:

Tassal have installed flow meters to provide traceability of waste movement as follows:

- The first flowmeter measures the volume of waste being transferred onto the Wallaby
- A second flowmeter previously fitted to the centrifuge provides a record of the volume of waste treated. This measurement will enable a comparison of the volume of waste captured with the volume of waste treated.
- A third flow meter has been installed on the filtrate discharge line from the centrifuge. This measurement will enable a comparison of the volume of filtrate generated as a proportion of the volume of waste treated.
- The fourth & final flow meter will be installed on the discharge line from the Wallaby. This measurement will enable a comparison of filtrate generated with the volume of filtrate discharged.

All flow measurement data for both the raw sludge & filtrate will be recorded direct to Tassal servers with local backup onboard the Wallaby.

In addition, daily log sheets will be kept to record waste solids volumes and manual measurements confirming filtrate storage levels.

Note: other inputs will occur within the waste treatment process that will influence the flow measurements, eg processing wash water etc.

8.3 Reporting:

Once the treatment plant is operational, the following additional waste treatment data will be included in Tassal's weekly / monthly reports:

- the volume of waste treated
- the volume of filtrate generated
- the volume of filtrate discharged/offloaded from the Wallaby
- the volume of filtrate being held on board the Wallaby
- the most recent weekly filtrate quality results
- the volume of filtrate transported for disposal
- the volume of filtrate disposed of and the disposal location
- the volume and dry weight of waste solids generated
- the volume and dry weight of waste solids offloaded from the Wallaby
- a summary of weigh dockets (wet weight) and dry weight for waste solids deliveries to composting facilities
- a description of any non-compliance with regulatory approvals
- details of complaints associated with waste treatment or disposal
- a description of management actions taken with respect incidents, non-compliance or complaints
- summary statistics for filtrate quality & daily volumes as specified in Part 7 of Environmental Approval 9777/1

9.0 Schedule:

Tassal has already commenced treatment of under pen waste onboard the Wallaby and will continue through to the completion of the 2016 Year Class Waste Capture Project, nominally in April 2018.

10.0 Risk Identification & Management

Tassal have conducted an environmental and project risk assessment. A risk register with subsequent mitigations is included in Table 3 below.

Identified risk	Mitigation
Raw waste sludge spill	<ul style="list-style-type: none"> Documented procedures developed for transferring raw sludge from vessel to vessel, vessel to land and any other waste transfer step, e.g. loading of trucks and tankers All Tassal vessels fitted with a spill response equipment & staff are trained in spill response procedures. Piping arrangements onboard the Wallaby will prevent contamination of treated filtrate storage from raw sludge, including spills. The contents of the backwater ballast hold will only be returned to the holding tanks for incorporation in the waste treatment process. Any spills onboard the Wallaby, including overflow or failure of the holding tanks will be contained onboard by the fully bunded deck and only directed to the backwater ballast hold. The backwater ballast hold has a capacity of 80 kL which provides a high level of margin to contain the full volume of the holding tanks should the need arise. The backwater ballast hold is to be monitored daily to ensure they always have sufficient spare capacity to receive deck capture.
waste solids spill	<ul style="list-style-type: none"> Wallaby fitted with spill response equipment & staff are trained in spill response procedures. Spills are likely to be low volume, ie less than 1,000L. Waste solids to be handled onboard the Wallaby in appropriately rated 1,000 L bulka bags. As solids bags are removed from the Wallaby, they will be handled and stored in a way to prevent spills or leakage to the surrounding environment, eg in a water proof bin. Waste solids are spadeable, so spills ashore will be collected and the area disinfected
Filtrate spill	<ul style="list-style-type: none"> Any spills above deck will be contained onboard by the fully bunded deck of the Wallaby and only directed to the backwater ballast hold. The 4 x Diesel holds will be used for storage of filtrate on board the vessel – in the event these are overfilled they will overflow to the backwater ballast hold and from there integrated back into the treatment process. Documented procedures will be developed for discharging filtrate from the vessel. All Tassal vessels are fitted with spill response equipment & staff are trained in spill response procedures.
Noise nuisance form waste treatment equipment	<ul style="list-style-type: none"> Equipment used will be compliant with marine farming license conditions The treatment location at the farm site and Aqua Hub are a significant distance from sensitive receptors
Impacts on high public interest sites	<ul style="list-style-type: none"> The leases are active marine sites & this activity is aligned with daily operations No impact to any recreational or natural scenic features is anticipated
Hazardous substances	<ul style="list-style-type: none"> Documented procedures will be developed for all potentially hazardous materials used in the treatment process, eg sodium hypochlorite & sodium bi-sulphide
Odour from waste	<ul style="list-style-type: none"> The waste treatment location & transport route is a significant distance from any sensitive receptors.
Increase to marine traffic	<ul style="list-style-type: none"> Increase to marine traffic within Macquarie Harbor, from waste treatment activity will occur primarily at the marine lease. Beyond the lease, marine traffic increases will be limited to daily travel from the aquaculture hub to the lease.
Filtrate contamination	<ul style="list-style-type: none"> Prior to filling with filtrate the Wallaby holds will be tested for diesel residues and will be decontaminated as required.
Adverse Weather	<ul style="list-style-type: none"> Adverse weather may impact treatment by preventing collection of raw sludge from the pens, in which case treatment is simply delayed. In the event weather interrupts operation of the treatment equipment, if raw sludge cannot remain inside the holding tanks it will be diverted to the backwater ballast hold and in this way both raw sludge and filtrate can be safely held below decks. The waste solids will remain on deck in weatherproof bulka bags.
Contamination	<ul style="list-style-type: none"> The waste treatment vessel is to be used only for that purpose Personnel must be dedicated to the waste collection & treatment for the working day and should not move to other operations Personnel should wear appropriate PPE when handling fish faeces due to zoonotic risk. PPE should be disinfected or disposed of at the end of each day
Waste treatment equipment failure	<ul style="list-style-type: none"> Tassal will identify a list of critical spares that will be held to minimize down time due to equipment failure In the event of critical equipment failure there is several days storage onboard the Wallaby for both raw sludge and filtrate, whilst equipment is repaired.

Table 3: Risk Identification & management

Attachment 1: Wallaby General Arrangement:

Attachment 2: Arrangement of Wallaby below deck Holding Tanks