BIOENERGY FROM WASTE PROJECT

PRELIMINARY HIGH LEVEL DESIGN REPORT

(refer Sustainability Victoria C-11614)

FOR ESTABLISHMENT OF A BIOENERGY FROM WASTE FACILITY

CO-LOCATED WITH DON KR IN CASTLEMAINE, VICTORIA

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MT ALEXANDER BIOENERGY PTY LTD

(wholly owned by Mount Alexander Sustainability Group)

Date	Revision	Revision Comment	Prepared	Review	Approve
31/03/21	H	High Level Design: drawing on information from 2018 Feasibility Study and Final Business Case	DB: ECO2Sys BM: Inoplex	DB	✓
08/04/21	I	Subtle wording clarification to section 5.2 (.4)	DB, BM	DB	✓
14/04/21	J	Adjustment to site layout of bioenergy plant	DB, BM	DB	✓
20/04/21	K	Updated document following G Egan review	DB	GE	

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TABLE OF CONTENTS

1 BACKGROUND 4
2 KEY OBJECTIVES 5
3 DESIGN EXECUTION STRATEGY 5
3.1 DESIGN WORKS 5
3.2 REPORTING 6
3.3 DESIGN SCHEDULE 6
4 QUALITY CONTROL 6
5 INNOVATION AND FEASIBILITY 7
5.1 STEEL FIBRE REINFORCED CONCRETE 7
5.2 PROCESS DESIGN 7
6 BASIS OF DESIGN 15
6.1 DESIGN LIFE 15
6.2 DESIGN REDUNDANCY 15
6.3 SITE LAYOUT 15
6.4 EARTHWORK AND GROUND CONDITIONS 17
6.5 ORGANICS RECEIVAL SHED 18
6.6 POTABLE WATER SERVICES 19
6.7 FIRE WATER SERVICES 19
6.8 SEWAGE SERVICES 19
6.9 ELECTRICAL 19
6.10 COMMUNICATIONS 19
6.11 SAFETY IN DESIGN 19

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1 BACKGROUND

The proposed bioenergy from waste facility has been designed for the Mount Alexander Sustainability Group (MASG) with support from Don KRC (DON) at the Castlemaine site location in Victoria. The facility has two complementary waste to energy technologies for processing two different type of biomass / waste streams, to offset Don KRC's power and heat use from renewable sources as well as providing a strategic solution to Don KRC's inherent waste treatment and disposal challenge.

The first waste stream is up to 30,000 tonnes per annum of commercial and industrial (wet) organic waste streams, including Don KRC's organic waste output, to be processed through anaerobic digestion (stage 1 of the bioenergy project). The second waste stream is dry matter and woody biomass and would be processed through combustion, burning up to 14,000 tonnes per annum (stage 2 of the bioenergy project).

The technologies have been selected from a technology sounding conducted by MASG. While the responses for anaerobic digestion technologies were adequately detailed to define a robust conceptual design, limited information was received from respondents in relation to the dry biomass processing technologies, however a pyrolysis-based approach has appeal as this yields a highly valuable co-product that will serve the regional agriculture sector and strengthen the overall circular economy focus of the project.

Stage 1:

The anaerobic digestion facility utilises mechanical separation on the front end under an enclosed negative pressure reception hall capturing and processing all odour to meet the EPA requirements. Outputting a clean pumpable organic stream ready for a mesophilic biological anaerobic digestion process, the process breaks down the organic volatile solids in the feed sludge by feeding bacteria in the primary digester tanks. The methane forming bacteria convert the organic acids to methane gas, carbon dioxide and water, producing biogas at ~65% methane. The gas is then fed through a gas dryer and associated gas management, for removing the H2S and providing processing through an onsite CHP to offset the site parasitic power and heat requirements of the plant. The CHP is a reciprocating engine for the production of electricity to offset and load follow waste to energy site's electrical requirements with the site's thermal load being met with heat from biomass plant. The generator will provide back-up emergency power and an enclosed biogas flare is included to safely vent biogas as required.

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The non-volatile solids along with the few non-biodegradable organic solids become digested sludge that is fed from the digester tanks into a digester outlet tank, ready for separating through a dewatering separator outputting the solids addition to the pyrolysis plant, the liquid fraction part will be recirculated back in to the process, with the surplus sent to sewer either directly or via Don KRC.

The anaerobic digestion plant comprises of a Receival Hall, Anaerobic Digestion Process (Tank Area) and the Gas Management and Power Utilities section. The anaerobic digestion plant also requires regular monitoring and maintenance of the process and equipment including quality control of the entire biogas production process.

Stage 2:

Biomass processing comprises a low pressure pyrolysis steam boiler. The pyrolysis configuration comprises of a feeding store for fuel handling, mulching/chipping and potentially drying with waste

heat (if required) to feed through the feeding hopper into a biomass heater, supplying steam to Don KRC and thermal energy to the anaerobic digestion process.

This pyrolysis heat plant system operates under low pressure and would generate up to 5MWth 10Bar steam for use by Don KRC. A heat exchanger will be selected to deliver heat to the specifications required by Don KR.

System outputs include biochar (around 20 % of fuel mass) which is a saleable product for agriculture, dependent on market and quality of biochar. Additional value can be added as the biochar is blended with high quality compost and minerals to produce a bio-fertiliser.

Being a community-based project, community involvement is a high priority for MASG and as such the project will draw on local expertise where it is available and seek to develop local capacity as appropriate. This includes project management, engineering, equipment providers (tanks, heat exchangers, fabricators, trades), civil works and operating personnel, both during the construction and operational phases of the project. Linked to this is a desire, consistent with circular economy principles, to keep resource flows, employment and investor capital as local as possible.

2 KEY OBJECTIVES

The objective of the design of this project is to build and operate a commercially viable integrated bioenergy facility at the Don KRC site in Castlemaine. This facility will be designed to:

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- Accept and process 40-120 Tonnes/day of organic waste that attracts an adequate gate fee
- Accept 40 Tonnes / day of woody biomass
- Include pre-treatment trains capable of accepting a broad range of wastes
- Produce biogas / steam to supply Don KRC's natural gas, to offset the site requirements.
- Minimise odour (compliant with EPA regulations)
- Minimise noise (compliant with EPA regulations)
- Maximise re-use opportunities for digestate

The key design objectives for the project are:

- Achieving zero harm;
- A facility with a high level of operability, maintainability and constructability; and
- No delays or additional cost on site due to design issues or errors;

3 DESIGN EXECUTION STRATEGY

The design will be completed in house by the EPC Contractor, unless otherwise specified.

3.1 DESIGN WORKS

3.1.1 Concrete

The design of all concrete works including footings will be designed by the civils contractor. The ground slabs should incorporate steel fibre reinforcement. The steel fibre reinforcing reduces site hours whilst

assisting in minimising thickness and shrinkage cracks in ground slabs. Where applicable, Strand7 a Finite Element Analysis program will be used to design the concrete.

3.1.2 Structural

All structural design will be completed on structural analysis package Space Gass and internal programs and spreadsheets. Design shall be in accordance with relevant Australian and New Zealand standards complying with the building codes and shall incorporate design for ease of construction.

3.1.3 EI&C

To accelerate the project schedule preliminary electrical calculations, modelling and earth grid design will be completed for input into the grid submission / site connection at the start of the project if the CHP option is viable and progressed. The remainder of deliverables will be completed in accordance with the project schedule when mature primary electrical data, equipment lists and General Arrangements are completed.

3.2 REPORTING

A weekly design progress report will be produced for the Project Report which shall include as a minimum work pack progress, earned hours, hold ups and outstanding Technical Queries.

3.3 DESIGN SCHEDULE

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The design schedule is included as a sub-section of the full project schedule. Progress of deliverables and associated works packs will be updated weekly to allow correct tracking to baseline.

4 QUALITY CONTROL

Quality assurance and control shall be in accordance and compliant with approved Design Procedure used by the EPC contractor. The following processes are included in the procedure and will ensure compliance with ISO 9001 requirements.

- Design Project Commencement Process
- Safety in Design Process
- 3D Model Development and Review
- Design Drawing Development and Review Process Design Drawing Squad Check Process
- Design Document Development and Review Process Vendor and Sub-Contractor Document Review
- Process Design Hold Process
- Design Change Process
- TQ/RFI Process
- Non-conformance Process Corrective Action Process Preventive Action Process
- Design Project Completion Process

5 INNOVATION AND FEASIBILITY

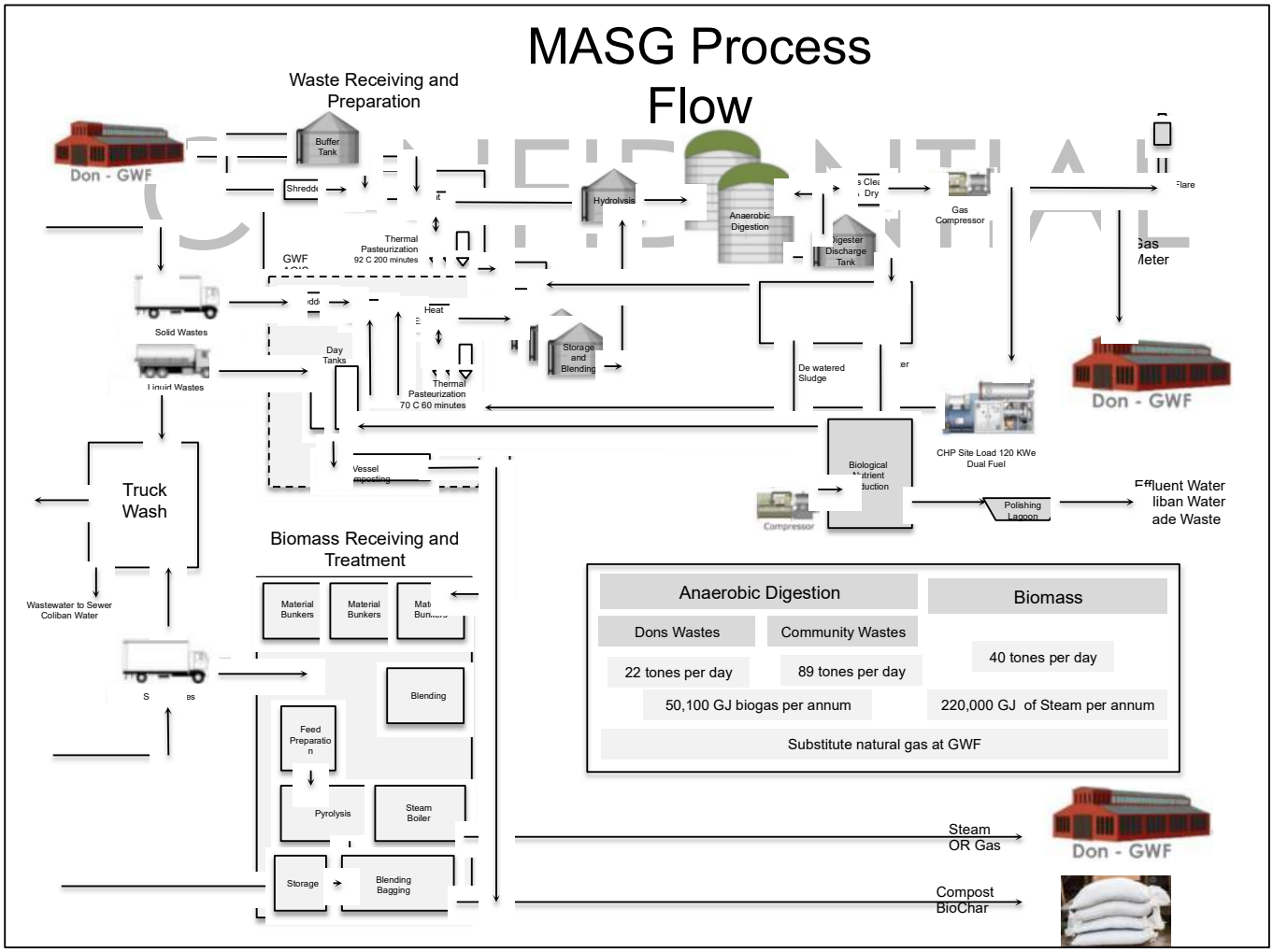
5.1 STEEL FIBRE REINFORCED CONCRETE

Recommend to utilise steel fibre reinforcement (where expertise available) in lieu of traditional steel rebar or mesh in the ground slabs. Steel fibres provide a more efficient construction plan. The steel fibre reinforcing reduces site hours whilst assisting in minimising thickness and shrinkage cracks in ground slabs.

5.2 PROCESS DESIGN

The process design has been broken out into separate areas:

- Receival Area(s)
- Anaerobic Digestion Building (Stage 1)
- Biomass Heat Plant Building (Stage 2)
- Gas Management and Power Utilities section.



5.2.1 Waste Feedstock

The following waste streams are envisaged for both Stage 1 (AD) and Stage 2 (BT). The volumes shown indicate what is available but not yet secured and assumes the bioenergy facility is operational from 2023. Individual company data is available on request. Note that for AD all the meat waste and DAF sludge will form part of the base load as its availability, quantity and quality is assured. A significant part of the food waste will similarly be assured and a portion of FOGO. From this the predicted 'recipe' of waste streams to design the AD plant around can be estimated. Technical parameters (COD, DS, N, Na) for the baseload waste is available. The AD plant will initially need circa 1/3 of the total shown below.

The biomass feedstock is likely to be quite consistent and will draw on a % of the waste streams shown below.

Technology	Waste Type	Approx Qty (tpa)	Availability for 2023	Seasonality	Pre-sorting
Anaerobic Digestion	DAF sludge (exc. SBA, Coliban)	6,520	Yes	Yes/ Partly	N/A
	Food waste	10,172 +	Yes	All Year	High level
	FOGO	76,000	Yes (tbc)	All year, with a small % seasonal	Yes
	Meat waste	3,860	Yes	All Year	N/A
Total		**~96,500**			

Technology	Waste Type	Approx Qty (tpa)	Availability for 2023	Seasonality	Pre-sorting
Biomass Thermal	Timber waste	18,000	Yes (regional & metro)	Minimal	Grinding to chips
	Cardboard/Plast. contaminated	2,160	Yes	All (8/5)	No
	C&I Timber and Garden	10,624	Yes	All (8/5)	Likely
	Dry organic (timber, husks & hulls)	2,500	Yes	All (8/5)	TBA
	Digestate	3,200	Yes	All (8/5)	No
	Other (fruit trees)	7,000	Yes	Part	Grinding to chips
Total		**~43,500**			

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5.2.2 Waste Receival

Receival of solid Organic and Liquid feed material – for Anaerobic Digestion

The input material, is dropped off into the 3-day storage bays allowing for 800 m^3 of product volume, including storage for stackable packaged non-perishable goods to be feed into the process. At this point the operators will have first sight on the input material and will be able to remove any problematic waste materials before being loaded into the process line. Note that the meat waste feedstock (from Don Smallgoods) is assumed to have 14.3% D.M. and 91% V.S.

The receival hall (also referred to as vehicle bay) allows for two waste trucks to back in at any one time. This reception building uses traffic lights to indicate which bay is free for the subsequent waste truck.

The solid waste stream is transferred via a front loader emptying the contents into a de-packager for removal of inert and plastic waste streams captured in the outlet skips. The de-packager is capable of

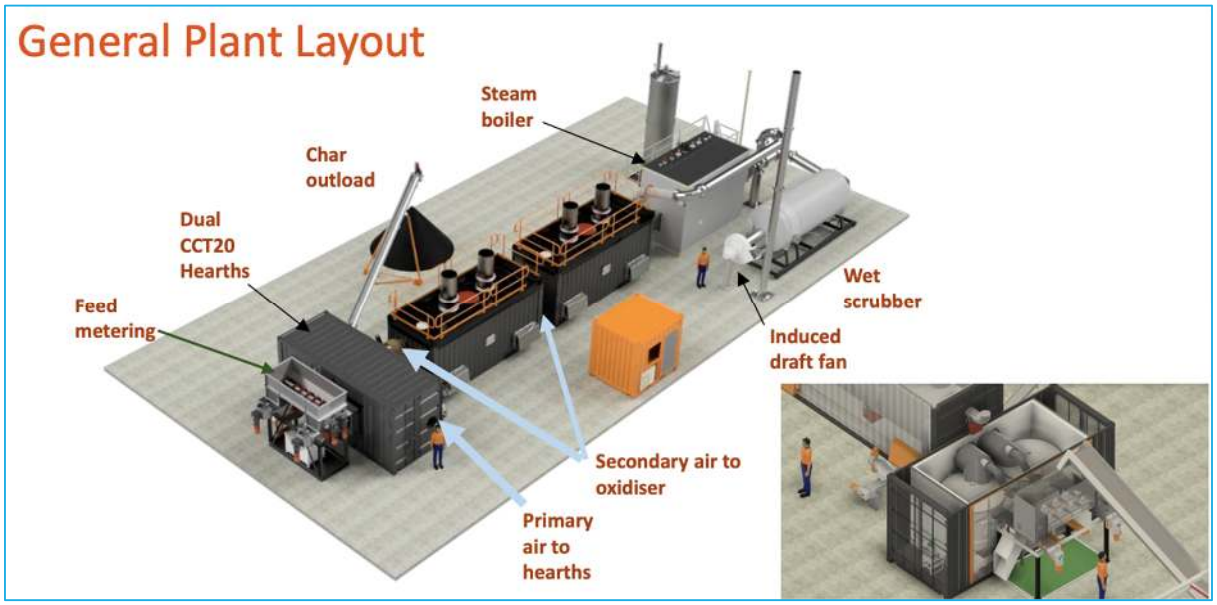
processing up to 12 tonnes per hour. Diluting the solid content with recirculated process liquor ensures a pumpable output as per the process flow and mass balance.

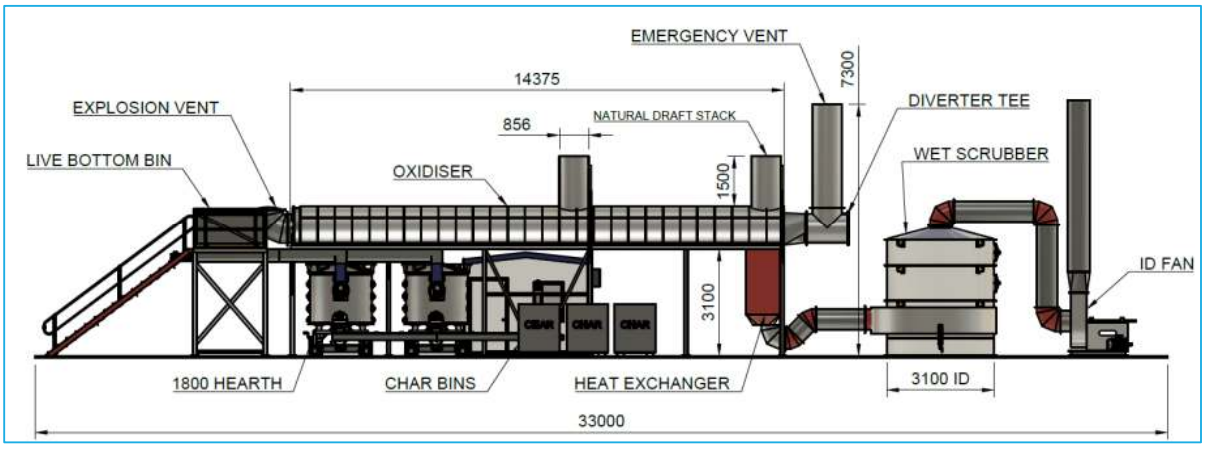
Product Recovery

The product recovery from the mechanical process can be segregated to process different waste streams ensuring a clean recoverable output can be recovered. Where the product cannot be recovered the output material will go to landfill. It is expected that circa 1% of material will not be able to be recovered from the input depending on the waste streams.

Receival of Biomass (stage 2) – for Biomass Heat Plant and Biomass Storage

The input material, is dropped off at the ~2-day storage bays (material bunkers) which have a volumetric capacity of 250m^3, with the option of drying to reduce moisture content - depending on quality of input stream. The operators will be able to inspect the input material and remove any problematic waste materials before being loaded into the process hopper. The image of a pyrolysis based thermal boiler plant below is illustrative only.





Odour Capture within the Receival Areas – Bio-filter

The receival area (or vehicle bay) for AD plant is under a slight negative pressure in order to remove and capture all odours within the building. This is sized to give 4-5 air changes per hour. The air is captured through the internal ducting system and transferred to a biological air scrubber for removal and cleaning of odour. The bio-filter is made from a suitable medium (commonly porous rock or possibly activated biochar) which is kept in a humid environment which is a habitat for odour eating bacteria and clean air. Noise suppression can be built into the design if required to comply with EPA requirements.

5.2.3 Digester – Pasteurisation Feed Tank

A Buffer Tank (700m3) is designed to hold incoming liquid wastes which is input at ambient temperature or above, on a 5-day basis, sized to allow for a daily increase in volume compared to outlet, allowing 365-day digester operation, this also allows for a more robust process if the pasteuriser is not operational for a short period of time.

The digester / pasteuriser feed tank is mixed by an in-tank agitator, ensuring a homogenous mix, keeping the solids in suspense ready for the output to the pasteuriser, based on an input waste stream of up to 15% dry solid content.

The digester / pasteuriser feed tank can be preheated by a closed loop heating circuit connected to the digester feed tank, recovering and reducing the digester feed temperature before being inputted in to the digester from the optional pasteurisation process, as per the process flow diagram.

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All pumps are vortex centrifugal chopper pumps reducing particle size for greater surface area as well as processing a higher percentage of dry solids.

5.2.4 Pasteurisation Tanks

The clean organic liquid feed is processed on an hourly basis from the buffer feed tank, this is based on up to 12m3 / hour 24-hour operation, utilising the surplus heat from the co-generation unit and biomass boiler. The process can handle up to 12m3/hour to allow for future expansion.

The clean digester feed is fed into a three tank pasteurisation system. The first operation is to fill and pre-heat up to 72degC, with the second phase held at 72degC for a period of 1 hour, while the third is emptying and pre-heating the incoming feed for tank 1. Tanks take one hour to empty, while the next tank is fed during the same time, allowing the heat from one tank to be transferred to the incoming materials (i.e. heat recovery and re-use). The design includes a goal of 50% heat recovery with the pasteurised materials released at around 45 C.

The retention for 50 minutes to heat from 25-30Deg C to 72 Deg C, allowing for full pasteurisation to the European PAS110 standards, reporting and holding each batch at over 70deg C for 1 hour, will ensure the meat waste pathogens (biological hazards) are removed and stabilised before transferring to the digester feed tank.

The process can be changed to pasteurise the outlet digestate if required, ensuring a full robust process. From analysis Biogass Renewables has conducted with in their lab they have found a shorter retention time by thermal treating waste streams pre digestion, gave a slightly higher breakdown and gas yield. This process will also assist in breaking down fats, grease and oils, by thermal treatment.

5.2.5 Anaerobic Digestion Process

The AD Plant is controlled from a main control centre (MCC) located in a container in the centre of the AD Plant area. Operation and control of the AD Plant process is provided by a programmable logic controller (PLC) in the MCC. Process status display and control parameters are monitored and adjusted via the MCC's human machine interface (HMI). The operation and adjustment of the HMI is by trained staff only.

The Anaerobic Digestion plant has two parallel feed systems; the first is dedicated to DONs, while the second serves the community wastes. The first treatment system is fully isolated to prevent any cross-contamination and tightly controlled. It provides the high standard of quarantine and treatment that AQIS and the EPA requirements for the DONs wastes. The treatment regime is regimented with all materials treated to a strict protocol and pumped directly into the Hydrolysis tank.

The community waste stream is flexible. The waste materials can be treated through a thermal pasteurisation process or simply macerated and pumped through to one of three storage tanks. The contents of these three tanks will be mixed blended for optimum biogas potential and then pumped to the Hydrolysis tank. Note that the image of a bioenergy plant below is illustrative only.

Hydrolysis Tank

The pasteurised materials will be fed into an acid phase tank for 5 days. This tank has a volume of 1400 m3 and commences the anaerobic digestion process. The feeds entering this tank will be warm, leaving the pasteurisation process at 45 C, so this tank will be insulated but is not expected to need heating.

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Main Digester Tank

Two 3500m3 primary mesophilic 38 degree C. digestion (tanks) process a set volume of blended feed every hour to achieve an appropriate continuous blend feeding system. Capable of processing up to 12m3/hour in each digester, the digesters are designed to process a up to 8 kgVS/M3/Day, with an expected digestion of 6kgVS/M3/Day – (kilograms of Volatile solids / digestion m3 / day) maximising the volume throughput to ensure ongoing growth of the bacteria in the digester tanks and subsequent production of organic acids into methane gas, carbon dioxide and water.

The main digester operates an external mixing maintenance and repair of mixing and heating systems without per the reference facility and heating system allowing for ease of draining the full content of the digesters as a part of the reference facility.

The Main Digester (tanks) is fed from the hydrolysis tank via the pre-calculated flow rate per hour that is set on the PLC by the AD Plant operator. This feed within the Main Digester is then mixed by three systems within each tank to ensure a homogenous blend of bacteria within the tanks. Each tank is monitored for a consistent temperature of the digestate and if required heat exchangers are activated to maintain a constant temperature between 37 and 38Deg C to maintain healthy bacteria growth.

The external mixing system has been designed for each of the Main Digester tanks to operate under the following methods.

- The directional mixing nozzle works by increasing the speed of the digestate at the bottom of the tank causing the contents to turn the tank.

- The venture mixing nozzle draws biogas from the roof space connection by creating a vacuum on the gas connection side, hydrolysing the digestate to improve gas yields and take off.

- The top mixing nozzle which enables the mixing of the tanks digestate through an actuated valve is utilised to break up any caking or crusting of the surface material.

The external heating system on each Main Digester tank has been designed to operate to the following parameters:

- The heating system is operational during normal operating process to ensure a constant linear heat transfer through the material ensuring a homogenous mixture within the digestate.
- Each Tank has a heat exchanger built into one mixing configuration, which is used to maintain and raise the temperature within the digester.
- Three (3) temperature measuring points are located on each tank which monitors the sludge temperature and hot water temperature.
- If the sludge temperature drops below a set value the hot water will flow around the heat exchanger when mixing pumps are running.

Operation of the Digester Discharge Tank

The digester discharge tank is fed hydrostatically from the main digester tanks. The digestate in this tank contains active bacteria that will decline over time, however will still produce methane gas that otherwise is fed back to the main digester gas space (dome). The spent digestate is mixed to ensure a constant blend of dry solids and liquid product.

Digestate Separation

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The dewatering stage takes the digestate and feeds it back (in to the receival area) for separation through a belt press, centrifuge or similar separator, separating the solid fraction from liquid. The odour is sucked into the odour control unit. The solid fraction is fed into the biomass plant for pyrolysis with the liquid fraction being sent to sewer through DONS existing agreement with Coliban Water. Based on the 2018 Feasibility Study (22,300 tpa of feedstock) the following outputs are estimated:

- Solids - 3,102T Digestate cake - Tonnes Per Annum @30% D.S
- Liquids - 15,578KL 1% D.S liquor - kLitres per Annum

Some of the water is recycled back into the food wastes which are otherwise quite concentrated. The project will seek to use this cleaned-up water at some point in the future.

Taking the sludge from the AD plant into the gasification/pyrolysis process enables a higher value product to be created, namely energy and biochar, whilst eliminating any potential biological risks associated with the digestate.

Liquor fraction typical characteristics

The digestate liquor fraction – Supernatant is made of the following characteristics, but will be dependent on feed input to the process.

Physical parameters of supernatant as tested from similar digestate:

If the liquor fraction is to be put to sewer, the ultimate recipient will be Coliban Water. They have specific requirements regarding COD/BOD and nutrients to be able to accept the liquor fraction of the digestate. A capex provision will be made for inclusion of additional wastewater (digestate liquor fraction) treatment to meet Coliban Water's specifications if required. Below is an outline of what is expected from the AD plant.

Physical Parameters **Sample No:** **Sample Description:** **Sample Date:**	**LOR**	**UNITS**	**17-06226-B-3** **W484B**
Alkalinity	5	mg $CaCO_3$/L	3,700
pH	0.1	pH units	8.2
Total Suspended Solids	5	mg/L	2,300
voltaile suspended solids	10	mg/L	
Biochemical Oxygen Demand **Sample No:** **Sample Description:** **Sample Date:**	**LOR**	**UNITS**	**17-06226-B-3** **W484B**
Biochemical Oxygen Demand	5	mg/L	1,400
Misc. Inorganics in Water **Sample No:** **Sample Description:** **Sample Date:**	**LOR**	**UNITS**	**17-06226-B-3** **W484B**
Chemical Oxygen Demand	10	mg/L	17,000

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5.2.6 Gas Management and Power Utilities

Biogas generated within the digesters is collected in the main digester headspace collecting up to 1200m3 of biogas storage on site, at 60-65%CH_4 and 35-40% CO_2. The digesters are under a small positive pressure to allow the biogas to flow out of the digesters to the gas management skid. This includes scrubbing to reduce H_2S contaminants to less than 50 ppm and no more than 1000ppm, and filtration to less than 5 ppm, and with water vapour to a due-point of 3C before it is boosted up to the operating pressure* – 100mbar (10 KPa) or higher - for piping to and consumption by either DON's gas boiler and/or cogen units.

This is a direct substitution of natural gas currently used in the boiler. *DON's require the biogas pressure to be between 30kPA and 500kPa, H_2S no more than 1000ppm, no free water, and O_2 less than 2%.

A 150KW internal reciprocating engine combined heat and power (CHP) generator will also consume some of the biogas to provide for parasitic loads of the bioenergy plant.

A flare is included in the design in order to safely dispose of any excess biogas - compliant with the gas code.

Design of the Gas Off-take Lines

The gas off-take digester lines are fed automatically from the gas levels within the primary digester tank No.1 and the discharge tank. The pressures within the digester tank (and discharge tank) are monitored by the PLC.

- The Off-take Lines on the Primary Digester Tank No.1 shall be monitored by the AD Supervisor to ensure that the gas flow is maintained at correct pressure and humidity content to either activate the Flare or CHP.

- The flow of gas from the primary digester tanks to the Off-take lines is at a normal operating rate when the gas reaches a pressure of 7 to 8 millibar.

    - The off-take lines will direct the gas into a dehumidifier to reduce the liquid content of the gas.

    - The off-take lines will direct the gas to a gas booster system, where the pressure of the gas will be increased from 8 millibar to 110 millibar for activation of the flare.

Design of the Combined Heat & Power Unit (CHP)

The electrical system has been designed with 1 x 150 KWe reciprocating combined heat and power units, designed to accept biogas with a high tolerance for H_2S. The 150 KW is sized to meet the parasitic load demands of the anaerobic digester and biomass plants.

The CHP unit is operational when biogas is produced by the digesters; the CHP unit can operate between 5-100% of its nominated range of 10 - 150 KWe.

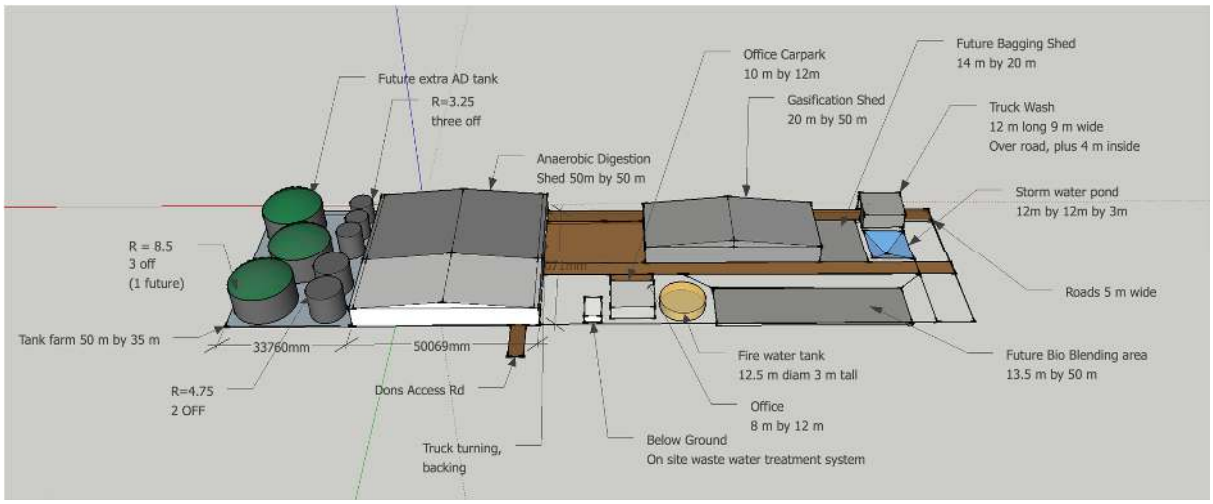
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Design of the H2S removal and gas clean up

H2S clean up within the biogas is managed by a chemical conversion of adding air in to the digester head space to give $H_2S + O_2 = SO_4 + H_2O$, which enables the SO_4 – sulphate to drop out into the digestate for removal. Further reduction, from 50ppm to less than 5ppm, is achieved with activated carbon filtration (or biochar) ready for input into Don's on-site boilers.

3D representation of proposed consolidated bioenergy plant NEED TO UPDATE

The schematic below provides a representation of the respective components of the integrated facility, including the biodigester tank farm, pre-treatments, receival halls, thermal plant, access roads and potential bio-fertiliser blending area.



6 BASIS OF DESIGN

6.1 DESIGN LIFE

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6.1.1 Operational Design Life

The operational design with regular routine maintenance has been designed for a 25 year design life period, to ensure the facility is fully operational for the period of the waste contract.

6.1.2 Structural Design Life

The infrastructure and concrete elements within the facility have been designed for a design life of 50 years, which subsequently means that the structure is design to safely withstand a 1/500-year storm.

6.2 DESIGN REDUNDANCY

The steel structures will offer design redundancy by providing multiple load paths, either through bracing systems or utilising the steel-concrete interface. Utilising an integrated footing system in the shed means there is a larger distribution stress, which manifests as further design redundancy.

The AD facility process design offers redundancy to ensure the total volume of waste, facility design – 30,000TPA can be processed with in the operational time for a standard operations.

6.3 SITE LAYOUT

6.3.1 Road Layout INCLUDE 2D PLAN VIEW SHOWING ROADS & BUILDINGS

The road will be a sealed bitumen road with crushed rock base course and select fill sub-base. The road layout has been designed to allow for little interference between incoming and outgoing vehicles off Richards Road, be they visitors or trucks ready to unload. The area in front of the shed provides adequate

room to manoeuvre the truck into place. The car park is situated away from the loading point to eliminate the interface between visitors and loading vehicles.

The waste will be delivered inside the shed(s) directly into bunkers which are appropriately separated to comply with biosecurity requirements. They can be used as an area for stockpiling up to four days of waste. The diagram below shows the site location and its proximity to major roads.

6.3.2 Signage

Adequate signage will be provided as per the requirements in the relevant acts and standards. Areas will be clearly marked with the appropriate signage for visitors and operators alike.

6.3.3 Tank Bunding

Tank bunding capacity of 3,850 m^3 has been included in this high-level design, and potentially used as a means to store up to 110% of the largest tank's capacity in case of a rupture or breach.

6.3.4 Drainage

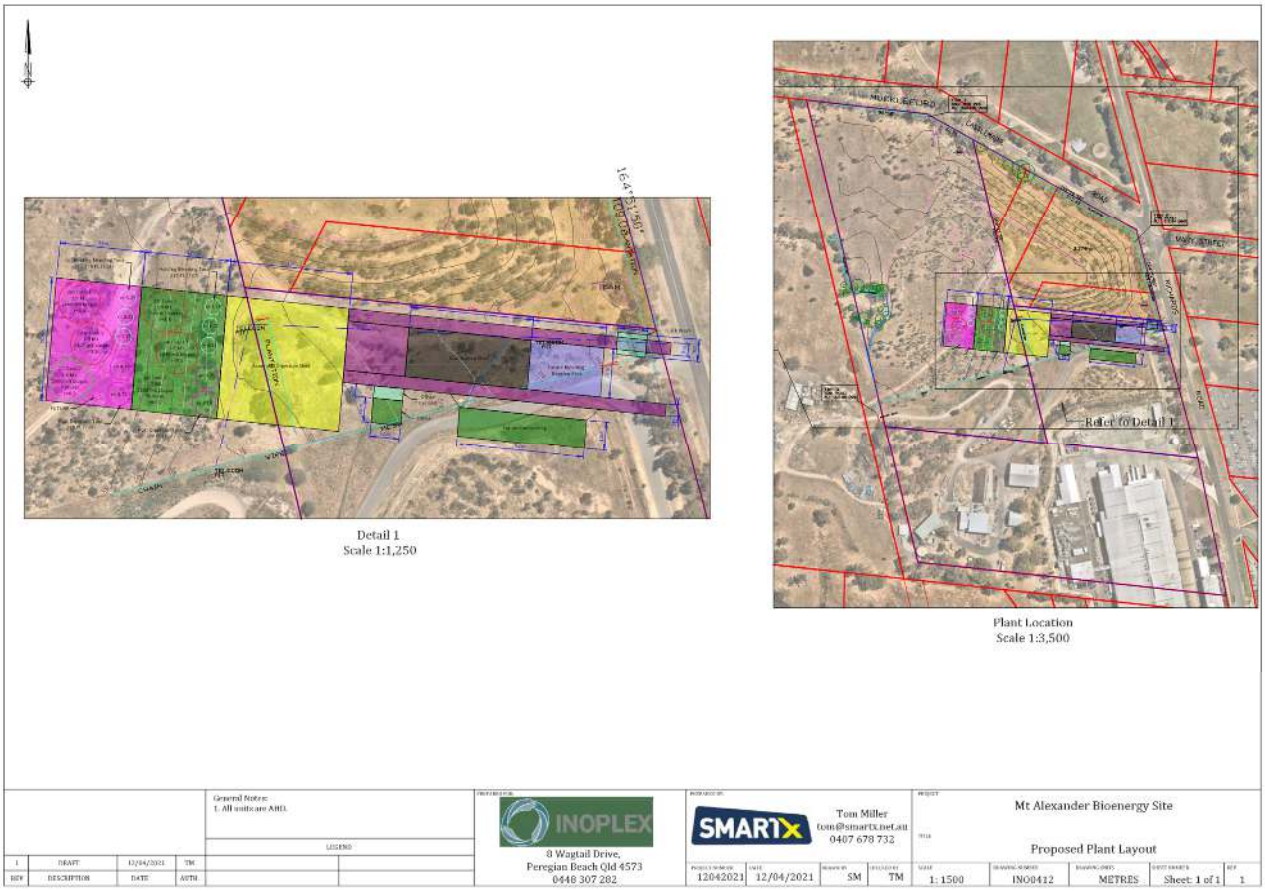
The water from the shed will be collected in a rainwater tank, whilst the surrounding bunded stormwater will be distributed across the site, running to a stormwater catchment dam prior to being released to the mains stormwater system.

6.3.5 Site Schematic INCLUDE DIAGRAM & UPDATE

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Shown below is the northern end of the land owned by Don KRC on which their smallgoods processing facility lies. This is classified as industrial zone (IN1Z and IN3Z). The total footprint of the proposed bioenergy site is between 10,000m2 and 12,000m2. Zone 3 lies to the north of the proposed site; it is generally considered as a buffer between heavy industrial and residential and is used to provide visual amenity or separation and will remain as such.

Accordingly the schematic below shows the currently proposed arrangement of the bioenergy site on IN1Z. This will be re-assessed during the detailed design stage.



6.4 EARTHWORK AND GROUND CONDITIONS (CHECK WITH THE GEO-TECH)

The proposed site (3ha) is on a parcel of industrially zone land to the north of the Don KRC factory. Earthworks will be required to level the site to provide a sufficiently large flat area to accommodate current and future needs as well as the various access and perimeter roads for trucks bringing the respective waste streams to the facility.

It is assumed that the earthwork contractors will sufficiently prepare the site to meet the following requirements. The foundations and footings with the facility require a minimum allowable bearing pressure of 200 kPa with a CBR of 7%. Allowance will be made to test the existing ground conditions to ensure it meets the design strength. Dependant on the geotechnical investigation, no allowance has been made to prepare the ground where it is shown to not meet the required specification. As a minimum, for a footing width of 2 m, the ground shall need to withstand 200 kPa at a maximum settlement of 5 – 10 mm.

6.4.1 Foundations

With the requirements set out above, the foundations for equipment, tanks and shed are one of the following:

- • Pad/strip footings
- • Raft footing
- • Ground slab with integrated thickenings

No allowance in the design has be made for concrete or screw piles as it is assumed that the ground conditions can be met.

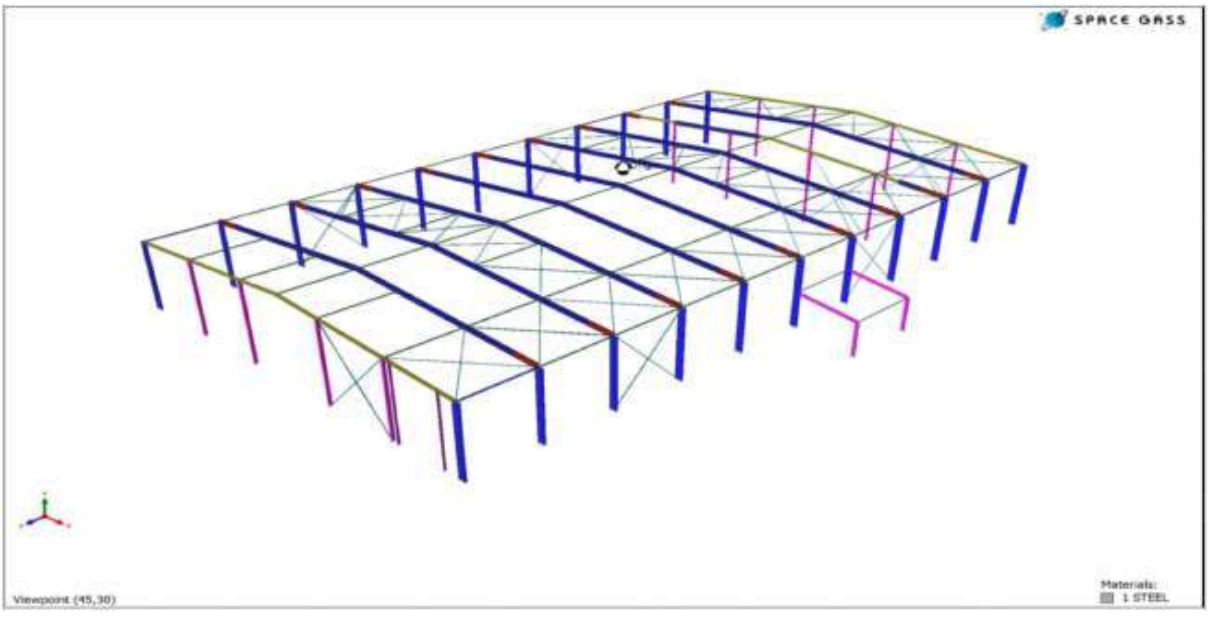
6.5 ORGANICS RECEIVAL SHED

The organics Receival Shed makes up majority of the structural work. The shed requirements is be an attractive steel portal frame building with Colorbond cladding and insulation. The concept designed focused on providing ample space to carry out the required process whilst also satisfying the following codes and Australian standards:

- Building Code of Australia and New Zealand
- AS/NZS 1170 – Structural Design Actions
- AS 4100:1998 – Steel Structures
- AS/NZS 4859.1:2002 – Materials for the thermal insulation of buildings
- AS/NZS 3500.3:2015 – Plumbing and Drainage

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The dimensions of the shed are 30 x 40m with additional coverage for pallet storage and a potential location for palletising the digestate. The layout of the receival shed includes 3m high bunkers in the inside of the building, there is in excess of 600 m^3 storage capacity (equivalent to four days of waste). The bunker walls are equipped with cast in steel to prevent damage from the loader



6.5.1 Concrete Slab

The concrete slab is reinforced with steel fibres to increase the spacing of joints and streamline the construction process by eliminating the need to tie 2,275 m2 of traditional reinforcement (rebar or mesh). The slab will also be epoxy coated to reduce the impact of the harsh chemical environment; the slab could be exposed to a pH as low as 3.

6.6 POTABLE WATER SERVICES

The Contractor will be providing a potable water storage tank (250 kL) for general facility such as truck wash down. It is assumed that for human consumption purposes reticulated mains water will be available.

6.7 FIRE WATER SERVICES

The Contractor will use mains town water to provide a fire water hydrant for use by the CFA. ~~in the RRF.~~

6.8 SEWAGE SERVICES

The Contractor will be provide a trade-waste connection directly to the sewer.

6.9 ELECTRICAL

It is envisaged the electrical supply to the facility will be from a spare circuit on an existing supply to the site to be metered, if the option for the generator is in place this will load follow the site to offset the power utilised on site at around 40kW. The plant switch room, will in turn provide power to the processing equipment within the facility. The connection may need to be bi-directional in future to allow surplus power to be supplied to the grid, however it is not an immediate requirement.

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6.10 COMMUNICATIONS

A suitable 4G will provide appropriate internet, wi-fi and telephone lines to the site to support remote and telemetry access.

6.11 SAFETY IN DESIGN

Safety in design will be completed in accordance with the relevant acts and standards. A risk register will be maintained to mitigate and control any risks identified throughout the design and construction phases for both stages 1 and 2; refer to Design Procedure for further details.

7 APPENDIX - CONCEPTUAL DESIGN (TAKEN FROM FEASIBILITY STUDY 2018)

The following schematics were based on available data from 2018. Two changes have occurred since then however the general principles are the same:

- The feedstock volumes from Dons have increased for the meat waste and slightly decreased for DAF sludge
- The energy output is no longer electricity and only biogas, and the large CHP plant has become a small (150kW) plant to only provide energy to meet the plant's parasitic load

Mass Balance for AD

High Level Mass Balance

Project Name	MASG - 30,000TPA Don's Facility	Document No:	J110-P100		
Project Number	J110 - Don's Option	Revision:	C		
		Date:	13/12/2017		
Project Section	Feedstock Analysis - Industry standard	Compiled By:	J Oliver		
		Checked By:			
		Approved By:	H Jolly		

Design Basis

	Units				
Waste Streams		**DAF Sludge**	**Meat Waste**		**Food Waste C&I**
Annual Throughput	TPA	2,800	900		18,197
Weekly Throughput	TPW	53.85	17.31		350
Daily Throughput	TPD	8	2		50
8 Hours /Day Input	TPHr	0.96	0.31		6.23
DM%	%	8%	32%		28.0%
VM%	%	89%	92%		89.0%
Density	Kg/m3	1,000	680		720.0
COD	Kg/m3	26.0	TBC		TBC
Biogas Yield	m3/ tonne	50	185		109.0
Methane Content	%	60%	60%		60%
Volitile solids	vskg/T	71.20	294.40		249.20
Biogas Production /yr	m3 / year	140000.00	166500.00		1983473.00
Biogas Production /hr	m3 / hour	15.98	19.01		226.42

Daily Load		Phase 1
Water input		0.00
Water recycled		
Total water input		0.00
Tonnes	tds/day	59.99
Tonnes of feedstock		59.99
Total Volume (m3/day)		59.99
Tonnes per hour - 8hours	tds/day	7.50

Blended Feed Characteristics

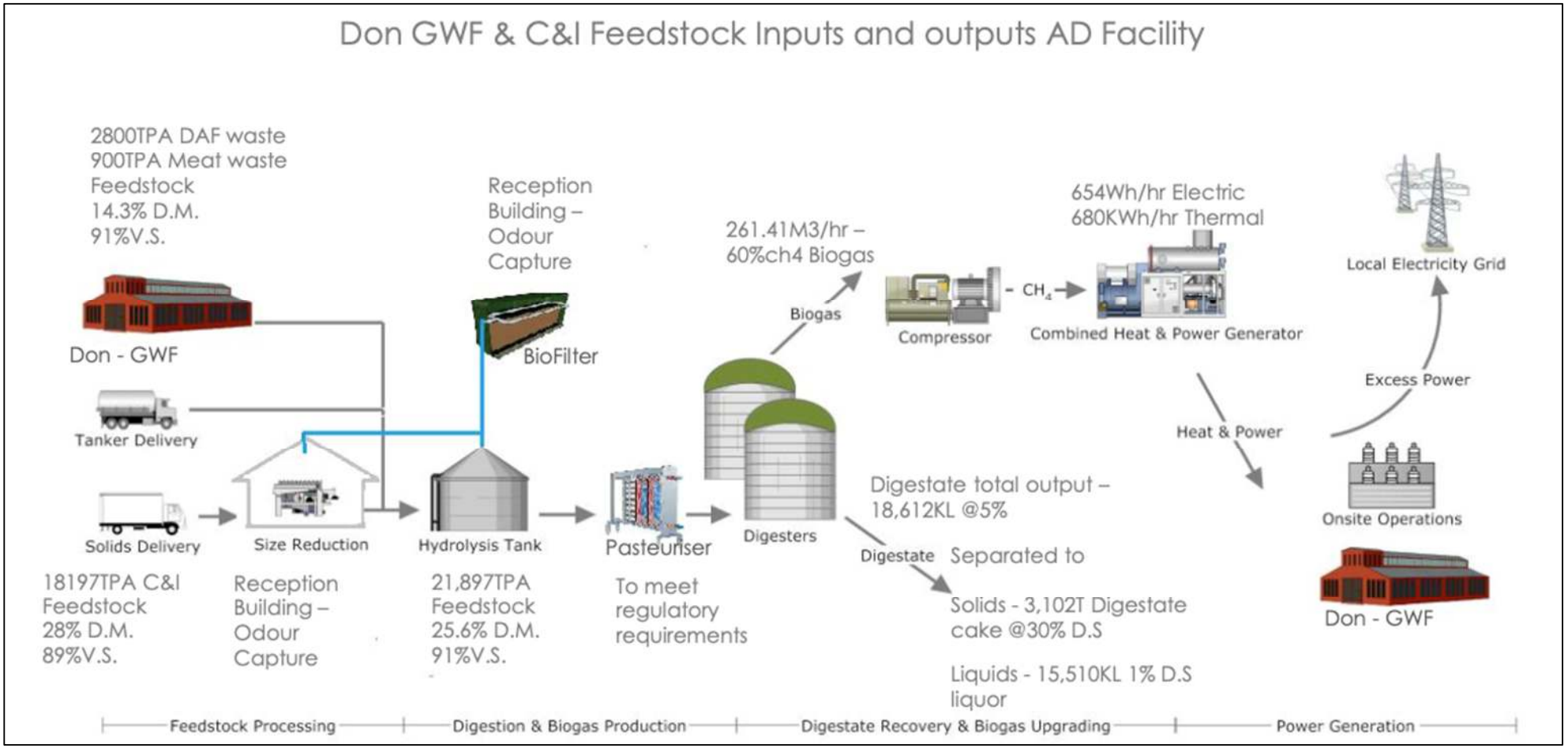
Dry Solids	25.6%	
Contaminant	2%	Assumed
Water	72%	

Operation

Days	Digestion	365	Days/pa
		Phase 1	
Total Annual Throughput		**21,897**	
KGVS/M3 / day		5.48	
Total Digestion volume		2,500	
Digestion Retention		42	
Total Digestion Capability at 30 Days Retention		30,417	
Digestion Spare Capacity at 30 Days Retention		39%	
Total Output @	5%	**18,612**	
Solids separated to	30% Tonnes / year	3,102	
	Tonnes / day	**8**	
Liquid fraction < 1% solids	m3 / year	15,510	
	m3 / day	**42**	
Liquid Recirculated	**m3 / day**	**0**	
Liquid Output	**m3 / day**	**42**	

		m3 / hour	m3 / Day	m3 / Year
Total Biogas / Hour		**261.41**	**6273.90**	**2289973.00**
Feedstock ave gas production / M3		**104.58**		
		KW / Hour	MW / Day	MW / Year
Biogas to Heat	KW thermal/hr	**1372.42**	**32.94**	**12022.36**
or				
Biogas to CHP	KW thermal/hr	**679.67**	**16.31**	**5953.93**
	KW Elec/hr	**653.53**	**15.68**	**5724.93**
		Kg/Hour	Tonne / day	Tonne / Year
	CO2 output	**239.98**	**5.76**	**2102.20**
or		**m3 / hour**	**m3 / Day**	**m3 / Year**
Biogas to biomethane	m3/hr-97%CH4	**133.32**	**3199.69**	**1167886.23**
			GJ/day	GJ/Year
Total GJ produced	GJ/Hour	**5.10**	**122.42**	**44683.25**

Process Flow Diagram for AD **WILL NEED TO UPDATE THIS**



WILL

Mass Balance for Biomass Thermal

The technology that formed the basis for the following mass balance is a boiler to electricity configuration (via ORC) however this has since been replaced by a pyrolysis-steam solution.

High Level Mass Balance

Project Name	MASG - Biomass	Document No:	J110-P200
Project Number	J110	Revision:	B
		Date:	04/12/2017
Project Section	Feedstock Analysis - Industry standard	Compiled By:	J Oliver
		Checked By:	
		Approved By:	H Jolly

Design Basis

	Units	Biomass			
Waste Streams		**Cardboard**	**ContaminatePlastic**	**Market Biomass**	
Annual Throughput	TPA	200	120	13,340	
Weekly Throughput	TPW	4	2	257	
Daily Throughput	TPD	0.548	0.329	36.548	
DM%	%	28.0%	28.0%	28.0%	
VM%	%	89.0%	89.0%	89.0%	
Density	Kg/m3	400.0	650.0	600.0	
Energy Yield	MJ/KG	15.0	32	16	
Biogas Production /yr	GJ / year	3000.00	3840.00	213440.00	
Biogas Production /hr	GJ / hour	0.34	0.44	24.37	

Daily Load

M3 Volume input / day	M3/day	64.53
Tonnes of feedstock	tds/day	37.42
Tonnes per hour - 8hours	tds/day	4.68

Operation

Days	Digestion	365	Days/pa
		24	hrs
		Biomass	
Total Annual Throughput		**13,660**	
Total Output @	1.5%	**205**	Tonnes

		GJ/ hour	GJ / Day	GJ / Year
Total GJ Hour		**25.15**	**603.51**	**220280.00**
Feedstock ave GJproduction / tonne		**16.13**		
		KW / Hour	MW / Day	MW / Year
Biomass to Heat (boiler)	KW thermal/hr	**5580.43**	**133.93**	**48884.54**
or				
Biomass to CHP	KW thermal/hr	**4526.30**	**108.63**	**39650.40**
	KW Elec/hr	**502.92**	**12.07**	**4405.60**

Process Flow Diagram for Biomass Thermal NEED TO UPDATE

