final report

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Investigation into Resource Recovery, Including Biogas Production, Harvey Beef Abattoir (WA)

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Abstract

This report includes the preliminary design of the biogas facility and the upgraded wastewater treatment plant, as well as a Business case for Harvey Beef to invest in a solution towards resource recovery, mainly Biogas. The preliminary design includes opportunities for recycled water and biogas production from mixed solid waste streams at Harvey Beef. Based in previous reports and technical discussions, we have confirmed the design assumptions considering two separate streams, solid and liquid, processed separately.

The liquid stream will be treated at the upgraded effluent treatment plant, aiming the removal of oil & grease, solids and organic matter, as well as nitrogen and phosphorous. While selecting the technology for the liquid stream treatment, we have prioritised the recovery of water with adequate quality for irrigation, and also a combination of engineered processes and natural processes (lagoons). The aim was to find a balance between energy-intensive processes and natural, passive, systems. The proposed concept provides a robust solution, whilst keeping operation and maintenance costs as low as possible without compromising the treated water quality.

The solid waste, the excess sludge and the processing residues will be processed in an anaerobic digester, aiming to produce biogas and bio-fertiliser. There are several possible configurations for the AD process, and we recommend running lab scale tests to obtain more accurate design parameters. The tests would also allow for us to explore the best alternatives to manage nitrogen levels, including process additives, mixed wastes, controlled temperature, etc.

Next steps include the detailed design of the upgraded wastewater treatment plant, based on further sampling results, and preparation of methodology and proposal for lab scale testing.

The successful implementation of the biogas and resource recovery project will bring the following benefits to Harvey Beef and to the wider Australian red meat industry:

Environmental	Social	Economic
• reduced discharge of solid wastes to landfills and/or environment. Increased levels of compliance for liquid wastewater disposal (irrigation, water reuse).	• reduced complaints regarding smells around the WWTP, opportunity of employment of more skilled operators, increased level of knowledge. Improved perception of the industry as "environmentally friendly"	• benefits from partially replacing the use of natural gas, reduced dependency on external energy price fluctuations. Preliminary feasibility analysis shows a positive NPV along the project life cycle. It is estimated that each ton of slaughterhouse waste mixed will result on around 250 m^3 of Biogas.

The financial analysis showed that the costs for upgrading and operating the wastewater treatment plant would be offset by 75% when considering the recovery of biogas, including mixed solid waste. The gas production is equivalent to 40-45% of the natural gas consumption at the processing plant, and the plant could become self sufficient if importing organic waste from external sources (food and beverage industries).

This is a summarised version of the full report; all confidential information was removed for the open version.

3D perspective of the proposed WWT

There are clear market signals in our high value international markets that emissions from livestock production are an issue for consumers who are also increasingly interested in the provenance of their food," – Richard Norton , Managing Director MLA

Executive summary

Harvey Beef has a range of valuable by-products currently being disposed via composting and/or landfilling. Taking a holistic approach on the waste and wastewater management in the plant can offset considerably the investments required for long-term environmental compliance.

The design approach used in this report was based on combination the most recent knowledge available both in Australia and in Europe, and the design assumptions were carefully selected based on plants that have been operating for over two decades in Europe and other sites in Australia.

The liquid stream will be treated at the upgraded effluent treatment plant, aiming for the removal of oil & grease, solids and organic matter, as well as nitrogen and phosphorous. The proposed design will ensure the effluent consent will be met consistently in the next years of operation.

While selecting the technology for the liquid stream treatment, we have prioritised the recovery of water with adequate quality for irrigation, and also a combination of engineered processes and natural processes (lagoons). The aim was to find a balance between energy-intensive processes and natural, passive, systems. The proposed concept provides a robust solution, whilst keeping operation and maintenance costs as low as possible without compromising the treated water quality.

The solid waste, including the DAF reject, the excess sludge and the processing residues will be processed in an anaerobic digester, aiming to produce biogas and bio-fertiliser. There are several possible configurations for the AD process, and we recommend running lab scale tests to obtain more accurate design parameters. The tests would also allow for us to explore the best alternatives to manage nitrogen levels, including process additives, mixed wastes, controlled temperature, etc.

Based on the more financial analysis, it is recommended to proceed to detailed design stage, to both optimise the wastewater treatment plant, and to obtain a higher degree of certainty on the biogas plant approach. The biogas plant as designed in this report has the potential to provide for 100% of Harvey Beefs gas requirements, if bringing waste from other facilities is considered in the matrix.

In short-term, the next steps include the detailed design of the upgraded wastewater treatment plant, based on further sampling results, and preparation of methodology and proposal for lab scale testing.

Table of contents

1 Background

1.1 Milestone 4 Description

The Milestone 4 report (Final Report) presents Business case for Harvey Beef to invest in a solution towards resource recovery. The concept design has taken into consideration the production of recycled water and the production of biogas from mixed solid waste streams at Harvey Beef. The business case includes the preliminary design of the biogas facility and the wastewater treatment plant and presents recommendations on the implementation and staging approach.

2 Project objectives

The overarching objective of this project is to deliver a summary on the detailed investigation into biogas production, capture, and use for energy purposes at Harvey Beef facility near Harvey, WA. The focus of this work is to delineate the concept of a resource recovery facility, aiming to produce biogas from mixed solid waste, recover water for irrigation and/or other uses, whilst complying with environmental regulations. The specific objectives of the Final Report are:

Producing a Preliminary Design
The preliminary design will determine the main characteristics of the equipment and ancillary structures (sizes, requirement for heating systems, estimate of efficiencies), and will serve as a basis for cost estimate. The preliminary design deliverables are presented in Figure 1.

Figure 1. Preliminary design deliverables. WWTP and Biogas plant.

Business Case

The preliminary design served as a basis for a high-level cost estimate, used to produce the business case, including a more accurate assessment of the next stages of the project, including procurement, construction and commissioning.

3 Success in Meeting the Milestone

Milestone 4 was successfully achieved, including the completion of the business case for Harvey Beef to invest in a solution towards resource recovery, including recycled water and biogas production from mixed solid waste streams at Harvey Beef. The business case included the preliminary design of the biogas facility and the wastewater treatment plant. The concept presented in the preliminary design was discussed with Harvey Beef, and approved in Milestone 3 report.

The preliminary design confirmed that producing Biogas is potentially an attractive option from the financial point of view, offsetting the total WWTP costs by 75% over the 20 years project life.

4 Design Drivers and Technology Selection

Harvey Beef's wishes to upgrade their wastewater treatment plant and explore opportunities identified for using a resource recovery approach, enabling a stream of revenue to be generated from the biogas produced from the waste and wastewater management processes.

The design drivers considered a balance between maximising resource recovery, while producing a robust outcome in terms of nutrient removal. The process was designed combining engineered solution for N and P removal, followed by polishing in the existing ponds. The concentrated streams from the treatment plant will be used to generate biogas. The solid waste streams can be incorporated in a second stage, increasing the revenue from biogas production.

The technology selection has taken into account the need for nitrification/denitrification to happen in low carbon concentrations, which results in relatively higher detention times. Safety was accounted for fluctuations both in quality and quantity of wastewater to be treated. The proposed system will allow for operational flexibility, via aeration, recirculation and chemicals dosing.

5 Basis of Design

5.1 Approach

5.1.1 Construction

The upgrade of the WWTP and construction of the new Biogas plant are a brownfield development and must be planned aiming to avoid or minimise any impact on existing Harvey Beef operations and processes. We have considered modular construction, with the majority of equipment being fabricated or built off site. The new upgraded plant will run in parallel to the existing one, allowing for time for commissioning and plant start up. Our design also allowed for minimising impact on existing tree coverage, and no disruption of the existing landscape and natural features.

5.1.2 Operational Strategy

The system designed considering the upgraded WWTP will be an unmanned site, with remote upervised operation. Routine operation and checks will continue to be performed by HB personnel, and specialist remote operation assistance will be made available to HB to deal with required

changes and adapting to seasonal conditions. Basic automation is proposed, aiming to maintain the process operating with no interruptions, and generating alarms when required. We have considered a self-contained site, with separate access to the site, allowing for its servicing and operation independent of HB production days.

5.2 Site Description

Harvey Beef is located 130 km south of Perth in the town of Harvey. The site comprises of 190 ha of land, mostly by pastures and other crops. The region has a Mediterranean climate experiencing dry summers and wet winters. The mean maximum temperature ranges between 17.2°C in June and 30°C in February. The average annual rainfall for the region is 726.1 mm (www.bom.gov.au) with the majority falling between May and September.

Figure 2. Harvey Beef site aerial view.

Harvey falls into the Pinjarra Zone mainly made up of Pinjarra Plain and the Ridge Hill Shelf. The area is generally flat, poorly drained alluvial plain with a variety of soils including grey deep sandy duplex soils, brown shallow loamy duplex soils and cracking clays.

The proposed site of the wastewater treatment plant is generally flat with minimal elevation. Effluent transfer will happen via pumping when gravity transport is not possible.

5.3 Wastewater Design Parameters

Historical data and composite sampling analysis were used to define design input parameters. The Waste characterization study was performed in Report 1 (Milestone 2). Report 2 (Milestone 3) summarized and compared several international innovative projects and industry best practices developing the concept design.

Wastewater discharged from the processing facility will be treated using a resource recovery approach whilst maintaining robustness and operational flexibility. The proposed system uses physical, chemical and biological processes for high levels of removal of BOD, Suspended Solids, Oil & Grease, Nitrogen and Phosphorous before being irrigated to pastures.

5.3.1 Exiting Treatment Plant

The Wastewater treatment plant has been designed for an average flowrate of 1,500 kL/day and maximum flowrate of 1,700 kL/day. Wastewater quality is equivalent to the average industry values.

The existing wastewater treatment plant consists in a series of ponds that will remain in operation until the new WWTP is online. The ponds will remain as safety and storage for treated effluent before final discharge via irrigation. It is recommended all ponds undergo a condition assessment to check if refurbishment is required to the banks and liner.

6 Wastewater Treatment Plant Process Design

The sections below describe the rationale behind the design of the different process operations in the WWTP.

6.1 Pre-treatment

Rotary Screen

Process wastewater generated from the processing facility is drained into a rotary screen. The rotary screen removes the bulk of solids reducing the load on the downstream treatment system. The existing rotary screen is assumed to be sufficient for current processing capacity and will remain in operation.

Screw Conveyors & Bins

Retained solids are transferred using a screw conveyor and collected in skip bins. The existing screw conveyor and bins will remain in operation. Solids collected in the skip bin will be transported to the solids receiving area proposed at the Biogas plant site.

Transfer Pump Station

A transfer pump is required to transfer screened wastewater to the downstream treatment system. The existing pump station is adequate to transfer screened wastewater to the existing Save-all/DAF, however it is recommended to assess the capability of the existing pump to transfer wastewater to the proposed WWTP location, due to higher total head. If required, a new pump and guide rails can be installed into the existing pump station tank during non-processing days as to not impact on processing. A new pipeline is required to direct screened wastewater to the new Buffer tank.

Buffer Tank

A new Buffer tank will be installed to receive the screened wastewater for analysing pH for further adjustment and control of hydraulic flow into the new treatment system, avoiding flow fluctuations.

Dissolved Air Flotation

The DAF will receive a higher wastewater flow from the Buffer tank during processing days (5 days/week), and a reduced flow on non-processing days (2 days/week). A chemical dosing skid will be part of the DAF system and includes pH adjustment, coagulant dosing, and polymer dosing all via static mixer in the inlet pipeline. A recirculation pump will feed treated water for the air saturation system.

6.2 Nutrients Removal

6.2.1 A_2O Phoredox Reactor

The A_2O Phoredox (anaerobic, anoxic and aerobic) reactor offers a robust solution for nutrient removal, with high levels of operational flexibility. The system is designed for concentrations of BOD, SS, Nitrogen and Phosphorous removal without the need for chemicals addition. The proposed reactor is designed as a 3-stage modular reactor composed of an anaerobic stage upstream followed by pre-denitrification (conversion of nitrate into gaseous nitrogen) and nitrification process (oxidation of ammonia to nitrite and then to nitrate). There are two recirculation lines in the system:

a) activated sludge return line from the secondary clarifier to the anaerobic stage;
b) recirculation from the aerobic stage back into the anoxic stage to maximise denitrification/nitrification.

Design Assumptions

The system has taken into consideration a robust, efficient and yet conservative design

The anaerobic stage main design function is for Phosphorous removal. A sealed covered steel tank with wastewater grade liner is proposed for the Anaerobic tank.

The second stage of the process (anoxic) is designed for the denitrification process, by recirculating nitrates from the outlet of the aerobic stage. A steel tank with wastewater grade liner is proposed for the Anoxic tank for the pre-denitrification stage.

The aerobic reactor is responsible for most of the BOD removal and for the nitrification process. The tank requires an aeration system to meet oxygen requirements (nitrification and BOD degradation). The aeration system will use air diffusers installed at the bottom of the tank.

The internal recirculation system has been designed with a 100 to 400% recirculation rate requiring three centrifugal pumps. The system will also require a sludge recirculation pump with a capacity to deliver a 50 to 100% recirculation rate.

6.2.2 Dissolved Air Flotation

A secondary package DAF system is proposed to separate the sludge from the clarified wastewater in the biological nutrient removal stage. The process has a smaller footprint compared to a conventional secondary clarifier. The DAF allows a higher application rate and significantly more operational flexibility, via recirculation rates and coagulants/ polymer dosing possibilities. DAF is also very effective in summer time when sludge tends to naturally float to the surface.

A chemical dosing skid will include coagulant and polymer dosing all via a static mixer into the inlet pipeline. A recirculation pump will feed treated wastewater for the air saturation system.

Part of the thickened sludge will be recirculated to the system, and the excess sludge will be sent out to the biodigester. The clarified effluent will be transferred via centrifugal pump to the next stage of the treatment in the stabilisation ponds.

Expected Performance

The minimum expected treatment efficiency of the 3-stage reactor and secondary DAF is: BOD > 90%; TSS >95%; TN>70%; and TP >70%.

6.3 Maturation Ponds

The existing ponds will be utilised as Maturation ponds a tertiary treatment step aiming to improve effluent quality and serve as a buffer for process fluctuations and high rainfall periods. The current Anaerobic pond will remain on-line until the proposed system is completely in operation. After the commissioning period, the pond will be taken off line for de-sludging to be converted to an emergency storage pond.

6.4 Storage Pond

Treated wastewater will be retained in the storage pond until required for final discharge via the existing irrigation system. It is assumed that no modifications to the existing storage pond or irrigation system are required.

7 Biogas Plant Process Design

The sections below describe the rationale behind the design of the different process operations in the WWTP.

The proposed integrated resource recovery process requires a solids/slurry receiving facility upstream of the biogas plant. The tank/s allow the system to support feeding flow variations from the production plant and high peaks of water consumption (e.g. yard cleaning carrying manure). Homogenizing the solid waste is necessary for process stability in the digester.

A solids receiving area and two buffer and blending tanks will be installed allowing separation of different residues types e.g. slurry; manure; and other types of biomass (paunch and fat content).

The transport from the solids receiving area to the blending tanks will be made through horizontal and inclined conveyor belt. A portion of the sludge from the wastewater treatment plant will be directly pumped into the blending tanks in order to dilute the biomass, achieving the desired Total Solids content for feeding the biomass. The blending tanks allow different solid waste generated in the wastewater treatment process to be mixed in the desired ratios increasing the biogas production in the anaerobic digester. The solids receiving area and blending tanks are covered.

A second function of blending tanks is to promote the partial hydrolysis of the material, making the digestion more efficient. During hydrolysis, long-chain molecules, such as protein carbohydrate and fats, are broken down to smaller molecules (monomers).

Design Assumptions

The solids receiving area was designed to receive approximately 1.5 days of solid waste generated in the process, resulting in an operational volume of 72 m^3. The receiving area will be constructed of concrete and be covered by an open walled roof.

Blending tanks were designed to have a minimum of 2 days retention time, resulting in a volume of 100 kL for each tank with 6.5 m diameter and 3.5 m height. The tanks will be sealed for odour prevention. Mechanical mixers with and heating system will be installed in the tank in order to keep the fat content in a liquid phase.

From the blending tanks transfer pumps with open impeller will be utilized to transfer the blended content into the digesters with minimal capacity of 2 m^3/h and power rating of 4 kW.

7.1 Anaerobic Digester & Biogas Storage

Two continuous stirred tank reactors (CSTR) has been designed as anaerobic digesters working in parallel. The digesters will receive solids content from the blending tanks with a total solids concentration up to 15%. The proposed design allows operational flexibility to the facility for processing all the solid waste produced in the wastewater treatment plant including: solids from the rotary screen, fats and solids from the DAF, and excess activated sludge. The system has been designed for operating at mesophilic conditions where bacteria are less sensitive to temperature variations.

The hydraulic retention time (HRT) is 30 - 40 days in order to promote a high removal rate of organic content (80 to 90%) optimizing biogas production and reducing remaining volatile solids.

The digesters will be sealed to maintain anaerobic conditions. To ensure continuous stirring in the digesters, two paddle mixers will be installed. The paddle mixers prevent crust formation at the surface and also mix the bottom to prevent deposition of inorganic material.

The produced biogas will be stored in a double dome on top of each tank. The biogas will be used to feed the existing boiler. A de-sulphurising system will be implemented for cleaning the biogas usingferric chloride (added in the feeding stream). A gas pipeline will be used to transfer the gas from the Biogas plant site to the boiler.

The biofertiliser produced from the anaerobic process will be directed to a sludge handling facility and to a biofertiliser storage tank. The biofertiliser tank will have an operational volume of 100 kL and designed for 1-day retention time. The quantity of biofertiliser to be directed to the sludge handling facility will vary according to the desired solid contents for land application. External tanker trucks will be required for transport of biofertiliser off-site.

Considering the preliminary design assumption and using both streams (solid and liquid), the biogas production estimation is shown in the Table 1.

Table 1. Estimated biogas production from Harvey Beef's Sludge and Solid Material.

Parameter	Solid Waste
Hydraulic Retention Time	30 - 40 days
Reactor Temperature (˚C)	37 - 42
BOD Removal Efficiency	80 - 90%
Methane Production (m^3/Month)	84,700 - 135,500
Annual Energy Production From Internal Wastes (GJ)	**44,000 – 80,800**

The estimated energy produced from Harvey Beef's own materials range from around 40 to 45% of the plant's needs. If additional biomass is imported, Harvey beef can become self-sufficient in terms of gas supply using the proposed configuration.

8 General Considerations

8.1 Access, Security and Lighting

The plant layout considers separate controlled access from the main Harvey Beef site to the wastewater treatment plant. The site access road typically allows for one-way vehicle movements around the main process elements and a two-way access linking to Seventh Street.

Pedestrian access paths from the main control room / office have been allowed for to enable operators to easily access key mechanical / process components such as the DAF units, pumps and mechanical mixers. All pedestrian paths and access roads are considered as unsealed crushed limestone.

The site is secured via the provision of a lockable gated entrance and continuous chainmesh boundary fencing with razor wire on top. No CCTV security monitoring or manned security is assumed at this stage.

Flood lighting is minimised to the key operational areas such as the DAF units, blower house and control room / office. Flood lights are assumed to be building mounted and operated on an 'as required' basis. Lighting of access roads and general site areas has not been included at this stage.

8.2 Site Services

8.2.1 Potable Water

It is assumed that a new potable water supply will be taken from Seventh Street with individual metering to service the WWTP. A 50mm service connection has been assumed at this stage. Potable water typical site demands will include Fire hydrants, Chemicals preparation/dilution, Safety showers and eyewash stations and Wash down facilities/toilets.

There may also be a requirement for potable water in some treatment processes. This will be determined at detailed design.

8.2.2 Sewerage

Welfare facilities (shower and toilet) are provided in the office / laboratory. A gravity sewer and septic tank disposal method has been included to treat the small volumes of wastewater produced from these facilities.

8.2.3 Communications

The treatment processes will typically run in auto mode. The ability to remotely operate the plant and see alarms will be essential considering the site will not be manned 24 hrs. At this stage, wireless (3G/4G) communication is assumed and no hard-wired communications connections (Telstra/NBN) are included.

8.2.4 Electrical

It is assumed that a new 3 phase 400V power supply will be taken from Seventh Street which will include individual main site switchboard and metering for the WWTP. At this stage, no plant load calculations have been completed.

In the event of mains power failure, an allowance has been made for the provision of a small backup generator to partially power essential site components such as control systems, recirculation pumps, blowers and mechanical mixers.

8.3 Earthworks and Drainage

The selected site is gently undulating. With high groundwater levels and soil strata with likely low permeability, direct infiltration of storm water will be limited. The concept design assumes limited additional areas of impermeable hardstand to avoid the creation of large volumes of storm water runoff. However, some runoff is anticipated and therefore a basic system of open channel v- drains/swales and shallow detention basins has been included to limit the impact of the development of the surrounded drainage systems and land use.

The main process components will be raised marginally above surrounding ground levels and storm water will be directed towards drainage swales.

8.4 Fire Protection

A fire detection system for the main building complex (blower room, control room, office) has been included with the provision of smoke / heat detention, appropriate alarms and emergency lighting and exits.

In terms of fire-fighting systems, provision of hydrants to cover the key equipment has been included. Hand held fire extinguishers will be provided in buildings and near to equipment as required.

No gas detection systems have been included at this stage however this will require further consideration depending on the final layout of the gas collection, storage and transfer system arrangement.

8.5 High Level Control Philosophy

It is anticipated that the control philosophy will incorporate the following components:

- Online field instruments will to control parts of the process.
- Systems will be controlled centrally integrating control from individual equipment units.
- Alarms (system / process monitoring) will be available as remote notifications.
- Some remote system control will be provided for key equipment.
- Auto shut down will be incorporated to avoid overflow.

The system will require attendance by operators at intervals to address the root cause of alarms, check on performance and carry out routine maintenance. Remotely Assisted operation can be an effective option to maintain the plant operating efficiently.

8.6 Chemical Storage and Delivery

Chemical storage will be required at both DAF units. This will include appropriate separation and bunding of individual chemicals. Chemical storage is considered in the form of Intermediate Bulk

Containers (IBCs) with overloading via forklift or vehicle mounted loader (Hiab). No bunded delivery areas have been included at this stage and should be considered as part of a hazardous goods risk assessment during the detail design phase.

8.7 Safety in Design

A preliminary review of hazards has been completed which will form the basis of the safety in design risk assessment.

8.8 Approvals

The new WWTP will require a granted works approvals before construction and amendment to existing DER licence prior to operating the new WWTP as set out under Part V, Division 3 of the *Environmental Protection Act 1986.*

Target approval timeframe of application is 60 days for works approval, Licences and significant amendments.

The proposed WWTP will remain under Category 54 according to prescribed premises set out in Schedule 1 of the *Environmental Protection Regulation 1987*.

In accordance with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974* of Western Australia, approval by the Department of Health is required via application to the Local Government Authority. The proposed system will treat up to 1714 kL/day and therefore in addition to the application, an independent third-party engineering certification will be required to ensure the design and performance. The DoH also requires prior approval from the DER before finalising application.

9 Implementation Staging

9.1 Construction Staging

Three different scenarios were modelled:

Scenario 1: Build only the Wastewater Treatment Plant (WWTP) aiming to comply with regulations in terms of N and P. This is the base case scenario, not considering biogas production, and considering the upgrade investment costs, plus the O&M costs along 20 years.

Scenario 2: Build the WWTP and a biodigester for the wastes produced at the WWTP and selected solid waste from production line. In this scenario the Stage 1 biodigester would be installed and operated as part of the WWTP. The estimated biogas yield is equivalent to 40-45% of Harvey Beef's consumption, depending on the wastes selected to feed the digester.

Scenario 3: Implementing the WWTP and Stages 1 and 2 digesters, including wastes from nearby sources (e.g. food waste, juices, expired beverages, etc.). In this scenario Harvey beef could become self-sufficient in terms of energy consumption.

The development of the WWTP and biogas plant is anticipated to be staged.

<u>Initial Stage (Scenario 1)</u>

The initial stage considers the development of the WWTP to improve separation of liquid and solid waste, improve effluent quality and allow for future increased loading to accommodate the increased capacity anticipated at the abattoir.

In the initial stage approximately 50% of the site will be developed.

Interim Stage (First Biogas Plant)

The interim stage considers the development of a single digester, feed tanks, sludge receival area, sludge handling equipment and bio fertilizer storage area. This will enable production of biogas from the high-energetic value by-products generated on WWTP site.

In the interim stage, roughly a further 30% of the site will be developed (80% in total).

Ultimate Stage (Second Biogas plant)

The ultimate stage would see an additional digester constructed on site which would allow the acceptance of the totality of the solid wastes produced in Harvey Beef, and potentially accept high carbon-based materials from third parties as well as facilitating an increase excess activated sludge.

9.2 Preliminary Project Schedule

The following project schedule cover the development and implementation of the Initial Stage only.

Table 2 Project Schedule

Item	Activity	Duration (months)
1	Further Sampling and Biogas production, and site investigations	3
2	Detailed Design	6
3	Statutory Approvals (LGA, DoH, DWER)	4
4	Major Equipment Procurement	4
5	Tendering and Engagement of Contractors	2
6	Construction period (interim stage only)	9
7	Commissioning	2
8	Plant performance verification (assisted operation)	12
	Total	**42 months**

Note: Cost estimates are considered confidential and were not included in this report.

10 Conclusions and Recommendations

Harvey Beef has a range of valuable by-products currently being disposed via composting and/or landfilling. Taking a holistic approach on the waste and wastewater management in the plant can offset considerably the investments required for long-term environmental compliance.

The design approach used in this report was based on combination the most recent knowledge available both in Australia and in Europe, and the design assumptions were carefully selected based on plants that have been operating for over two decades in Europe and other sites in Australia.

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In short-term, the next steps include the detailed design of the upgraded wastewater treatment plant, based on further sampling results, and preparation of methodology and proposal for lab scale testing.