Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for works approval

Division 3 Part V of the *Environmental Protection Act 1986*

Works approval number	W6408/2020/1
Applicant	Cleanaway Co Pty Ltd
ACN	127853561
File Number	DER2019/000570
Premises	Cleanaway Co Pty Ltd Lot 126 Warlu Road COOYA POOYA WA 6714
Date of report	13 April 2022
Status of report	Final

1. Decision summary

This report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of a new waste treatment system at the premises. As a result of this assessment, works approval W6408/2020/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this report, the department has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Overview

Cleanaway Co Pty Ltd (the applicant / Cleanaway) proposes to construct a Heated Overland Thermal Treatment pad ('Hottpad') system at its existing Karratha liquid waste treatment plant and waste transfer station at Cooya Pooya, about 6 km south-west of Karratha. The existing premises is subject to licence L8332/2009/3.

Table 1 describes the prescribed premises category the application is subject, as defined in Schedule 1 of the Environmental Protection Regulations 1987.

Table 1: Prescribed premises category

Classification of premises	Assessed design capacity (as per application)
Category 60: Incineration: premises (other than premises within category 59) on which waste, excluding clean paper and cardboard, is incinerated.	11,000 tonnes per annum; 1,256 kilograms per hour

2.3 Application details

The Hottpad system will initially be used to treat hydrocarbon contaminated soils and sludges from Chevron's Gorgon and Wheatstone LNG operations. Currently, these wastes are received at the Cleanaway Karratha premises and stored temporarily before being transported interstate for thermal destruction.

The system will use a self-sustaining smouldering combustion process (flameless oxidation) to thermally degrade hydrocarbon contaminants within a porous matrix. It has been designed to treat up to a maximum of 11,000 tonnes per annum (tpa), however the applicant proposes an average throughput of about 4,000 tpa. The system has an estimated design life of 25 years.

Process by-products, namely treated solid material (cleaned sand), will be recycled for subsequent processing runs. Any material removed from the process will be disposed to landfill or supplied for secondary use, such as clean fill.

Background

In 2018, Chevron constructed and operated a field-scale Hottpad system in Batangas, Philippines. The volumetric capacity of this facility was about a third larger than the system being proposed in this application (156 m^3), with measurements of air emissions collected during the testing phase used to develop an emissions profile and inform an air quality assessment submitted with this application.

According to the applicant, field trials at the Batangas facility demonstrated that treatment of oily sludge containing 25,000 – 35,000 mg/kg total petroleum hydrocarbons (TPH) in the Hottpad system could result in treated material with a residual TPH content of less than 200 mg/kg.

Key infrastructure and specifications

The proposed system will comprise the following infrastructure and equipment:

- 2 x containerised (mobile) Hottpad units, each with:
  - 22 m^2 grid mesh floor equipped with heating elements and air injection induced draft (ID) fans;
  - removable emissions extraction canopy equipped with sprinkler system for quenching and flexible emissions exhaust pipe;
  - dust suppression sprinkler system located in between the Hottpad containers;
- exhaust gas management system, which will receive exhaust fumes from both Hottpad containers into a common duct, comprising:
  - 2 x particulate/oil/moisture ‘knock-out’ (KO) pots with horizontal flow mist eliminators;
  - mercury recovery unit (MRU);
  - odour control unit (Ecosorb);
  - 10 m stack; and
- continuous emissions monitoring system (CEMS) for process control monitoring of process gas emissions (CO, CO_2 and O_2).

The volumetric design capacity of the system is 99 m^3 (49.5 m^3 per Hottpad unit) of sludge/sand material for treatment in a 2 m high bed, including 0.5 m of clean soil as a cap material on top of the sludge.

A 420-kW diesel generator will be installed to provide additional power to the heaters.

The proposed system and generator will be located within an existing concrete bunded hardstand area on the premises.

Treatment process

Feedstock handling, delivery and storage

Sludge from Chevron’s WA operations will be accepted onto the premises in isotainers in accordance with existing waste acceptance requirements set out in condition 1.2.5 of L8332.

The untreated sludge will predominantly comprise petroleum hydrocarbons (C6 – C40 range), with lesser concentrations of some cations and anions and metals and metalloids. An analysis from a single sample in 2018 is provided in Table 2, which gives an indication of average concentrations for key contaminants.

Table 2: Sludge analysis and inputs

Contaminant	Average (mg/kg)	Relative std dev.	95% CI (mg/kg)
TRH (C_{6-40})	320,041	21%	36,055
Chloride	5,358	36%	1,089
Fluoride	3.17	26%	0.47
Sulfur	8,792	21%	1,030
Arsenic	<5	N/A	N/A
Cadmium	2.6	22%	0.31
Chromium	34.8	16%	3.24
Copper	45.9	20%	5.11
Mercury	57.8	21%	6.55
Nickel	44.1	22%	5.3
Lead	9.02	31%	1.53
Zinc	639	27%	93
Chromium (VI)	<1	N/A	N/A

Following acceptance, the sludge will be blended with clean sand (or treated material from a previous batch) in an existing fixation pit on the premises, to achieve a TPH content of <10 wt % (expected ratio of about 1 part sludge to 2 parts clean sand).

Treatment process

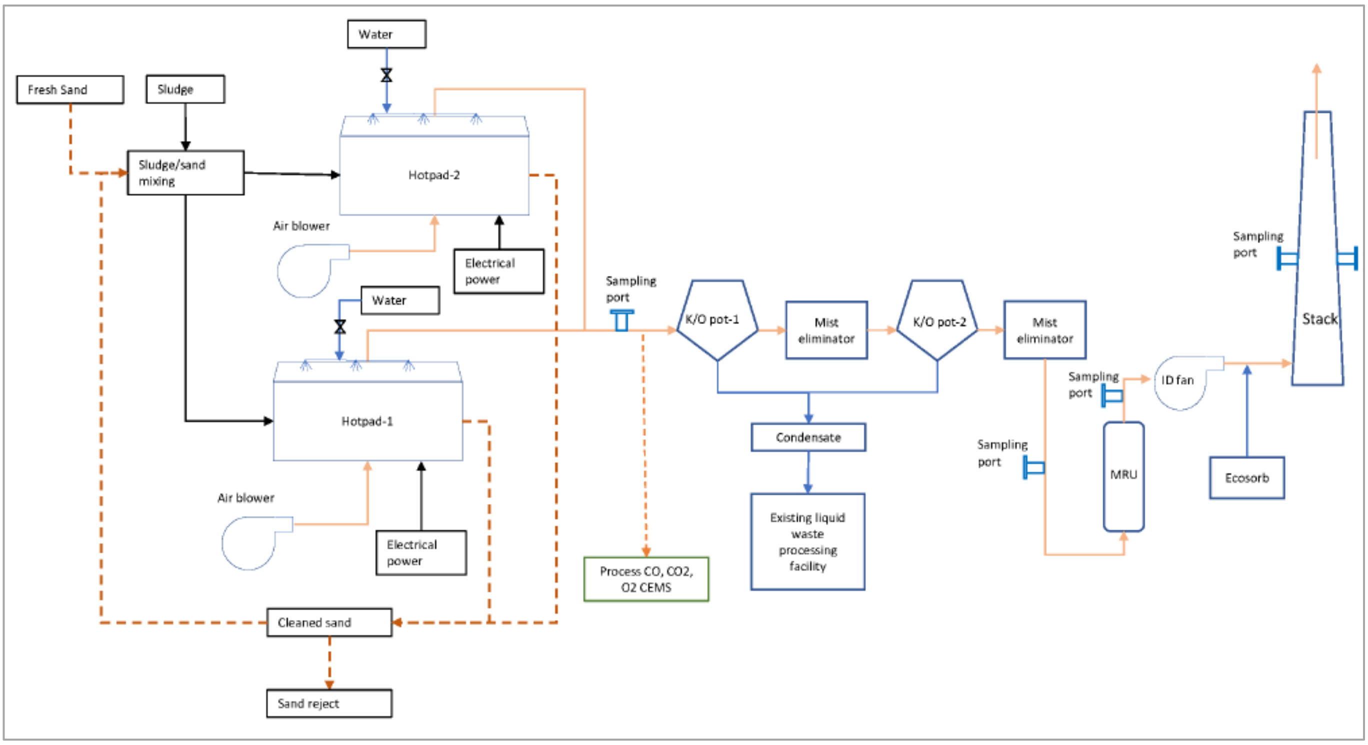
An overview of the treatment process is provided below, with process flow illustrated in Figure 1:

- blended waste oil sludge will be transferred from the mixing pond to the Hottpad containers, where it will be covered with clean capping material (sand);
- an emissions canopy is placed on the containers and extraction piping connected;
- the base of each pad is then heated, igniting the hydrocarbons in the fill material, for about 12 hours with simultaneous air injection;
- once smouldering is initiated the heaters are turned off, with the smouldering sustained by air injection for about 3.5 days until the hydrocarbon content is exhausted; and
- upon completion of treatment the material is ‘quenched’ with water to cool the solids bed and removed for reuse (blending with new sludge) in subsequent batches.

Waste gas treatment

Waste gases from the Hottpad units will be extracted to two KO-pots, where the gases will be slightly cooled to allow some vapours to condense, removing some of the pollutants in the waste gases. The gases will then pass through a Mercury Recovery Unit (MRU), which consists of two vessels filled with sulfur-impregnated activated carbon that removes a high percentage of the pollutants in the waste gases (efficiency varies per pollutant).

Once it has passed through the MRU the waste gases are then emitted to atmosphere via a 10 m stack.



▲ ***Figure 1: Hottpad process flow diagram***

2.4 Construction and commissioning

To reduce on-site construction time, the Hottpad structures will be prefabricated and transported to site for installation and assembly.

Commissioning will commence immediately after construction, with the applicant allowing for a commissioning phase duration of 3 – 6 months from the completion of construction.

Commissioning will involve running a test cycle, with validation monitoring of emissions through CEMS and SmartFID to allow for optimisation of the process and reconfigurations in the treatment process to ensure air quality criteria can be achieved during operations.

2.5 Operational aspects

General operations

Following loading and closure of the Hottpad unit, via installation of the emissions canopy, the heating phase will be initiated. The bed will be heated using gas fired burners with simultaneous air injection for about 12 hours. The section of the bed nearest the heaters and air injection will reach temperatures greater than 500°C when combustion is established, which is indicated when the carbon monoxide (CO) concentration in the exhaust gas exceeds 50 ppm as recorded by the CEMS. The heaters are turned off and airflow maintained to allow smouldering to proceed for up to three days.

The air injection blowers will be equipped with variable frequency drives which allows for sufficient oxygen supply to optimise the flameless thermal destruction of the hydrocarbons in the sludge.

Air flows through the Hottpad system will be monitored using inline flow meters on both the injection and extraction lines to control the extraction flow rate and maintain the target vertical Darcy velocity of 1 cm/s of gas movement through the combusting materials. The extraction airflow rate is controlled by a drive fan and will be higher than the injection rate to avoid back pressure on the inlet side of the Hottpad unit.

The process will be run as a semi-continuous batch process, with the heating phase of the Hottpad units staggered to reduce peak energy loading (burning) scenarios and to favour a more even rate of combustion. The total batch treatment is anticipated to take four days, including loading and unloading.

Following the completion of the combustion process, the treated material will be cooled by increasing the air injection rate and associated extraction rate. Visual inspection will be used to identify areas of poor hydrocarbon destruction to assess the operational efficiency of the system. Any untreated material will be retreated in subsequent batches.

Emissions controls

The Hottpad system's emissions are influenced by several factors. In its basic principle, the Hottpad system ignites the sludge, which then smoulders and emissions from this are only passively controlled by passing through 2 KO-pots and the MRU (one or two vessels filled with activated carbon that has a certain scrubbing efficiency for VOCs and mercury (and some of the other gasses)). If odours (VOCs) become excessive, the applicant proposes to inject Ecosorb into the stack to prevent odour emissions from causing issues off site.

The overall performance of the system is heavily dependent on the quality of the sludge feedstock, the effective functioning of the MRU, and the effectiveness of Ecosorb (for odour control).

Optimisation of feed loading and composition

The applicant provided an estimation of the expected sludge composition, based upon sampling results of several batches of the sludge (see Table 3), and used this composition to compare it to the measured sludge composition from the Batangas trials. From this comparison the applicant then estimated emission rates from the Hottpad system prior to the KO-pots and the MRU (see Table 4). As such the sludge composition is a crucial input variable for the determination of emissions.

Table 2: Sludge components and emissions

Sludge component	Emission to air	Comment
Hydrocarbons	CO, CO_2, H_2O, VOCs, PAHs	Hydrocarbons provide the fuel for the combustion process. The rate of CO, VOC and PAH emissions will be dependent on the fuel loading and smouldering and combustion conditions. Optimisation of fuel loading, heating conditions and air flow rate will be carried out during commissioning to maximise throughput and minimise emissions. Knockout pots will provide additional emission control via removal semi-volatile organics (e.g. PAHs) and some VOCs from exhaust gases.
Sulfur	SO_2	Emissions will be minimised by blending of feed material.
	Thiols and sulfides	Emissions will be minimised by blending of feed material. Ecosorb (see below) can be operated if odour impacts are considered significant (with thiols and sulfides likely to be major contributors to odour).
Nitrogen	NOx	Most of the NOx formation and emissions is expected to arise from the combustion conditions, which are controlled by air flow rate once combustion is established. Some NOx will be generated from nitrogen in feed material (fuel NOx). The fuel loading and combustion optimisation tests to be conducted during commissioning will also assess extent of NOx control.
Mercury	Hg vapour	Emissions will be minimised by blending of low Hg concentration feed material with higher Hg concentration material. An understanding of the variability in Hg content and the extent of blending required will be developed during commissioning. KO pots (see below) will provide additional Hg emission control, with condensed Hg reporting to the condensate underflow stream.
Chlorine	HCl	Some HCl will be removed via condensate in the KO pots. Blending of feed streams will also be examined.
	Dioxins and furans	Significant formation of dioxins and furans is not expected. Any dioxins formed will be removed via condensate in the KO pots.
Fluorine	HF	Some HF will be removed via condensate in the KO pots. Blending of feed streams will also be examined.
Particulates	PM_{10} and $PM_{2.5}$	Emissions will be controlled by the KO pots, with PM being captured along with the condensate.

The delegated officer notes that sludge composition can be variable and as such this may cause variable emission rates from the Hottpad system. To ensure that a variable sludge quality can be processed, the applicant amended the proposal to include the MRU (activated carbon filter) that is able to capture mercury and VOCs.

During the commissioning period more information should be obtained about sludge composition and the emissions that these may cause to establish a direct relationship between these.

Engineering controls

Air emission controls will be provided by KO pots, mist eliminators and an MRU. An Ecosorb odour control unit will be installed to inject masking and/or odour sequestering agents into the flue gas before discharge from the stack:

- KO pots: two KO pots will be installed to remove moisture are particulates from the exhaust stream – a drop in the velocity of the exhaust will cause liquid aerosols to settle out of the gaseous phase with vanes and mist eliminators installed to capture and prevent re-entrainment of the condensate material.

The condensate underflow will be discharged to the on-site liquid waste treatment plant.

- Mercury recovery unit: will comprise two vessels filled with sulfur-impregnated and pelletised activated carbon (AC) designed specifically for the treatment of air streams containing mercury vapours.

  The waste gasses enter the MRU at the bottom and leave the column of AC at the top. During the operation of the MRU, the activated carbon at the bottom will first be spent and then this line of spent AC will slowly move up the column. The MRU will lose its efficiency once there is not enough AC left to ensure effective capture of the contaminants. The shorter the residence time with the available activated carbon layer, the lower the adsorption rates.

  Establishing the efficiency of the MRU during commissioning is essential, as is the replacement frequency of the activated carbon.

  Spent AC will be disposed off-site to a facility that is approved to accept and treat mercury wastes, most likely the Karratha Mercury Plant or the Sandy Ridge Class V intractable landfill (following further treatment).

- Ecosorb odour control: will be installed immediately prior to the stack and involves spraying a proprietary solution containing plant oils and surfactants into the flue gases, prior to discharge. The system is intended to adsorb to odorous substances in the gas phase, or absorb them as aerosols, to eliminate their detection as an odour.

  This system is intended to be used when there is a risk of odour emissions causing an unacceptable impact to the workers. The only odorous compound, that was modelled to be above the odour threshold, is thiophene and modelling predicted this to potentially be causing an impact of about 250% of the odour threshold (maximum 3 min average of 4.88 ug/m^3 v odour threshold of 1.93 ug/m^3 at 25°C). Thiophene is rated as an irritant with a toxicity of LD50 orally in rabbits of 1,400 mg/kg. It is a noted skin, nose and eye irritant, but is not toxic to humans at the predicted levels.

  The emission rates are expected to be the highest after about 14 – 17 hours of the start of each Hottpad system. During these periods Ecosorb is planned to be injected in the waste gas stream after the MRU to capture odorous compounds.

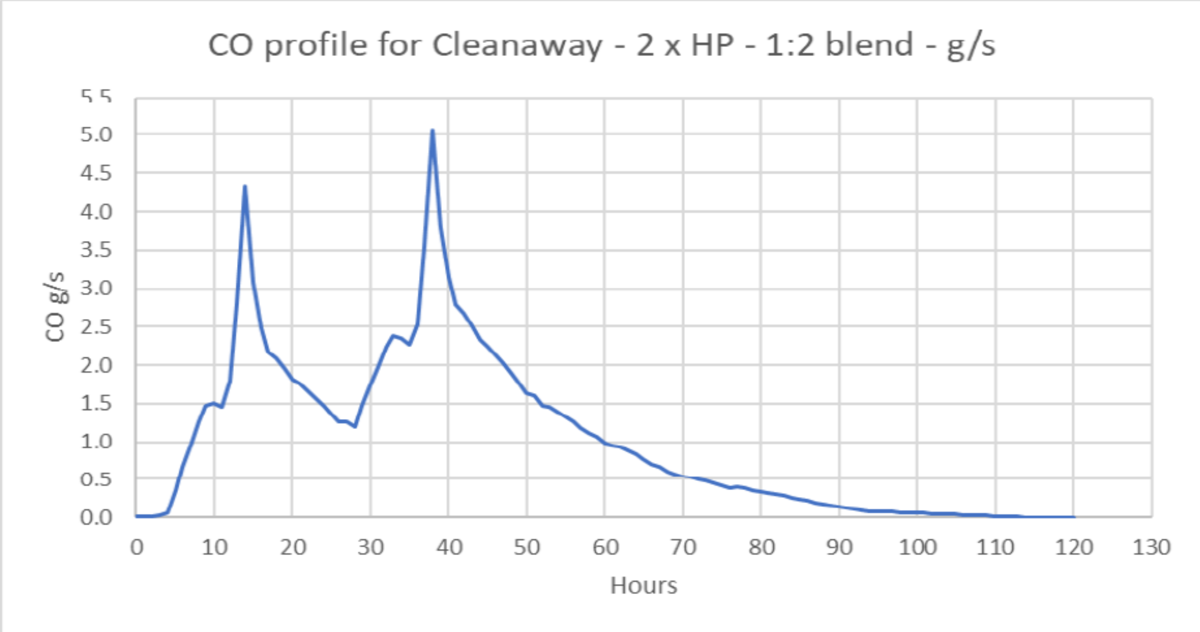
  Although the application mentions a masking agent, which indicates that the Ecosorb product has its own more pleasant odour, the delegated officer considers the Ecosorb product should not contain a masking agent and should be odourless. Ecosorb is expected to capture the odorous compounds which then would reduce the immediate odour, however this is likely to be released further in the atmosphere (thus enabling better dispersion without causing nearby odour impact).

<u>Emission rates</u>

The applicant provided predictive air emission rate estimates for the Hottpad system that it derived from air monitoring results from the field trials at the Batangas facility.

The results of the field trials were compared with the proposed size of the Karratha system, with consideration of the difference in contamination levels of the feedstock used at the Batangas facility the proposed feedstock for the Karratha system.

The specific operating conditions of the Hottpad system were also considered by the applicant, whereby the highest emissions occur in the first 15 hours before reducing significantly. The applicant has created specific emission rate profiles for the relevant pollutants, instead of using a constant emission rate, which reflects a more accurate emission profile of the Hottpad system compared to a constant emission rate (example profile provided in Figure 2).



▲ ***Figure 2: Hottpad system – example emissions profile***

The applicant also considered the effectiveness of the KO-pots, demisters and MRU in the estimation of the emission rates. The MRU is expected to reduce all VOCs and mercury emissions significantly. This has been included in the estimated emission rate profiles that were used for the modelling.

Emission control efficiencies

Control efficiencies across the KO pots have been determined from thermodynamic modelling that assumes an equilibrium gas temperature of 40°C and 1.05 atm, which represents nominal day-time temperature and the least efficient performance in respect of condensation of water, mercury and VOCs. Mist eliminator efficiencies are per the manufacturer specifications; MRU efficiencies for mercury removal have been obtained from vendor literature, which ranged from 85% to 99.9% (Table 4).

Table 4: Emission rates and emission control efficiencies

Parameter	Concentration (mg/m^3)	Mass emission rate (g/s)	KO pot efficiency	Mist eliminator efficiency	MRU efficiency
CO	228,716	82.6	0%	0%	0%
NO_x	255	0.1	0%	0%	0%
SO_2	3,727	1.4	0.01%	0%	0%
PM_{10}, $PM_{2.5}$	45	0.017	0%	99.9%	99%
HCl	2	0.00069	0%	99.9%	0%
HF	1.4	0.00053	0%	99.9%	0%
Dioxins (TEQ)	1.76×10^{-7}	1.38×10^{-7}	0%	50%	99%
Hg	79	0.03	0.01%	0%	95%
VOCs	Variable		0 – 0.7%	0%	25 – 90%

Process monitoring

The applicant proposes to have a continuous emission monitoring system (CEMS) installed after the MRU during commissioning. This monitor will be able to continuously monitor CO, CO_2, O_2, SO_2, NO_2, VOCs (as propane), moisture, velocity, temperature and volumetric flow.

The applicant considers using the CEMS in the stack with the Ecosorb may damage the CEMS/process monitor and that VOCs readings would not be accurate, as the Ecosorb is likely to cause interference (i.e., increase readings).

A combustion gas analyser will be installed upstream of KO pot #1 to analyse the waste gasses for CO, CO_2, O_2, SO_2, NO, NO_2 and NO_x. There will be sampling locations installed before and after the MRU and sampling ports in the stack.

During commissioning the applicant proposes to sample the waste gasses at three monitoring locations for mercury with a portable mercury detector (before KO Pot #1, between KO pot #2 and MRU and downstream of MRU).

The first week emissions will be monitored using the CEMS/process monitor and the portable mercury detector. After the emissions have been measured during this first week and the emission profile has been established, manual stack testing will then occur in the second week at the time periods of peak emissions to confirm modelled emission rates. The portable mercury detector will also be used during this period.

There will be three sampling ports installed on the stack and the sampling plane will be designed to be compliant with AS 4323.1.

During the commissioning period the portable mercury detector will be used frequently to monitor the process for mercury emissions.

The activated carbon will be monitored through grab samples to determine the saturation rates of the activated carbon (at 20%, 40%, 60% and 80% of the carbon bed height). The timing of this will be at predicted levels of saturation (25%, 50% and 75%) and depends on the results of the sludge testing as compared to predicted levels of saturation rates from the supplier of the MRU.

During the commissioning of the Hottpad system, the sludge will be analysed for the contaminates listed in Table 2, prior to being loaded into the Hottpad system. The sampling of the sludge should occur before and after mixing with the inert material just prior to use in the Hottpad systems. Sampling of the stockpile after mixing should ensure that results of analysis are representative of the whole stockpile.

Along the Hottpad system, the applicant will also monitor the pressure, which will assist in picking up saturation of the AC in the MRU.

The results of CEMS/process monitor during commissioning, monitoring during commissioning of mercury and the monitoring of the saturation rates of the MRU, will be reviewed to determine whether a CEMS for mercury is warranted, or require CEMS as per the CEMS Code or EN148181.

Monitoring conducted during the commissioning of the plant will be used to establish a correlation between the composition of the sludge and emissions when the MRU operates as expected. If the to-be-processed sludges are within a defined range (to be determined during commissioning) and the MRU operates normally, emissions are expected to be acceptable. Monitoring of the AC saturation in the MRU will provide clarity on the loading the MRU can take before mercury and VOCs are slipping through at unacceptable levels.

Fire risk

Emissions of toxic smoke may occur from an emergency outbreak of a fire; firewater run-off may also cause impacts to the nearby ephemeral stream and contamination of local soils.

Fire is not considered to be a normal part of operations and would only be foreseeable in an exceptional emergency. Potential emissions would depend on the severity and extent of the fire affecting the premises. Given the uncertain nature of fire outbreak, and the potential fire emissions to be released to air and land that include persistent heavy metals, sulfur, oxides of ammonia, carbon monoxide and a range of hydrocarbons and particulates the delegated officer considers it suitable to require the applicant to develop a fire and emergency management plan to manage the risk associated with emergency uncontrolled fire.

2.6 Exclusions to this assessment

The following matters are out of the scope of this assessment and have not been considered within the technical risk assessment detailed in this report:

- emissions and discharges from existing waste management activities conducted on the premises under L8332;
- waste acceptance, receipt, handling and storage of hydrocarbon contaminated soils and sludges accepted on the premises; and
- mixing of hydrocarbon contaminated soils and sludges on the existing mixing pond, prior to introduction into the Hottpad system.

The works approval is related to category 60 activities only and does not offer the defence to office provisions in the EP Act (see s.74, 74A and 74B) relating to emissions or environmental impacts arising from non-prescribed activities, including those listed above.

3. Consultation

The application was advertised for public comment on the department's website during June 2021. No public comments were received during the specified timeframe.

The application was also referred to the City of Karratha, who did not provide a response.

4. Location and receptors

The premises is located in the Pilbara region in the state's north-west. The site is on the outskirts of Karratha, an urban hub for the petroleum and liquefied natural gas operations of the North West Shelf Venture.

The premises is located on a coastal plain which is broad, low-lying, and slopes gently seawards and is straddled by two north flowing creek lines. The local area has formed on alluvium, with sediments including clay, sand, silt and calcrete, with the soils comprising clays, cracking clays and red duplex soils.

Seven Mile Creek is located about 1.2 km east of the premises, which flows northwards into Nickol Bay which comprises tidal and salt flats and sensitive mangrove communities. Other minor drainage lines and tributaries exist within proximity to the premises, with the nearest about 100 m west of the premises boundary. There are no beds and banks or riparian vegetation of significance within immediate proximity to the premises, however the premises has been established above the 100-year annual recurrence interval flood level as the local area is potentially subject to flooding from high sea storm surges and surface runoff from ranges to the south.

Table 5 lists the relevant sensitive land uses and specified ecosystems in the vicinity of the site.

Table 5: Sensitive human and environmental receptors within proximity

Human receptors	Distance from prescribed activity
Population groups (residential) – Karratha City townsite	About 6.4 km north-east
Stayover Kingfisher Village	About 2 km north
Neighboring industrial premises – Seven Mile Waste Facility	About 250 m north
Neighboring industrial premises	About 175 m west
Environmental receptors	**Distance from prescribed activity**
Priority 1 Ecological Community (PEC): Roebourne Plains gilgai grasslands	Located within boundary of Priority 1 PEC
Endangered Fauna Species: Northern Quoll	36 records located 2 – 5 km west and

(*Dasyurus hallucatus*)	north-west
Seven Mile Creek	About 1.2 km east of the site
Unnamed ephemeral waterbody	About 250 m west of the site
Groundwater	Fractured rock aquifer, depth to groundwater ~ 9 mbgl

Note: the neighboring industrial premises are also managed by Cleanaway, however, fall outside the premises boundary. These receptors have been considered in this assessment to ensure that workers at those premises are not exposed to unacceptable emissions.

5. Modelling data

5.1 Air emissions assessment

Air dispersion model

The applicant engaged consultant Ramboll Australia to undertake air dispersion modelling for the project (Ramboll 2019), which was later updated by consultant JBS&G Australia using supplementary data regarding sludge composition and revised assessment criteria and receptor characterisation and implementation of additional pollution control technology (Strategen-JBS&G 2020).

Version 9.9 of the AERMOD air dispersion model was used to assess the potential air quality impacts of atmospheric emissions from the project, comparing the ground level concentrations (GLCs) predicted at sensitive receptor locations against relevant ambient air quality guidelines values (AGV), as per the department's *Draft Guideline: Air Emissions* (DWER 2019).

Predictive emission rates, which were derived by the applicant from air monitoring results from the field trials at the Batangas facility (see Table 3), were used as inputs into the model. The model focuses on two scenarios, being normal operation and a delayed start operation (where both Hottpad units would start up about 14 hours later than normal), which captures the different weather patterns during the different times of the day.

Results

Normal operations

The modelling indicates that predicted GLCs of all air emissions parameters were found to be below the respective AGVs at the nearest off-site sensitive receptors during normal operations.

The highest concentrations are predicted to occur at the premises boundary, to the south and north of the site, respectively, with the maximum predicted 1-hour averages for NOx being 312% and 243% of the AGV, and 48% and 24% of the AGV for mercury. Significant concentrations of benzene are also predicted to occur at the boundary, being more than 500% of the annual AGV at the southern boundary of the premises, however the applicant considers most of these emissions will originate from the generator and not the Hottpad units.

Conversion of the 1-hour GLCs for NOx and mercury to an 8-hour average indicates that maximum GLCs are below the relevant time-weighted averages in terms of occupational exposure for workers at the existing Cleanaway site.

The highest off-site GLCs predicted to occur at the nearest sensitive receptors (Shell roadhouse, Stayover Kingfisher Village) are less than 20% of the 1-hour AGV for NOx and less than 5% of the AGV for mercury.

Delayed start operations

Under delayed start operations, NOx GLCs are dominated by emissions from the generator, which occur for the first 6 hours after start of the heating phase for each Hottpad unit, whereas mercury emissions peak about 12 – 14 hours after commencement of heating.

The highest concentrations are predicted to occur at the premises boundary, with maximum predicted 1-hour average for NOx being 454% of the AGV at 11 PM, being 4 hours after the start of heating for either Hottpad unit 1 on Monday or Hottpad unit 2 on Tuesday. A peak (1-hour average) for mercury is predicted to occur at 5 AM for start-up commencing mid-afternoon on the previous day, being 54% of the AGV.

The highest off-site GLCs predicted to occur at the nearest sensitive receptors are less than 40% of the 1-hour AGV for NOx, and less than 5% of the 1-hour AGV for mercury.

Cumulative emissions

The addition of the peak measured NOx concentration from the Pilbara Air Quality Study of 1998 – 2002 (DEP 2002), which involved monitoring of air quality within the Karratha townsite, to the maximum predicted NOx GLC at the nearest off-site sensitive receptor to the premises (Stayover Kingfisher Village) gives a cumulative concentration of 155 $\mu g/m^3$, which exceeds the 1-hour AGV based on the current (2021) National Environment Protection Measure (NEPM) standard (150 $\mu g/m^3$).

DWER technical review

DWER's review of the air dispersion modelling (Strategen-JBS&G 2020) identified that:

- the air quality assessment was conducted in accordance with the Air Quality Modelling Guidance Notes (DoE 2006);
- the methodology used for estimation of the emission rates is very simple and not ideal, however it is noted there is limited information available for this type of project, being a new waste treatment method, and the only data available being from the Batangas trial;
- it is noted the same sludge to sand ratio is being proposed for the Karratha plant as per the Batangas trial, despite the untreated material for the Karratha plant comprising about 56 times the hydrocarbon content of the Batangas trial. A higher blend ratio (e.g. 1:4) is therefore suggested to minimise pressure on the emission control systems;
- the applicant needs to ensure that ID fans are maintaining the flow extraction rate and a net negative pressure in the system to ensure emissions are properly extracted. It is noted the findings of a similar Hottpad system supported by Chevron indicated the extraction system must flow at least 1.25 times greater than the air injection flow to ensure full emissions from the top of the pile are effectively captured; and
- given several emission controls will be in place and the nearest sensitive receptor is located 2 km away, it is likely the risk of impacts to off-site receptors can be acceptable. However, it is critical that all emission rates and modelling results are reviewed when monitoring data during commissioning is available, to confirm the accuracy of predictions.

6. Risk assessment

6.1 Determination of emission, pathway and receptor

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

6.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and takes into account identified potential source-pathway and receptor linkages. Where linkages are incomplete, they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls, these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in the below table.

Risk assessment table

The table below describes the risk events associated with the proposal consistent with the *Guideline: Risk Assessments* (DWER 2020). The table identifies whether the risk events are acceptable and tolerated, or unacceptable and not tolerated, and the appropriate treatment and degree of regulatory control, where required.

Table 6: Risk assessment table

Risk Event				Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls
Source/ Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
Construction works								
Construction and installation of Hottpad units and associated infrastructure	Noise and fugitive dust associated with construction works	Unreasonable interference with the health, welfare, convenience, comfort or amenity of nearby sensitive receptors (2 residential receptors within 2 km, including accommodation village)	Adequate separation to nearby receptors (>2 km) Short duration of construction work, predominantly limited to day light hours	Minimal impacts to amenity on local scale **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, generally not subject to regulatory controls	Some additional noise and dust is expected during construction works; however, the delegated officer considers this will not significantly differ from existing noise and dust levels from existing operations at the premises. Considering this, and there being sufficient separation in place to nearby receptors (>2 km), the delegated officer does not reasonably foresee that noise and dust from construction works will impact on the amenity or health of off-site human receptors.	Works approval controls: None specified.
Commissioning and time-limited/full operations								
Environmental commissioning of the Hottpad units and associated infrastructure, and subsequent operation	Noise associated with Hottpad operations	Unreasonable interference with the health, welfare, convenience, comfort or amenity of nearby sensitive receptors (see above)	Adequate separation to nearby receptors (>2 km) Operations predominantly limited to day light hours	Minimal impacts to amenity on local scale **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, generally not subject to regulatory controls	Some additional noise is expected during operation of the Hottpad units, however delegated officer considers this will not significantly differ from existing noise levels from existing operations at the premises. Considering this, and there being sufficient separation in place to nearby receptors (>2 km), the delegated officer does not reasonably foresee that noise from operation of the Hottpad units will impact on the amenity or health of off-site human receptors.	Works approval controls: None specified. Licence controls: None specified.
	Stack emissions during commissioning and testing, and subsequent full operations		Optimisation of fuel loading, heating conditions and air flow rates Installation of pollution control equipment (KO pots, mist eliminators, MRU) Installation of CEMS Installation of 3 sampling ports on stack to allow periodic stack sampling Continuous emissions monitoring for process gases Periodic stack testing Monitoring of Hg levels and activated carbon in MRU	Specific consequence criteria (for public health) are likely to be met **Minor**	Not likely to occur in most circumstances **Unlikely**	**Medium** Acceptable, generally subject to regulatory controls	Exhaust gases from the Hottpad units will be passively controlled through two KO pots and an MRU, which is expected to remove most semi-volatile organics, some VOCs and mercury. Air dispersion modelling (Strategen-JBS&G 2020) indicates that with the above controls in place, maximum GLCs for NOx (1-hr) and mercury (1-hr) will be below the relevant AGVs for off-site human receptors under normal operating conditions. The delegated officer notes the limited information available to inform the model, and that emission rates are based on one trial in the Batangas using a feedstock with much lower contamination levels. It appears the performance of the system and pollution controls are heavily dependent on the quality of the feedstock and the effective functioning of the MRU. It is therefore critical that appropriate monitoring data is gathered during commissioning to validate the assumptions used in the modelling and the predicted emissions. To ensure an acceptable level of risk is maintained during commissioning and time limited operations, controls will be imposed on the works approval to require installation of the proposed pollution control equipment, installation of continuous emissions monitoring (CEMS) after the MRU, separate stack sampling ports to allow manual testing, and submission of an environmental commissioning plan within 3 months of the commencement of commissioning. Any issues identified by the department will be addressed with the applicant, prior to the commencement of commissioning works. The delegated officer expects that validation of emissions will be conducted during commissioning (stack testing) and calibration of the CEMS system in accordance with the CEMS Code (in preparation for continuous emissions monitoring during commissioning, time limited operations and continued operations under the licence). Routine stack testing will commence under full operations of the licence and will include monitoring of all parameters likely to be present in the exhaust fumes.	Works approval controls: - Infrastructure design criteria specified, including pollution control infrastructure for treatment of flue gases (KO pots, mist eliminators, MRU); - CEMS and separate sampling ports to be installed on main stack; - Submission of a commissioning plan; - Submission and implementation of an environmental commissioning plan, including validation of emission rates and air emissions monitoring; - Submission of a commissioning report; - Limit for mercury emissions imposed with management actions Licence controls: - Infrastructure design and operational requirements specified in infrastructure table; - Continuous air emissions monitoring on main stack for process gases (CO, SO_2, NO_X), routine stack testing for other parameters; - Operational requirements for maintaining extraction air flow rates

Risk Event				Consequence rating[1]	Likelihood rating[1]	Risk[1]	Reasoning	Regulatory controls
Source/ Activities	**Potential emissions**	**Potential receptors, pathway and impact**	**Applicant controls**					
							An environmental commissioning report must be submitted following the completion of commissioning, in addition to a CEMS calibration report following completion of successful calibration and verification of the installed CEMS system. The delegated officer has determined not to impose emission limits on the works approval or subsequent licence at this stage on the grounds the pollution control equipment proposed is appropriate for the risk profile for this type of plant, and predicted emissions are below the relevant AGVs at the nearest sensitive receptors. In addition, process gases from the Hottpad units (CO, SO_2, NO_X) will be continuously monitored to provide assurance over the effectiveness of pollution control equipment, and this can be reviewed should issues arise during operations. The exception to this is for mercury emissions – an emission limit has been imposed on the works approval and licence based on the European Union's *Industrial Emissions Directive* for the commissioning period, which is linked to a management action to stop emissions through the use of a sprinkler system in the hood of the Hottpad units and quench the smouldering feedstock, should mercury levels exceed 0.05 mg/m^3. Spent mercury from the MRU must also be removed off-site to a facility that is authorised to accept mercury and mercury compounds for treatment. Operational requirements to maintain flow extraction rates and net negative pressure will be specified on the licence during operations, including a performance requirement to maintain flows at least 1.25 times greater than the injection flow rate.	
	Odour – stack emissions (Thiophene)	Unreasonable interference with the health, welfare, convenience, comfort or amenity of nearby sensitive receptors (see above)	Installation of odour control unit (Ecosorb) – injection of masking agent into stack after MRU after each Hottpad unit reaches smouldering phase	Minimal impacts to amenity on local scale **Minor**	Could occur at some time **Possible**	**Medium** Acceptable, generally subject to regulatory controls	Air dispersion modelling (Strategen-JBS&G 2020) predicts that thiophene levels may exceed the odour threshold by 250% at the premises boundary. Thiophene is a noted skin, nose and eye irritant. Levels are expected to be highest after about 14 – 17 hours after the start of each Hottpad unit, where the applicant proposes to inject a masking and/or odour sequestering agent into the flue gas, to capture odorous compounds, before discharge to the stack. To ensure an acceptable level of risk can be maintained during commissioning, time limited operations and ongoing operations, controls will be imposed on the works approval to require installation of an odour control unit (Ecosorb) and operational controls to specify that it must be operated at least 14 hours after start up, or when there is a risk of odour causing impacts to workers or off-site receptors.	<u>Works approval controls:</u> - Infrastructure design criteria specified, including installation of odour control unit; - Operational requirements for operating Ecosorb at least 14 hours after start up or when there is a risk of odour causing impacts to workers or off-site receptors <u>Licence controls:</u> - Infrastructure design and operational requirements specified in infrastructure table; - Operational requirements, as per WA conditions
	Contaminated surface water runoff from Hottpad area	Overland runoff from site, causing adverse health impacts to downgradient native vegetation and local ecosystems	Surface runoff within plant footprint will be contained and transferred to the on-site liquid waste treatment plant.	Minimal off-site impacts on local scale **Minor**	Not likely to occur in most circumstances **Unlikely**	**Medium** Acceptable, generally subject to regulatory controls	The applicant has already established surface water management measures on-site and is regulated under the existing licence L8332. No additional changes are required for this proposal.	<u>Works approval controls:</u> None specified. <u>Licence controls:</u> None specified.

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the Guideline: Risk Assessments (DWER 2020)

7. Decision

The delegated officer has determined the proposal to install and operate a new waste treatment system (Hottpad) at the premises, with an assessed throughput of 11,000 tonnes per year of hydrocarbon contaminated sludge and soil, does not pose an unacceptable risk of impacts to public health or the environment. This determination is based on the following:

- the location of the premises being within an existing waste management precinct on the outskirts of Karratha with sufficient separation to sensitive environmental receptors, such as residential dwellings, permanent waterways, groundwater, conservation significant flora and vegetation, etc.; and
- cumulative predicted GLCs for all air pollutants of concern being below the relevant AGV and workplace exposure standard criteria, noting the potential for exceedances of the current NEPM (2021) NO_2 (1-hour) criteria in the Karratha airshed.

To minimise the potential for impacts to human health and the environment, the applicant has proposed the following engineering controls, which will be imposed on the works approval as they are considered critical for maintaining an acceptable level of risk:

- exhaust gases from the Hottpad units will be collected and passed through KO pots and an MRU to minimise the concentration of air pollutants;
- an odour control unit installed, to adsorb odorous substances in the gas phase, or absorb them as aerosols and eliminate their detection as an odour; and
- air emissions will be continuously monitored during operations, to provide assurance over the effectiveness of the pollution controls.

In addition, the applicant proposes to conduct monitoring of the following during environmental commissioning, to validate the predicted emissions from the system and to provide assurance the system can be effectively operated with the proposed emissions controls in place:

- investigations into the variability of sludge composition, and how this influences the variability of emission rates from the Hottpad system;
- stack testing will be conducted of the exhaust gas stream during commissioning for all relevant parameters.

The delegated officer is satisfied the above engineering controls and monitoring lower the overall risk profile of the proposal, and providing that validation monitoring adequately address the potential for unacceptable impacts to public health or the environment.

The Hottpad system falls under the term 'waste incineration' as it is a kind of thermal destruction of waste. As there is no energy recovery, it is not deemed a waste to energy plant. The delegated officer notes the Minister for Environment has set maximum emission standards for waste to energy plants, which are listed in the European Union's Industrial Emissions Directive (IED). Mercury emissions from the proposal must therefore be minimised in accordance with the Minamata Convention.

Works approval and licence

Works Approval W6408/2020/1 that accompanies this report authorises construction, commissioning and time-limited operations only. The conditions in the issued works approval, as outlined in the above risk table have been determined in accordance with the *Guideline: Setting Conditions* (DWER 2020b).

An amendment to the existing licence L8332 is required to authorise emissions associated with ongoing operation of the infrastructure. A risk assessment for full operations has been included in this report, however licence conditions will not be finalised until the department assesses the licence amendment application. Conditions will be imposed to ensure day-to-day operations do not pose an unacceptable risk of impacts to public health and the environment.

Applicant comments on draft decision

The applicant was provided with drafts of the works approval and this report on 28 January 2022 and sought a number of clarifications and corrections to more accurately reflect the actual infrastructure to be built.

Several operational changes were also sought, relating predominantly to continuous monitoring and the recovery, management and monitoring of mercury. The applicant proposed several practical alternatives to that originally drafted by the department, which the delegated officer accepted as being reasonable.

8. Conclusion

Based on this assessment, it has been determined the issued works approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Daniel Hartnup
MANAGER, PROCESS INDUSTRIES
REGULATORY SERVICES

Delegated officer
under section 20 of the Environmental Protection Act 1986

References

1. 360 Environmental 2019, *Karratha Liquid Waste Treatment Plant and Waste Transfer Station: Hottpad – Works Approval Supporting Document*, Perth, Western Australia.
2. Department of Environment (DoE) 2006, *Air Quality Modelling Guidance Notes*, Perth, Western Australia.
3. Department of Environment Regulation (DER) 2016, *Guidance Statement: Environmental Siting*, Perth, Western Australia.
4. DER 2016, *Continuous Emission Monitoring System (CEMS) Code for Stationary Source Air Emissions*, Perth, Western Australia.
5. Department of Water and Environmental Regulation (DWER) 2019, *Draft Guideline: Air Emissions*, Perth, Western Australia.
6. DWER 2020a, *Guideline: Risk Assessments*, Perth, Western Australia.
7. DWER 2020b, *Guideline: Setting Conditions*, Perth, Western Australia.
8. Strategen 2020, *Cleanaway Hottpad treatment system Works approval application – emissions and discharges: Karratha Liquid Waste Treatment Plant and Waste Transfer Station*, Perth, Western Australia.
9. Variation to the *National Environmental Protection (Ambient Air Quality) Measure 2021* (Cth). https://www.legislation.gov.au/Details/F2021L00585 (NEPC 2021).

Appendix 1: Figures

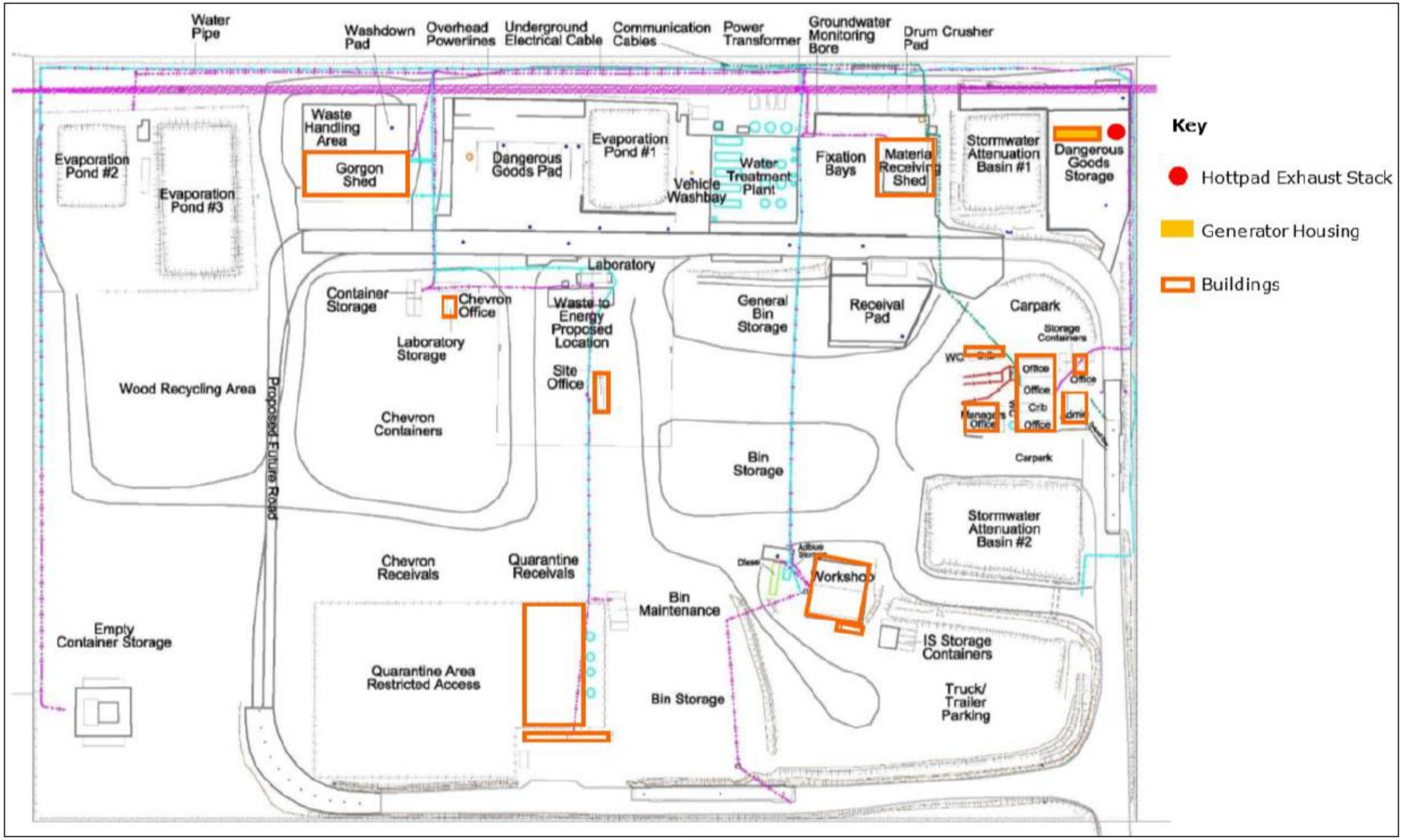


Figure 6: Premises layout and location of Hottpad system

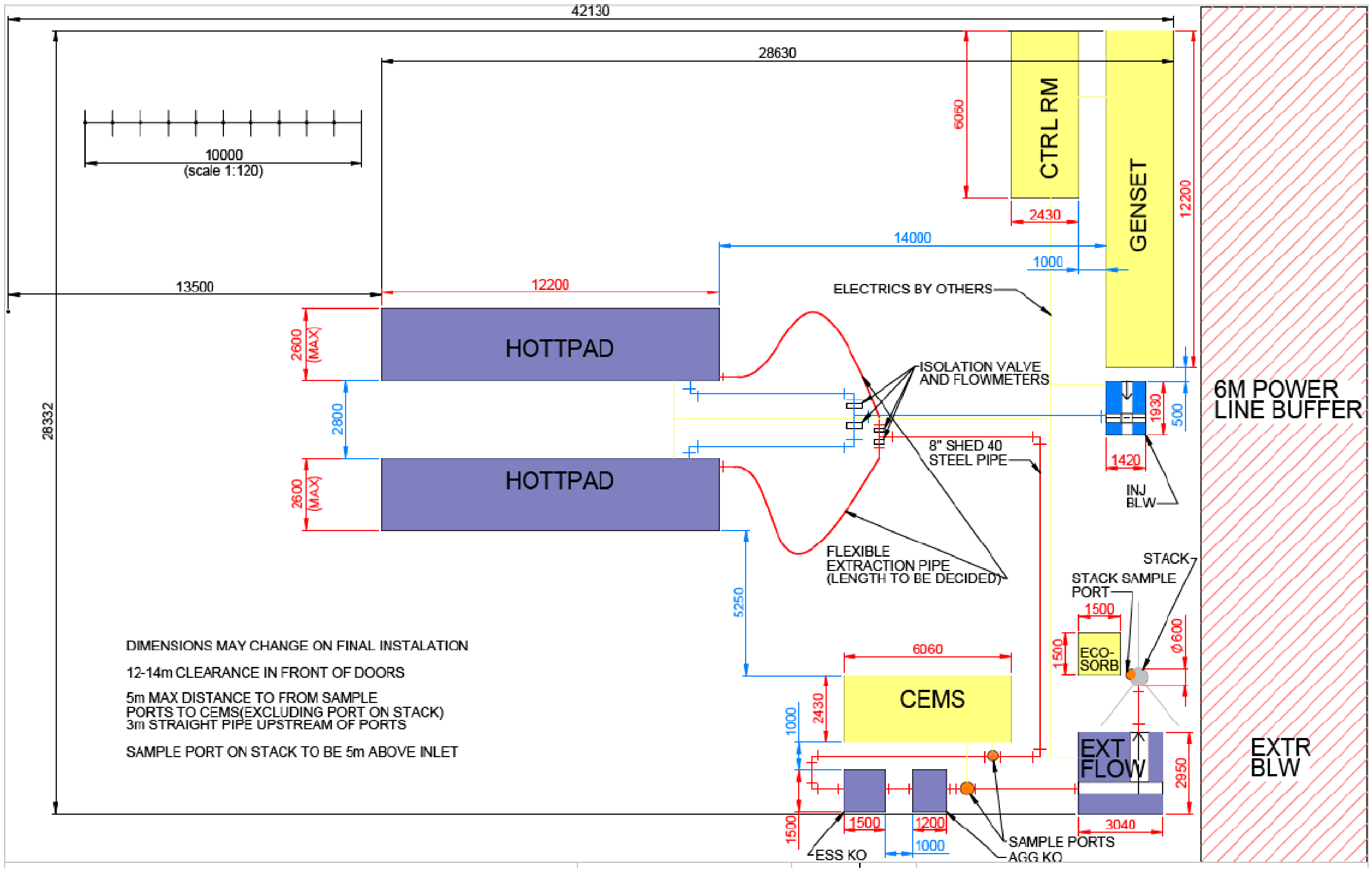


Figure 7: Site layout of Hottpad system