29 April 2026

Paul Duder
Project Director - Principal
Babbage Consultants Limited

By email: pduder@babbage.co.nz

Dear Paul,

WPI site future development – resource consent (air quality)

Existing air discharge consent

Resource Consent APP-2002010157.06 was issued by Horizons Regional Council on the 17 October 2025. The issued consent authorises the discharges to air from a pulp and paper facility located on State Highway 49, Karioi. During the re-consenting, the sites operations ceased, however the consent process was continued to ensure future use of the site can be provided for.

Broadly the air discharge permit covers:

- Log debarking, handling, chipping and storage
- A 12 MW oil heater fuelled by wood chip biomass
- A 2 MW wood chip drier fuelled by sawdust
- A 2 MW LPG-fired boiler
- Mechanical pulping of wood
- Wastewater treatment processes (WWTP)

As outlined in the supporting Assessment of Effects, the emissions from the plant included particulate matter (including PM_{10}), combustion gases in the form of nitrogen dioxide and carbon dioxide, volatile organic compounds derived from the Pinus radiata and odour from the WWTP.

Revised resource consent application

Air Matters understands that WPI is submitting a revised resource consent application to enable a prospective purchaser of the site to operate a wood torrefaction facility on site. The revised resource consent application is to enable discharge of wastewater to water resulting from a torrefaction process.

Torrefaction is a thermal treatment process used to upgrade biomass (such as Pinus radiata) into a more energy-dense, coal-like solid fuel. In this process, wood chips are heated to approximately 200–300 °C in an oxygen-limited environment to prevent combustion. As the temperature increases, the more reactive components of the wood thermally decompose, driving off moisture and volatile organic compounds and leaving behind a dry, carbon-rich solid.

Energy recovery systems capture the resulting VOCs and combust them to provide heat for the process. Further details of the process are provided in the Babbage Memorandum dated 20 April 2026 (attached as Appendix 1). To enable torrefaction, a number of processes are required. A high-level overview of these processes is outlined in Table 1 below along with the expected emissions to air.

Table 1. Torrefaction process and expected emission to air

Torrefaction Process	Concept for the WPI site	Expected emission to Air
Wood debarking and chipping	Annual volume of500,000 tonnes of raw (wood chip) chipped material	Fugitive release of course particulate matter and small quantities of VOC
Torrefaction reactor Central unit where heating occurs in an oxygen-limited environment (200–300 °C):		None (emissions directed through the **Energy recovery systems)**
Heat source (biomass combustion) Provides controlled thermal energy to the reactor	Up to a 20 MW biomass burner fitted with advanced particulate filtration system (ESP or Baghouse)	Particulate matter and combustion gases
Energy recovery systems To capture and reuse energy from off-gases through combustion process	Combustion of VOCs and treatment of flue gas through advanced particulate filtration system (ESP or Baghouse)	Combustion gases, heat and water vapour

Suitability of the existing air discharge permit in the context of the revised application

Expected emissions from the torrefaction facility outlined in Table 1 include particulate matter (including PM_{10}), combustion gases such as NO_x and CO, and limited quantities of volatile compounds arising from wood debarking and chipping. The types of emissions anticipated from the proposed torrefaction facility are directly aligned to those authorised under the existing resource consent.

Emissions rates across the site are expected to result in:

- Significant decrease in VOCs due to their capture and thermal destruction within the energy recovery systems
- Decrease in particulate emissions as a result of the advanced filtration systems
- Minimal change to combustion gas emissions given the modern design and efficiency of the proposed combustion equipment.

Based on the initial review of the change in onsite activities, Air Matters considers that emissions to air will be of a comparable nature and scale to those already authorised under Resource Consent APP-2002010157.06. Confirmation of offsite effects from any changes would need to be demonstrated through dispersion modelling of the specific discharge points and emission rates. Air Matters understands that plant configuration (e.g. stack heights and volumetric flow rates) can be adjusted if required to ensure that offsite effects remain consistent with the existing consented level of effects.

Kind Regards,

Nigel Goodhue
Principal Air Quality Consultant
Air Matters Limited

MEMORANDUM

TO:	Sukhi Singh	Date:	20 April 2026
COPY TO:		Job No:	68095#ID1
FROM:	Paul Duder: Project Director - Babbage Consultants		

TE ARA HIKO – PROJECT SUMMARY AND TORREFACTION TECHNICAL MEMO

Our Torrefaction Project – Te Ara Hiko

Te Ara Hiko Project proposes to utilise the strategic location of the WPI site and its existing infrastructure to produce torrefied solid biofuel from radiata pine. Torrefied biomass fuel can, in many cases, be used as a direct replacement for coal, thus supporting industries' move towards renewable energy.

This project is being undertaken in collaboration with the New Zealand Governments' Energy Efficiency and Conservation Authority (EECA) and aligns with New Zealand's objectives to reduce emissions from non-renewable energy sources.

Te Ara Hiko will produce 180,000tpa of solid biofuel, which will require in the order of 500,000tpa of radiata pine feedstock, which will be sourced from surrounding forests. This is approximately the same quantity of feedstock that was imported onto the site to supply the previous WPI pulp process.

The existing site has a log yard, debarking, chipping and storage facilities that were used in the previous pulp manufacture process, and which are directly usable for the new Torrefaction process. Likewise, the existing rail spur onto the site provides the ability to export torrefied biofuel by rail directly to the customer or port.

In addition to the utilisation of this existing infrastructure, the project will also require the construction of a new processing plant on the existing WPI site. The new production building will be constructed at the northern end of site, which is currently vacant of any significant building or infrastructure.

The existing pulp mill building (and the process within) is not required as part of the Te Ara Hiko project and, as such, will be left "as-is". Similarly, the existing wastewater treatment system, which was used to treat pulp wastewater, is not required for the new Torrefaction process and will be either left 'as-is' or strategically part demolished to create space if necessary.

The overall site layout is shown in **Appendix 1**.

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We understand this facility will be one of the first of its type in NZ. Internationally, there are numerous operational Torrefaction commercial facilities, including:

- Idemitsu - Vietnam

https://idemitsu.vn/idemitsu-group-in-vietnam/green-energy/

- TSI - USA

https://www.tsitorrefaction.com/news-1/blog-post-title-one-ekzpt/

- Nextfuel

https://nextfuel.com/

- Aymium

https://aymium.com/about/

- MUCC

https://www.mu-cc.com/en/corporate/business/energy.html

What is Torrefaction?

Torrefaction is a thermal treatment process applied to wood chips to improve their characteristics as a solid biofuel. Moisture and volatile compounds are evaporated from the wood chips by applying heat, resulting in a final product that has increased energy density, is low in moisture and exhibits other beneficial properties such as becoming hydrophobic and therefore more resistant to environmental moisture (i.e. rain and humidity).

Torrefaction involves wood chips being heated in a low-oxygen environment for around 20 minutes at a temperature of around 300 °C. After torrefaction, the torrefied wood chips are ground and densified into pellets to further improve their properties and efficiency of handling.

Torrefied biomass fuel can, in many cases, be used as a direct replacement for coal, thus supporting industries' move towards renewable energy.

***Figure 1**: Feed source- Radiata Pine wood chip*

***Figure 2**: Finished Product - Torrefied Pellets*

What is the Te Ara Hiko Torrefaction Process?

The specific end-to-end process for producing torrefied biofuel on the WPI site is as follows:

Phase 1: Log receival, Storage and Chipping – **Existing activities on WPI Site**

1. **Log Yard:** Pine logs are received from the surrounding forests and stored in the existing log yard
2. **De-barker:** Logs are taken from the log yard and fed through the de-barker system. Bark is removed from the log and stored for use as a fuel for the hot water heater on site.
3. **Chipping:** De-barked logs are then fed into the chipper, where the logs are chipped into approximately 25mm square wood chips.
4. **Screening:** Wood chips are then screened to remove any oversize chips before being conveyed to the main chip storage piles.
5. **Storage:** Wood chips are stored on the two existing main storage piles prior to being conveyed to the torrefaction process.

It's worth noting that all the prementioned steps currently exist on the WPI site as part of their current pulp manufacturing process and will be reused in the torrefaction process.

Phase 2: Torrefaction of wood chips – **New process on the site**

6. **Chip Dryer:** Wood chips from the storage piles are received via conveyor and then passed through a belt dryer, where hot air is used to evaporate the majority of the moisture in the wood chips.
7. **Torrefaction:** After drying, the chips are fed into the Torrefaction Reactor. This is where the actual Torrefaction transformation takes place. During torrefaction, further moisture and volatiles are removed.
8. **Cooling:** The torrefied wood chips exit the reactor at a temperature greater than 200 °C and thus must be cooled. Cooling is done by transferring the torrefied chips via a water-jacketed conveyor. Heat is taken from the chips by the cooling water, thus cooling them down.
9. **Densification:** Once cooled, the torrefied chips are ground and pelletised into a final biofuel product. This 'densifies' the torrefied product, increasing both its bulk density and physical robustness.
10. **Storage:** Finished product is then stored in a pile on site, awaiting export via rail. The finished product pile will be able to store up to around 5 days' worth of production and provide a buffer against short-term logistical interruptions.

The above steps replace the pulp manufacturing process currently on the WPI site, although it is worth noting that the chip drying does have similarities to the current sawdust drying process used by WPI.

Phase 3: Export of finished product – **Existing activities on WPI site**

11. **Export:** Finished product is loaded onto the rail for export to customers using the existing rail spur on site.

What are the main discharges generated from Torrefaction?

The main discharges from Torrefaction are:

a) Wastewater from condensate, which is proposed to be discharged to the river via a constructed wetland, and
b) Air emissions from the wood chip drier and heat plant

Air discharge emissions

- **Wood chip drying process**

Raw wood chips have a moisture content of around 55% and must be dried to around 5% before being torrefied.

This drying process is done by placing the wood chips onto a belt dryer and passing hot air over the chips to evaporate the moisture. The hot air is approximately 100degC upon entry to the belt dryer.

During the drying process, both water vapour and some volatile organic compounds (VOC's) are evaporated off the wood chips.

Although different in quantum and location on site, from a compositional perspective, the hot air-drying process is the same as that currently used by WPI to dry their sawdust for feeding into their current biomass boiler.

For commentary on air discharges from the Torrefaction process, refer to the technical memo from Air Matters Limited and the Planning Report.

- **Combustion flue gases discharge**

The full torrefaction process includes combustion of biomass (wood chips and bark) in a new hot water heater and combustion of biomass gas (Torr Gas) in the torr gas burner.

Combustion of wood and torr gas creates flue gas, which is discharged to the air via an exhaust stack.

Although different in quantum and location on site, the biomass combustion process and flue gas discharge are essentially the same as that currently used by WPI in their current biomass boiler.

For commentary on air discharges from the Torrefaction process, refer to the technical memo from Air Matters Limited and the Planning Report.

Wastewater discharge

Wastewater is formed when heat is recovered from the flue gas streams of both the Torr Gas burner and the biomass hot water heater by condensing the water vapour contained in the flue gas streams.

A summary of the condensate stream is provided below. A detailed compositional analysis of the condensate stream is contained in **Appendix 2.** The resulting condensate is a wastewater stream which is discharged from the site.

Where and how is the wastewater generated?

Wastewater is created from two locations within the wider process. These are:

Source 1: Torrefaction flue gas condensate

The Torrefaction transformation takes place in the reactor. During this process, both free moisture and volatiles are evaporated from the wood chips through the application of heat.

The volatiles evaporated from the wood chips are known as “Torr Gas”. Torr Gas is combustible and, as such, is sent into a burner (called the “Torr Gas Burner”) where it is combusted to generate heat, which is then used in both the chip dryers and the reactor.

When Torr Gas (or any biofuel for that matter) is combusted, an amount of water vapour is created. In the case of the Torr Gas burner, water vapour is created from the combustion of hydrogen contained in the wood chip (i.e. 2H + O2 = 2H2O) AND the free moisture being evaporated off the chip directly.

This water vapour travels in the flue gas stream and contains useful heat energy. Therefore, a flue gas condenser is used to condense the water vapour from the flue gas stream, thus recovering its energy.

Condensing the water vapour changes it from a gas to a liquid stream, and it is this liquid condensate stream which is the first source of wastewater.

Source 2: 20MW Hot water boiler flue gas condensate

At times when the raw chip moisture is high and/or the ambient air temperature is low, there is a need for a supplementary heat source to provide the level of heat energy required for the drying and Torrefaction process. The additional heat required comes from a new 20MW biomass-fuelled hot water heater to be installed as part of the project. The fuel used is the bark and waste wood chips obtained from the logs when they are debarked, plus other raw waste wood streams not suitable for Torrefaction.

In exactly the same way as occurs when Torr gas is combusted, wood burned in the hot water heater creates a flue gas stream that contains water vapour from both the combustion of hydrogen AND the water being evaporated off the bark/wood fuel.

There is useful heat energy to be recovered from the water vapour, and hence a condenser is again employed to recover the energy.

Condensing the water vapour changes it from a gas to a liquid stream, and it is this liquid condensate stream which is the second source of wastewater.

What are the wastewater characteristics?

The combustion processes in both the Torr Gas burner and the biomass hot water heater occur at around 1,000 °C. At this temperature, organic compounds, phenols and the like are fully destroyed.

Accordingly, the resulting wastewater condensed from the flue gas does not contain these groups of contaminant compounds.

Metal contaminants in the condensate arise from those same metal elements present naturally in the wood at micro levels. The wood (i.e. trees) naturally takes up these elements from the environment as they grow.

For a detailed compositional analysis of the condensate stream, please refer to the technical memo attached in **Appendix 2.**

How does Torrefaction wastewater compare to existing WPI wastewater?

Being condensate, the wastewater stream from the Torrefaction process is significantly 'cleaner' than the approved discharge from the pulp process. The colour of the condensate will be visibly clear.

The volume of wastewater is also significantly reduced with the Torrefaction process, producing less than 750m^3/day compared to the current pulp process, which is consented to discharge 5,200m^3/day.

The temperature of the condensate off the plant is expected to be around 40-50 °C. After holding in the condensate tank and transferring and transiting through the wetland, it is expected that the condensate discharge temperature to the river will be below 25 °C.

Appendix 1 – Site Layout

Appendix 2 – Assessment of Condensate Composition – Technical Memo