FINAL REPORT

Value –Adding to Carnarvon Horticultural Produce: Ideation, Innovation, Market

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EXECUTIVE SUMMARY

This report and associated appendices summarises a research project to assess the pre-feasibility of processing Gascoyne horticultural out of grade and seconds product to produce ingredients for food service and institutional catering.

The project had several phases as summarised below.

a. Literature review and market assessment for aligned products.
b. Whole of chain consultation to initially determine possible products and define opportunities and barriers and later to define the most technological and economically feasible products for detailed investigation.
c. New product development trials in commercial facilities to understand feasibility of production, processing recoveries, packaging options and quality issues.
d. Investigation to determine the volumes of product that might be available for processing.
e. Design and costing of the processing facility.
f. Cost benefit analysis.
g. Reporting.

It is noteworthy that the framework developed can be easily transferred to other communities, products and sectors.

Approximate Raw material availability was calculated based on three forms of waste: packing shed discards; seconds sent to market at below cost return and unharvested product.

The final products selected as the initial proposed outcomes for the facility were tomato water and diced tomato; pureed banana and mango; honeydew melon juice and diced capsicum and zucchini. All products were to be frozen. The products were selected were based on end-user demand and being able to be produced by equipment that could be used across different sectors. The determined approximate volumes of waste, the equipment and the outputs were used in the design and costing of a modern processing facility, powered with renewable energy.

Using the input and output assumptions developed following consultation with industry and end-users a pre-feasibility cost benefit analysis was conducted. This analysis was undertaken expecting that growers would be paid for the input product at cost plus a small premium. The base case CBA was determined using only the packing shed and seconds below cost volumes, although a preliminary hi-yield case also included unharvested product. The CBA indicated that the proposed facility could be economical provided ~90% confidence in the assumptions.

The results of the study have been variously reported during the project, and were completed by a community forum and this report.

Should the project be further progressed, the following activities are recommended

a. Further community/grower consultation as the project remains unsupported by a number of influences and is unlikely to succeed with the current level of negativity in the community.
b. Further proofing of the assumptions to increase the confidence levels of the CBA.
c. Define equipment needs and best forms.
d. Undertake a large scale (~20 tonnes) technical trial in an existing commercial facility to verify feasibility.
e. Seek formal commitment from end-users in the form of contracts or off-take agreements.
f. Further investigate ownership, organisational and management models
g. Seek funding to undertake a more detailed business case which can then underpin development of large scale infrastructure grant submissions.

In summary a transferable framework has been developed to investigate the feasibility of developing new products from horticultural waste. In the Gascoyne case study, technical and economic pre-feasibility has been indicated, however this will need to be confirmed by a large scale technical trial and a more extensive business case. Gaining community and end-user support remains a priority activity for such initiatives to succeed.

1. INTRODUCTION

The Gascoyne Development Commission (GDC) has an overarching vision of a processing, storage and logistics hub to add value to Gascoyne primary production. This vision also has as an objective for the development of new, skilled employment opportunities associated with primary production in the Gascoyne.

These development activities are in line with a change in State and Federal government policy to provide funding support for reduction of waste, food innovation and regional innovation, growth and new industries to support job creation. In addition value-adding primary produce, Australia based not off-shore, is an emerging priority, with food safety/biosecurity risks and new labelling laws pushing a return to Australian rather than off shore based processing of Australian food products. Further Australia clean/green reputation enhanced by processing in Australia.

A number of relevant documents include

- Water for Food Gascoyne Master Plan (and specifically Recommendation 8 (Value-Adding and Export opportunities) and Recommendations 9 (Marketing and Branding),
- Feasibility study for Carnarvon multi-sector processing facility: A report commissioned by the GDC and prepared by GHD report.
- GDC blueprint document states that priority is regional economic and business development and sustainable jobs.

Phase 1 of the overarching project, as summarised in this report, is understanding the feasibility of undertaking collaborative processing to produce new products from horticultural waste. The project, titled Value –Adding to Carnarvon Horticultural Produce: Ideation, Innovation, Market, was conceived and developed following discussions between GDC and Curtin University developed a proposal which was accepted. The project was to focus on investigating new outcomes for seconds and packing shed discards or unharvested horticultural product. Premium product was not to be included in the investigation. A Research Services Agreement was developed and signed between Curtin University and GDC. The project commenced in July 2017.

2. OBJECTIVES OF THE PROJECT.

1. Two “investment ready” value-added products from horticultural waste.
2. Platform to fund further value-added product development

3. METHODS

The methodology to undertake the project was divided into eight different activities. It was intended that the methodology for these activities could be developed into a transferable research framework which could be used by other regions investigating the feasibility of similar opportunities in value-adding to primary produce. The activities are summarised below and discussed in detail in the following sections.

1. Background: literature review and market prices.

2. Initial consultation: group explorer consultation with supply chain stakeholders: list of products; barriers; opportunities followed by end-user consultation for formats, prices and demand (which product options to pilot)

3. Product development trials in commercial facilities in Carnarvon and Manjimup.

4. End-User Consultation for target products.

5. Approximation of raw material availability and tonnages

6. Generic facility design and preliminary costings

7. Pre-feasibility cost benefit analysis model development and implementation.

8. Reporting (workshop and written)

The following agreed project principles were sustained through the project.

1. Whole of chain consultation would be undertaken throughout the project
2. Fair return to the producer was a mandatory consideration.
3. The project would be based on collaboration across sectors (incorporating one facility with equipment able to be used on multiple sectors).
4. The facility design to be "building for tomorrow" not today (including aspects of renewable energy; flexibility; adaptability).
5. The project was to incorporate a modular approach: this report is Phase 1, other stages/product outcomes can be added later.
6. The project framework is to be continuously adaptable and transferable for new information/products/regions.

Ethics approval to undertake various relevant aspects of the project was obtained from the Curtin University Human Research Ethics Committee.

3.1: Literature and Market Review.

3.1.1 Literature Review.

The first stage of the project was to undertake a review of the relevant literature and other reporting in regard to value-adding to horticultural waste, both Australia wide and also specifically in the Gascoyne. Previous value-adding investigations were reviewed and assessment of success/failure and likely reasons summarised. A total of 57 documents were reviewed.

3.1.2 Current Status of Market Review.

Retail markets were examined for value-added aligned products (form and source {local or imported}), prices and packaging to commence the product development ideation process. The target sectors were mangos, tomatoes, eggplant, zucchini, melons, bananas and capsicums. Food service markets were also investigated however it was often difficult to get meaningful data from these sources due to confidentiality.

3.2 Initial Consultation.

3.2.1 Group Explorer

An initial whole of chain consultation was undertaken to identify potential new products which could be produced with the identified waste raw materials.

This whole of chain consultative stakeholder list was chosen by identifying six top waste sectors (tomatoes, bananas, mangos, melons, capsicums, zucchinis) and inviting relevant whole of chain stakeholders (producers, chefs/retailers, exporters, government policy representatives, distributors, marketers) to take part in the consultative process.

The group explorer protocols developed by Professor Fran Ackermann from the Curtin Business School were chosen as the initial consultative methodology. This computer based methodology, successively used in similar seafood industry initiatives, allows contributions to be gathered from each participant whilst allowing for both anonymity (and thus a wider and more open capture of views) and simultaneity (therefore increasing the productivity of the group).

Two group explorer work sessions were held with the following participants.

Session 1 Thursday 13 July 2017 (3-5pm).

Participant	**Affiliation**	**Comments**
Jennie Franceschi	Fresh Produce Alliance	Regional processor, exporter
Doriana Mangili	Sweeter Banana	Marketing Manager, local Co-op; Gascoyne Food Council executive officer.
Melissa Italiano	Eat West Buy Best	Government branding
Peter Jecks	Abacus Fisheries	Local seafood producer, processor
Fred Fairthorne	CEO, Farmer Jacks	Supermarket
John Zar	Farmer Jacks	Supermarket
Paul Shain	Chair, Carnarvon Growers Association (CGA)	Local producer
Phil May	Dept of Agriculture and Food (DAFWA)	The “Food Centre”
Tim Archibald	Horticulture Innovation Australia (HIA)	
Marcus Doumany	Minderoo Group	Agricultural Economist
Neil Lantzke	Industry consultant	Horticultural consultant

Session 2 Friday 14 July 2017 (10-12noon)

Participant	**Affiliation**	**Comments**
Valerie Shrubb, David Rogers	DAFWA	Local rep and compost expert, project officer
Jocelyn McPhee	Gourmet Selections	Processor, pre-prepared salads etc.
Joyce Babun	CEO, Loveapple	Local producer, distributor
Chris Higham	Meedo Station	Local producer, RTE meat

Luke Skender	CGA	Local producer
Rob Kuzmicich	Gascoyne Gold	Local Producer
Pete Manifis	Chef	End-user
Richard Kvecich	Harvest-Time	Pre-prepared salads etc.
Robyn Bumbak	Bumbak and Sons	Local producer
Eddie Smith	Calypso Plantations	Local producer
Luke Wheat	Future Green Solutions	Insects
Brett Hogan	Mareterram	Large integrated Seafood company

The group explorer sessions commenced with an introduction by the GDC Chair, Tony Beard, and then followed with a presentation by Phil May, Food Centre, DAFWA and Melissa Italiano Buy West Eat Best, DAFWA. Dr Janet Howieson, Curtin University, then gave a brief presentation providing background to the project before Professor Fran Ackermann commenced facilitation of the "group explorer" process (see Figure 1).

Figure 1: The second Group Explorer session.

3.2.2. Initial Consultation with End-users.

Following aligned assessment of the new product ideas emergent from the group explorer workshop, the product ideas and market opportunities were discussed with ~15 potential end-users (including Directus, Compass Catering, several chefs, Minderoo, Future Green Solutions, Fresh Produce Alliance) and the results collated. This consultation narrowed the product list and forms to be investigated in the semi-commercial new product development trials. During this consultation end-users were also asked about possible prices that they might pay for the identified products.

3.3 New Product Development (NPD) pilot trials

From the group explorer consultation and follow up consultation with end-users, ~30 potential value-add ingredients/products were chosen that were considered to have end-user interest, and technical and possible economic viability for production in the proposed processing facility.

It was decided to trial production of these identified products in commercial processing facilities to generate relevant semi-commercial data on feasibility, processing recoveries and product quality/shelf-life.

Two sets of NPD trials were completed in commercial facilities, the first at the Abacus Fisheries processing facility in Carnarvon and the second at the Fresh Produce Alliance processing facility in Manjimup.

3.3.1 Abacus Fisheries Trials.

Two product development experts, Andy Molyneux and Andrew Sankey worked with Curtin food scientists and Abacus processing staff to produce some of the suggested new products in the Abacus Fisheries commercial processing facility. Details of equipment and methodology for the trials are described in detail in the detailed report of the trials, attached as Appendix 1.

In summary the commercial processing equipment tested during the trials included a bowl cutter, microcutter, steam jacketed kettle, screw press, dicing machine, double chamber vacuum sealing machine, coupe table top cutter and a separator/extractor. Product was chilled or frozen in a spiral and/or blast freezer.

The value-added products produced, packaged and assessed in the Abacus Fisheries trials included

- Tomato Products: raw tomato water; roasted tomato water; concentrated roasted tomato solids; 15mm diced tomato; cooked 10 mm diced tomato sauce; Gazpacho; Salsa; Roast tomato
- Banana Products: Peeled and preserved banana; Banana puree with preservative; Banana/melon juice; Fried green banana chips.
- Honey Dew Melon Products: Pickled honeydew melon; melon juice;
- Mango Products: mango puree; mango chilli sauce
- Basil Products: basil paste; pesto
- Eggplant Products: Babaganoush; smoky eggplant water.
- Asparagus Products: dried asparagus
- Chilli products: chilli paste.
- Combined ingredient products: XO sauce; Fruit/vegetable packs; Ratatouille vegetable base (Zucchini, capsicum, eggplant, onion, tomato); roast vegetable packs.

Assessments taken during the production trials included:

Assessment of Production Feasibility and Processing Recoveries
The feasibility of successfully producing the products in the various equipment was assessed. The processing recovery was also calculated for key unit operations. This recovery was calculated on both the pre-processing manual operations (peeling, deseeding, coring, etc.) and also on the

machine processing operations (dicing, chopping, juicing, pureeing, etc.). Measurement of produce input and product/waste output weights were used to calculate percentage yields for individual unit operations and whole processing lines.

Sensory Quality assessment

The visual and aroma sensory product quality before and following vacuum packing/bottling was assessed at the time of production. Vacuum packed product samples were also transported to Curtin University and evaluated at 13 days post-production. Products remained vacuum packed and were visually and tactilely inspected for quality changes such as mould, liquid exudate, discolouration and textural changes. Samples were not opened or assessed for sensory quality and shelf-life as it was considered that this would occur once all production processes were optimised. Products were also observed at 20 days post-production, however all products were extremely degraded and therefore results were not recorded.

3.3.2 Fresh Produce Alliance Trials.

Following the production trials at the Abacus Fisheries facility, the list of products to be further tested was reduced based on these results. It was further decided to test a range of new products at the Fresh Produce Alliance facility in Manjimup as, at the time, there was a high pressure pasteurisation (HPP) apparatus at this facility. This emerging technology extends the shelf-life of fresh product without impacting quality was considered relevant to the Gascoyne product and value-adding initiative.

High pressure processing (see equipment example in Figure 2) involves subjecting a product to high pressure at ambient temperatures in order to achieve a variety of quality outcomes, such as shelf-life extension, flavour, appearance and texture enhancement. Products are typically processed in their final packaging in order to avoid recontamination.

Figure 2: Hyperbaric HPP machine.

The detailed results of the Fresh Produce Alliance trials are summarised in Appendix 2. Summary details are provided below.

The products for testing were initially produced at Curtin University or by a product development expert Susannah Morley-Wong. The test products are listed below.

- Tomato Products: raw tomato water; concentrated roasted tomato solids; 15mm diced tomato; Gazpacho;
- Banana Products: Peeled and preserved banana; banana puree with preservative;
- Capsicum Products: 15mm diced capsicum; ajvar
- Melon Products: honeydew melon juice;
- Mango Products: mango puree;
- Basil Products: basil paste;
- Chilli products: chilli paste.
- Combined ingredient products: XO sauce; Ratatouille vegetable base (Zucchini, capsicum, eggplant, onion, tomato); roast vegetable packs.

Detailed recipes are shown in Appendix 2.

Due to the nature of HPP, products must be packaged in flexible, water-tight packaging, to protect the product from contamination with the surrounding water during processing. Suitable packaging options include minimum 75 micron thick vacuum pack bags and Polyethylene terephthalate (PET) plastic bottles. These options were used for packaging all sample products.

Where possible, products were vacuum packed in a primary packaging of 70 micron vacuum pack bags. These products were subsequently double packed in 80 micron vacuum pack bags in sets; this improved handling during processing. Liquid products not suitable for vacuum packaging with the available equipment were packaged in 125 mL clear PET Boston bottles with screw cap lids. Both packaging formats maintained their integrity during processing.

Product samples were processed over two days at the Fresh Produce Alliance HPP facility in Manjimup, Western Australia. During the first day of trials, small batches of product samples were processed at 500 and 600 MPa for 3 minutes and subject to quality assessment (see below), in order to identify the pressure that produced the most desirable sensory outcomes. The chosen processing parameters were applied during the second day of trials to larger quantities of the products for shelf-life assessment (see below). Non-HPP treated controls were also produced for each product.

Sensory Quality assessment

Informal sensory analysis, in the form of a group discussion, was conducted on product samples after HPP processing on the first day of trials. The sensory panel consisted of several food technologists and industry representatives experienced in HPP. Products were assessed for differences between the control and treated sample. Key attributes assessed included appearance, texture, flavour, aroma and general preference. Based on the sensory analysis, the processing parameters that produced the best sensory outcomes for each product were chosen for shelf-life assessment.

Shelf-life evaluation

Product samples subject to HPP on the second day of trials and aligned untreated controls were transported back to the Curtin Aquatic Research Laboratories (CARL) and stored chilled at <4˚C. Informal quality assessment was performed at various time periods from processing. Samples were assessed for appearance and tactile texture differences between control and treated samples. Samples were not removed from their packaging during the assessment.

Product samples were sent for microbiological analysis over an up to 41 day long shelf-life study. All samples were analysed at the Mérieux NutriSciences laboratory in Perth, Western Australia. Total plate count (TPC), *Staphylococcus* and *Listeria monocytogenes* analyses were undertaken. A TPC $>10^7$/g was considered unacceptable.

3.4 Whole of Chain Stakeholder Consultation on NPD results

Seventeen end-users (five chefs; seven large scale distributors; three small scale (2-3 products distributors); three govt/industry reps/associations (food policy/marketing) end-users were consulted on various aspects of the products that emerged from the trials as possibilities. These aspects included initially a yes/no (interested in purchasing; worthy of further investigation) but where appropriate also included commenting on demand, packaging, price, opportunity. The intent was to select up to six products with market appeal to use as case studies for the cost benefit analysis. It was also hoped that this process would assist in identifying possible commercial partnerships should the project move to implementation.

3.5 Determination of Raw Material Availability, Tonnages and Break Even Production Prices.

In this section, new approaches were used to try and approximate the sector specific volumes of products that might be available for processing.

Noting that alternate options for first grade premium product was not included in the project in the first instance it was decided to separate waste product into three different categories.

a. Out of specification discards from the packing /grading operation.
b. Seconds product being sold at below break-even prices (sent or not sent to market).
c. Unharvested product.

Determination of Waste product volumes under the three waste categories was treated on a sector specific basis due to the different operating conditions for the different sectors.

The following methods were used to determine waste volumes in the three different categories as outlined. The waste volume estimation were continuously updated in response to new information during the period of the project. This information gather is expected to continue if the project reaches the next stage.

a. Survey with selected growers undertaken by GDC staff (July 2017).
b. Consultation with graders/packing shed/marketing stakeholders by Curtin University staff (February 2018).
c. Production figures and extrapolation based on previous literature and annual production statistic reporting. It should be noted that the production figures for the region are based on product actually transported to Perth market so do not include figures for the three

categories above. These approximate figures must be interpolated from secondary sources of data as indicated below.

More detail on the methodology for each activity are detailed below.

3.5.1 GDC Survey with selected growers.

GDC Staff undertook this survey in in mid –August, 2017.

The information gathering consisted of two separate components which are described below.

Grower unstructured interviews

In this process an informal interview / conversation was undertaken with selected growers to provide estimated yields or weights per container of harvested crop and to provide any additional information regarding horticultural waste management practices.

Interviewees were chosen based on approachability, the crops they produced and prior relationships with the GDC. The list was compiled with the assistance of Joyce (Loveapple) and Luke (Carnarvon Growers Association).

Meetings were not structured, the order of which the growers were interviewed/observed was dependent on their location, whether or not they were available and whether or not they were harvesting at the time.

The interviews were based on a semi structured list of questions as below.

- What crop(s) to you produce and are you picking today?
- How much of each crop have you picked (boxes, kilos, unit), how many rows did you pick from to get this quantity? (this was also observed based on what was packed in the shed)
- What proportion of what you pick is left on the ground in the field? How does this compare to the proportion of firsts / seconds?
- What sort of things should we look out for to identify inedible waste?
- What do you normally do with your on farm waste? Are you required to employ specific methods of discarding waste due to fruit fly concerns / other concerns?

Observational survey.

An observational survey was also undertaken to determine the type and amount of waste that occurs during crop harvesting and to observe growers harvesting practices. This included attempts to quantify the amount of waste that occurs on farm and the proportion of which was inedible.

The project officers walked down each row of crops that had recently been picked and counted the number of fruit/vegetables remaining on the floor and the number of fruit/vegetables that were inedible.

Inedible produce was defined as produce that was not fit for human consumption. Signs of inedible produce included

- Visible rot
- Evidence of pests

- Badly split fruit/vegetables or produce that has been damaged so much that is unsalvageable (i.e. it was run over by a tractor).
- Other signs as identified in discussions with growers (e.g. Zucchinis with pointy ends)

The amount of edible waste included produce that may have been blemished, overripe, under ripe, deformed, too large or too small. This figure was not directly counted but calculated by subtracting the inedible quantity from the total (per row).

3.5.2 Curtin University Survey with Carnarvon stakeholders

As the project progressed another survey of ~15 stakeholders was undertaken in February 2018 to better understand and clarify the waste calculations under the different categories. The survey was undertaken by Dr Kelly Burns from the Curtin University Business School. These figures were also used to inform the cost benefit analysis (Section 3.7).

Survey questions are summarised below
Q: If fruit fly were eradicated, would you expand your distribution to export markets that are currently restricted to you?
Q: Would you expand your current operations to service this market?
Q: If yes, what additional net profit do you think you could achieve?
Q: If you could pay a once off fee to eliminate fruit fly, what would you be "willing to pay"?
Q: Can you estimate the value of produce lost due to fruit fly?
Q: Do you think your land would be more valuable if waste was eliminated? (I.e. visual, aromatic and other positive externalities)
Q: if yes, can you estimate how much more your land would be worth?
Q: How many additional person-hours would be required under the proposal in the roles of:
(a) Collection of waste,
(b) Processing of products, and
(c) Transportation of goods?
Q: Do you think you would hire additional people to meet the extra labour needs?
Q: what are the main crops grown here:
Q: how many people do you currently employ?
Q: how many people work unpaid on the farm (including yourself, partner, children, and other family members)?
Q: how many hours of unpaid labour are provided each week / month / year?

3.5.3 Analysis of Regional Production figures (product sent to market) and Extrapolation.

The estimated total production volume includes the volume sent to market (premium and seconds) and discards from the packing shed (i.e. all produce picked and sent for grading). The production volume sent to market is sourced from transport company manifests and includes the total amount of product sent to the Perth market, excluding pre-transport waste. This data was collected and summarised. Assumptions about levels of packing shed waste, second grade product not transported due to uneconomic returns, and unharvested product were estimated from surveys. These estimates were then added to the transported product volumes to result in an estimate for total production volume.

3.5.4 Calculation of Break Even Production Prices.

If the labour and freight costs associated with sending seconds produce to the Perth market is avoided by sending this produce to the proposed processing, it is reasonable to assume that the farmer's breakeven price would be the current breakeven price less these costs. Costs to send to the seconds' market were estimated and include labour, freight, bin/carton costs and agents commission (18%). A survey of growers was therefore undertaken to ascertain breakeven prices, and assumptions were then tested with growers for verification.
To allow for the possibility that the seconds market price could be above the breakeven price (and therefore growers have no financial incentive to send the seconds produce to the central facility), in the cost benefit analysis a premium was added to the breakeven price. This breakeven with premium price is then used as the purchase price incurred by the facility to undertake the processing.

3.6 Design and costing of commercial processing facility

An external consultant Herve Calmy was contracted to design and cost the proposed processing facility. The detailed report is attached as Appendix 3.

The Objective of the Brief was summarised as below:

The GDC is assessing the feasibility of a horticultural processing facility to value-add to current waste or seconds product in the local industry. The objective of this proposal is to establish the size of the processing facility needed based on the equipment to be utilised , the desirable and efficient processing and packaging flows (automated, manual and or combined), holding storage capacity and ultimately derive an optimum layout for the operation. The facility will need to meet food safety/quality certification requirements (domestic and export) and be constructed to allow the majority of energy demand obtained from sustainable sources (solar and biodigestion). We have reviewed the January 2016 GHD Feasibility Study for the GDC Multi-Food Processing Plant and taken into account the Plant Design flow chart dealing with washing, sorting, peeling slicing, waste removal, pulping, juicing, paste, puree, and concentrate for some 8 to 10 most produced fruits and vegetables.

The building Concept Design for the Carnarvon Pilot Horticultural Processing Facility (HPF) to value-add to current waste or seconds product was articulated around six fundamental principles:

1. The need for a standalone operation also capable of being potentially integrated to the Gascoyne Gold (GG) or similar existing grading operation subject to a suitable arrangement between the various proponents.

2. A clear traffic and access separation between staff/visitors and logistics supplying or dispatching products in and out.

3. The committed aspiration to rely on an off-grid carbon-free energy supply based on roof mounted photovoltaic panels and lithium battery storage.

4. A flexible construction system allowing for the cost-effective adaptation to a range of processes and equipment together with the expansion of the facility over time.

5. Compliance with health and food standards and regulations in force and the ability for the out-going products to suitably access domestic, national and international markets.

6. Sufficient capacity to handle existing and prospective supply of selected seconds products

3.7 Cost Benefit Analysis

An external consultant Ewan Colquhoun, Ridge Partners was contracted to undertake the cost benefit analysis for the project. Detailed methodology is shown in the detailed report attached as Appendix 4.

However it is noteworthy that the CBA was undertaken on two scenarios

a. *A PILOT BASE CASE scenario* that value-adds existing 2nd grade and discard produce, to create consumer products and animal feeds,
b. *A Hi-Yield LONG TERM scenario* that value-adds to existing 2nd grade, discard and traditionally unharvested produce to create ESLP consumer products and animal feeds.

3.8 Reporting

3.8.1. Community Reporting

A schedule of community reporting (email and face to face) was developed in conjunction with GDC.

3.8.2 Written Reporting.

Final reporting was to be completed as per GDC requirements.

4 RESULTS AND DISCUSSION

4.1: Literature and Market Review.

4.1.1 Literature Review.

The executive summary of the literature review is presented below.

A literature survey of a number of desktop and pilot studies (56 in total) investigating potential horticultural value-adding and waste utilisation was undertake generally and also specifically for the Gascoyne region.

Since 2011, annual production statistics for Carnarvon horticulture have been made available. The production values published are provided by transport companies who deliver produce to the Perth markets. As such they are not comprehensive and do not represent the gross production of produce. The produce with the largest annual production in 2016 was tomatoes (all varieties) (18321 t) followed by melons (all varieties) (12314 t) and bananas (all varieties) (4151 t). These values reflect the majority of the post-packing shed volumes, with estimates of >20% of gross production not reaching the packing shed and an estimated 5% discarded during packing.

Several studies have investigated value-adding to this wasted produce with particular focus on banana and mango waste. Products developed have received positive market feedback but not been commercialised. A lesson learnt from these studies is that investment in capital has to be supported by adequate volumes of produce; potential ways to overcome this are to outsource processing or

form a group and invest in a shared facility. Additionally, there is potential to leverage the varietal differences of produce to differentiate in the market.

A number of studies have looked at export opportunities for the Gascoyne region as well as Western Australia as a whole. This avenue appears to have several limitations as it is emphasised that Australia must market high quality, low volume niche products to be competitive in the global market place. The use of waste produce may not be suitable for producing export quality products. Additional barriers include the long distances to container ports from Carnarvon, the very low volume of waste produce available to process and the additional costs of meeting export requirements.

As an alternative to food production a number of studies have investigated production of bioenergy, compost, insect farming and extracting useful chemicals from horticultural waste as well as organic landfill waste. Bioenergy has the potential to utilise large volumes of waste however will likely require a large initial capital investment to set up a facility. Some reports have also suggested that there is insufficient waste in the Gascoyne to make such a facility financially viable. Composting is a slow process that produces a stable soil amendment. This practice is currently used by some farmers to utilise waste, however producing high quality compost requires a balanced input of carbon and nitrogen. Direct horticultural waste is unlikely to produce high quality compost due to a lack of nitrogen, addition of other waste streams and a bulking agent such as wood chips would be required to make a suitable process. Insect farming is currently only conducted on a small scale in Western Australia. The process has potential but issues surrounding its up-scale need to first be addressed. Fruit and vegetables contain a multitude of valuable compounds such as flavours, phytochemicals, colourants, etc. However extraction of these can be very costly and any facility set up would require highly skilled workers.

From the literature three key opportunities and challenges were identified for the current project:

Opportunities

1. **Simple value-adding** (pulp, juice or pre-prepared/frozen) has the greatest potential to form a viable business case. Varietal differences and origin should be leveraged to differentiate in a competitive market.
2. **Tomato, melons and banana** have the highest production volumes and likely the largest waste streams suitable for value-adding. Additionally they have long seasons and can likely provide the most consistent supply of waste produce for value-adding.
3. Due to the limitations of the Gascoyne region (distance to market, comparatively low production and limited existing infrastructure) the **formation of a group** (such as cluster/co-op) by growers is essential to reduce costs, increase funds for R&D and capital investment.

Challenges

1. **Existing tensions between growers need to be overcome** and collaborations formed. Additionally, for projects to progress beyond the R&D stage some **investment risk** needs to be accepted (this can be minimised for individuals by forming a group).
2. Previous attempts to **formulate viable business plans** have not been successful. Inclusion of intangible benefits of waste utilisation may assist with this. Alternatively, a different approach may be required (i.e. outsource processing) to overcome the financial barriers.
3. Supply of horticultural waste is predicted to be highly seasonal. **Overcoming the seasonal supply constraints** will be critical to the development of a viable operation.

4.1.2 Market Review.

The results of the market review are available as an excel spreadsheet. This review informed product development trials (see Section 4.3) and the cost benefit analysis (See Section 4.7).

4.2 Initial Consultation.

4.2.1 Group Explorer

A summary of the feedback results from the two group explorer workshops is shown below.

Table 1 prioritises the identified product areas, including the support for further action. Support for each product idea is itemised after the product idea: G is supported, R is no interest. In the second workshop a third criteria, B (personal interest) was included.

Table 1: Prioritised Product Ideas by Workshop.

Workshop 1 [green = go, red = no interest]	**Workshop 2: (G) = go, blue (B) = personal support, red (R) = no interest]**
Juicing [7G 1R]	drinks [4B 4G]]
Feed for cattle [7G 1R]	process vegetables [6B 2G
chop chop veg [5G 1R]	dried product [5B 2G]
fruit and veg puree (HPP) for food service and food production in value added foods - mango, banana, tomato, pumpkin) [4G]	puree and stock [5B 2G]
dried snack food - bananas, mangoes, melons, strawberries [4G]	health [3B 4G]
Nutrient dense powder [R4 5G]	insect use [5B 1G]
mango cheeks to sell frozen [5G 4R]	sauces [2B 3G]
vegetable stock [3G 2R]	compost [2B 5G 1R]
bio fuel [2G 3R]	freeze [4B 2G 1R]
compost [2G 4R]	stockfeed [1B 4G 1R]
indigenous foods / bush food [5R]	HPP [4B 1G 1R]
	bio fuel [1B 3G 3R]
	weeds [1B 2R] fabrics [1B 2G 1R]
	biodegradable packaging [1B 2G 1R]
	beauty [1B 1G]
	sweets [1B 1G]

Table 2 details the specific product types suggested under the broader product separations.

Table 2: Product Ideas Emergent from Group Explorer Sessions.

Use[1]	Examples
process vegetables [6B 2G]	tomato/pasta sauce

[1] B=personal support, G=support in general, R=not supported

chop chop veg [5G 1R]	vegie dips pickling vegetables sliced onions cut vegie /package pickled chilli gherkins canned vegetables vegetable pulp chunky chips, fries, crisps, soups
dried product [5B 2G] dried snack food - bananas, mangoes, melons, strawberries [4G]	fruit leather fish jerky sun dried/dehydrated veg vegetable snacking chips meat jerky dried fruit dried seafood and kangaroo eggplant chips/crisps veg
drinks [4B 4G] Juicing [7G 1R]	fresh tomato juice juice extract of veg carbonated juice drinks Gascoyne juices- grapes - mango - banana - melons - cucumber - etc. fruit wines banana beer distilled products distilled fruit – Gin Champagne from table grapes
Stockfeed Feed for cattle [7G 1R]	pelletised fish /stock food
biodegradable packaging [1B 2G 1R]	banana waste to starch pellets or cellulose for use in biodegradable packaging
health [3B 4G]	Nutrient dense powder [P4 5G] ingredients for health products potential nutraceuticals or functional food nutrient extraction - for pharmaceutical, nutrient injection, 3D printing potential to grow for process i.e. acerola indigenous foods / bush food [P4 5R] pawpaw anti-cancer leaves medicinal uses from native foods Protein substitutes vitamin supplements Offcuts of trimmed asparagus -dried, powdered as a prebiotic
puree and stock [5B 2G] vegetable stock [3G 2R]	Puree pumpkin soup Fruit puree in ice-creams vegie/seafood stock
insect use [5B 1G]	Use of insects for conversion of waste into high-value products (fertilisers, proteins, oils, pharmaceuticals etc.
sauces [P3 2B 3G]	harissa XO sauce
sweets [1B 1G]	Candied peel

	Lollies, Cordials preserves Stevia replacing sugar in candied fruit, cordials etc. watermelon peel
freeze [4B 2G 1R] mango cheeks to sell frozen [5G 4R]	Frozen Bananas ingredients ie frozen, freeze dried juice puree i.e. frozen, freeze dried juice puree sorbets freeze dried strawberries - amazing taste and flavour frozen veg
compost [2B 5G 1R] compost [2G 4R]	soil conditioner wood from pruning's improved compost
bio fuel [1B 3G 3R] bio fuel [2G 3R]	bio fuel - power generation for product not fit consumption electricity generation
uses [P3 1B]	banana extruded cereal Processing to RTE meals/portions food service ingredients reforming of products - marked or damaged products food service value add - restaurant ready banana bread export gift ready fruit combined RTE meals for aged care baked nut and fruit goods e.g. pecan pie, banana pie pawpaw is a tenderiser functional food products preserves cakes
weeds [1B 2R]	WA nightshade - ripe fruit sold as fruit drops in USA another weed Caltrop the dried weed is bought to make Viagra
beauty [1B 1G]	ointments, scrubs, creams, healthcare and cosmetics
fabrics [1B 2G 1R]	cloth paper packaging

Key Barriers/Challenges Emergent from Workshop Discussion.

- Supply
    - Continuity of supply
    - Volume of supply
    - link volume to type of waste to outcomes
    - differentiate between seconds and waste
- Costs
    - cost of power - need sustainable and cheap energy source
    - high capital cost
    - cost of leaving on the ground (fruit fly)
    - cost of flooding the market with less than quality product
    - cost of labour
    - recognise costs of freight
- collection and transportation issues
- demand level/market

- skills and know-how

Next Step Actions emergent from Workshop discussions.

Workshop 1

- Nutrition analysis of waste and volume of waste to inform stock feed usage
- establish type, value and volume of waste
- establish grading processes
- HPP trial on products
- combinations - trials to assess benefits of different products
- ensuring flexibility of processes to address all by product
- ensure flexibility of processes to address all by product
- look for 1 - very simple to produce low value or 2 very complex high value options
- develop a brand for Gascoyne - build critical mass eg Buy West Eat Best - colour Gascoyne
- undertake cost benefit analysis

Workshop 2

- map Core Raw materials by Type
- Assess base cost of collection from the paddock for the top waste crops
- collectively questionnaire F2F on rough figures on scale volume and season from producers
- use DAFWA and HI data for market data
- explore trends (global food and health) and adaptations
- mine Buy West Eat Best data
- run tests using variety of equipment on products
- trial with aged care homes

Common areas for action are

1. undertake assessment of waste including volume (recognising variability between years), seasonality, grade (seconds versus on the field) nutrition and product type (type of tomato)
2. understand and manage market (review market data, develop brand, explore trends)
3. undertake trials
4. assess cost benefit analysis
5. Table illustrating contributions

In summary, 27 participants from throughout the horticultural supply chain took part in the sessions, with 96 product ideas identified. These product ideas were grouped broadly into cattle feed, insect feed, biofuel, composting, juices/drinks, purees, stocks, chopped veges, dried snacks/sweets, protein powders, health/nutriceuticals, fabrics and packaging. Participant interest in forwarding any of the opportunities was canvassed and recorded. The session also identified the two major challenges: supply (continuity and quality) and costs (power, infrastructure, transport etc). Next step activities were identified: these included better understanding of waste volumes and type, further consultation with the market/end-users, product development trials and a cost benefit analysis.

4.2.2 Initial Consultation with End-users.

The list of product idea results emerging from the "Group Explorer" workshops were assessed by the project team for feasibility and technical challenges. The list of product ideas was then further discussed with various end-users for further feedback. Table 3 summarises the results of this further consultation.

Table 3: End-User Feedback on Product Ideas from Group Explorer Session.

Product	**End-user Feedback.**
Juicing/drinks	Yes, institutional catering markets exist.
Stock Feed for cattle	Volumes are too low to be economically viable and nutritional composition is not optimized, would require addition of other high protein ingredients.
Processing/ chop veg	Yes, institutional catering markets exist.
fruit and veg puree, sauces and stock (HHP/freeze) for food service and food production in value added foods - mango, banana, tomato, pumpkin)	Yes, institutional catering markets exist.
dried snack food - bananas, mangoes, melons, strawberries/sweets.	Markets exist but drying is expensive and low return due to moisture loss. Consider pre-processing then despatch to other processes or as second stage of development.
Nutrient dense powder	*Markets exist but processing equipment too expensive for volumes. Suggest investigate/consider pre-processing to reduce volume then send to established facility for further processing.*
mango cheeks to sell frozen	Markets exist, but would require mango only equipment (decheekers cannot be used for other sectors). Consider in costings.
biofuel/gas	Equipment is expensive and volumes are too low to be economically viable
compost	Market issues in Carnarvon, transport costs prohibitive for other markets. Consider as smaller operation after processing (eg skins etc).
indigenous foods / bush food	Markets exist, volumes are low, but simple processing equipment (eg vacuum packaging/freezing) could also be applied to this sector.
weeds	Volumes are too low for complex processing equipment, technologies and costs. Market challenges.
biodegradable packaging/fabrics	Volumes are too low for complex processing equipment, technologies and costs. Market challenges.
beauty/health	Markets exist but processing equipment too expensive and complex for volumes. Suggest investigate/consider pre-processing to reduce volume then send to established facility for further processing.

insect use	Volumes are too low

As a result of this consultation it was decided to focus further research activity on developing simple partially processed ingredients for the institutional catering market. This simple processing was described by one end-user as slice/dice; puree/juice; package and freeze. The advantages of these types of products were considered to be

a. Ability to use processing equipment across a range of sectors and decreased cost of equipment due to simple processing.
b. Decreased costs associated with retail packaging and mark-up.
c. Ability to develop partnerships with distributors able to manage large volumes.
d. Freezing allows extended shelf-life and prevents oversupply on the market.

More complex product development processes, for example, drying, production of pre-prepared ready to eat meals; and products packaged for the retail market were considered to be possible next steps.

Following the results of the end-user consultation the following specific products were chosen for initial semi-commercial new product development trials.

- Tomatoes: sliced and diced (different sizes) (cooked and raw); paste; water; roasted;
- Melons (honeydew melons as trial): juiced, pickled; juiced.
- Bananas (whole: puree)
- Mangos (puree; juice)
- Eggplants/Zucchini (diced) (note currently no diced eggplant on market)
- Mixed ingredient products; Chill paste/sauce, salsa, babaganoush; XO sauce; ratatouille; mixed roast vegetables; vegetable and fruit chips.

4.3 New Product development pilot trials

4.3.1 Abacus Fisheries Trials.

Detailed results from the Abacus Fisheries NPD trials are shown in Appendix 1. The executive summary is reproduced below.

This report summarises the results of preliminary horticultural product development trials undertaken at the Abacus Fisheries facility over three days in August 2017. A range of products were produced, through different processing equipment/processes and packaging formats, with and without the addition of some additives. These products were based on suggestions emanating from a previous Group Explorer consultation process undertaken with a range of stakeholders. These pilot trials encompassed assessment of processing abilities, recoveries and feasibility across the range of products and equipment and included visual observation for quality over time.

Key learnings from the trials included
1. Processing of low grade waste can yield quality value-add products.

2. Further work is required to optimise protocols and shelf life of products selected for the next phase.
3. Recoveries from the food processing machines tested were, in general, very high.

4.3.2 Fresh Produce Alliance Trials.

Detailed results from the new product development trials are shown in Appendix 2. A short summary is reproduced below.

In noting that the sensory assessments were informal and that the microbiological shelf-life data was based on single samples, Table 4 summarises all the results from the different products for the HPP trials.

Table 4 Summarised Results from Trials at Fresh Produce Alliance facility in Manjimup.

Product	**Microbiological Shelf-life : Control samples**	**Microbiological Shelf-life : HPP treated samples**	**Comments on informal sensory assessment**
Tomato Water	Day 7	>Day 41	No visual difference; more intense fresh tomato aroma after HPP
Tomato Solids	Day 7	>Day 41	No visual difference; more intense fresh tomato aroma after HPP
15 mm diced tomato	15	>Day 41	No visual difference; more intense fresh tomato aroma after HPP; softer texture after HPP.
Banana Puree	>Day 29	>Day 41	No colour difference but watery layer in HPP treated product. Mild fresh aroma in treated, stronger less fresh aroma in control.
Peeled and Preserved Whole Banana	>14	>19	Control released liquid and was darker colour. HPP had lighter colour and no liquid released
15mm diced Capsicum	29	34	Samples similar, but liquid with red particles in control but not in treated.
Ajvar	>27 (but higher TPC than HPP)	>29	No visual differences, fresher aroma in treated
Honeydew melon juice	13	>27	Aroma deteriorates more in control than treated.
Mango puree	29	>34	No colour difference, aroma fresher in treated sample.
Chilli paste	>29 (but higher TPC than HPP)	>41	No colour/visual difference, stronger aroma in treated.
Roast vegetables	14	19	No colour difference, softer texture in treated samples.

Product	Microbiological Shelf-life : Control samples	Microbiological Shelf-life : HPP treated samples	Comments on informal sensory assessment
Ratatouille	>29 (but higher TPC than HPP)	>41	No colour texture differences, stronger onion aroma in treated sample.
Gazpacho Version 1	Day 7	>Day 19	
Gazpacho Version 2	>Day 19 (but higher TPC than HPP)	>Day 19	
Gazpacho Version 2	>Day 19 (but higher TPC than HPP)	>Day 19	

In this initial trial, 500 psi for 2 minutes seemed to be the best treatment for the range of horticultural samples tested. The shelf-life results are preliminary due to only one sample per microbiological test and the sensory assessment being informal. However, there was consistent microbiological shelf-life improvement in HPP treated samples. Generally colour and visual differences were not noticed between the control and HPP treated samples, aroma was generally better with HPP although some softening of texture was observed in some of the products.

The results demonstrated that HPP could be seen as alternative to freezing in looking at the extended shelf-life needed for Gascoyne value-add produce due to remoteness and impact on logistical supply. Such a technology may also allow access to "fresh" export markets.

Unfortunately, not long after the trials the HPP plant at Manjimup was closed, therefore, atthe moment there is no longer a HPP capacity in Western Australia.

4.4 Whole of Chain Stakeholder Consultation on NPD results

The results of the end-user consultation on the selected products trialled in the Abacus Fisheries and Fresh Produce Alliance trials is shown in Table 5.

Table 5: Results of End-User Consultation following NPD trials.

Product	% of end-users who said yes	Other comments
Raw Tomato Water	53	Double use of tomato waste; extend shelf-life Add functionality for increased health benefits
Roasted tomato water	35	Potential as umami concentrate
Concentrated tomato solids	29	
Unripe/Ripe raw tomato pulp	17	
Diced tomato	35	Need large scale customers;
Gazpacho		Beverage market opportunity; need to extend shelf-life
Salsa	12	
Whole roasted tomato	53	Bulk packaging and improve shelf-life; need to maintain physical integrity
Peeled and preserved Bananas	41	Minimize preservatives
Banana puree	41	Minimize preservatives
Banana/Melon juice	12	Clarification?

Banana/Mango Juice	0	
Fried green banana chips	35	Ethnospecific market
Pickled honeydew melon	23	Niche markets
Honeydew melon juice	65	Sterile processing; bulk packaging; clarification
Mango puree	35	Price point challenges
Mango chilli sauce	17	
Basil paste	35	On trend
Pesto	11	
Babaganoush	11	
Smoky Eggplant water	29	Bulk packaging; improve shelf-life; clarification
Dried asparagus tips (probiotic)	12	
Chilli paste	47	Mexican varieties
XO sauce	24	Use seconds seafood and onions
Mango cheeks	41	
Diced eggplant with onion	24	No diced eggplant currently on market
Diced red capsicum	53	Usually currently source from China
Diced green capsicum	53	Usually currently source from China
Diced pumpkin with eggplant	35	
Diced vegetable mix (zucchini, capsicum and onion)	65	Any combination of raw diced vegies will be popular
Diced onion with zucchini	35	
Cooked ratatouille vegetable base	52	

Products for detailed cost benefit analysis were thereafter selected on these preferences and comments; as well as raw material tonnages, and simple processing and packaging. Products chosen were tomato water; banana puree; mango puree; diced tomato; diced capsicum; diced zucchini.

4.5 Determination of Raw Material Availability, Tonnages, Breakeven Productions Prices.

4.5.1 GDC Survey with selected growers.

Observation and interviews

Collectively the 15 plantations visited grew 11 different crops (banana, cabbage, capsicum, grapefruit, mango, paprika, pawpaw, rockmelon, sweet corn, tomato and zucchini).
Not all growers were willing to allow us to observe their picking habits, this was due to a lack of trust, their crop not being in season, them not picking their crop recently, bio-security concerns or because it was an inconvenience to them.
Only 8 growers allowed us to observe the produce left on the rows. A total of 56 rows were observed – broken down into 16, 33, 3 and 4 rows respectively for gourmet tomatoes, capsicums, sweetcorn and zucchinis.

Combined Results of the GDC survey are shown in Table 6.

Sector	Plantations visited (no.)	Interviews			Observational	
		% Seconds (assume all edible)	% grading discards	**% on grading discards that were edible**	**% on farm waste (not harvested)**	**% on farm waste which is edible**
banana	2	12-15	1-5	65 (est)	5	65
mango	2	No data	No data	No data	-	4.44
capsicum	3	No data	No data	No data	20.6	49
tomato	5	No data	No data	No data	30.7	70.5
zucchini	3	No seconds market	No data	No data	87.6	72

B*anana Overview*
The two banana growers surveyed indicatd that their preferred disposal method was to leave banana waste to rot in the rows or to collect it and "dump it out the back".
Both of the growers were open to the idea of processing edible waste locally assuming that it was viable to increase labour costs to collect the edible waste. Furthermore, they expressed interest in collaborating with the "fruit fly guys" in this project as they are required to take measures to meet fruit fly regulations.

Capsicum overview
It is likely that a higher proportion than shown of "floor fruit" was edible as pickers were instructed to break unsatisfactory produce to assist decomposition – this it would have been perceived as inedible. The amount of edible on-farm waste could very likely be larger than 49%. Furthermore, it was difficult to identify how long the produce had been on the floor – it was estimated to decompose within 7 days.
The capsicum growers employed two methods of waste disposal. Two of them simply broke up the produce and allowed it to decompose on the floor – these growers both had extensive netting. The third grower collected the produce and kept it in a hole covered in webbing, this was supposedly burnt once full. Capsicums that were deemed unsuitable through the packing process were sent to the tip. This costs approximately $360 / week for 3 to 4 skip bins (an average cost of $102 / bin).

Gourmet tomato overview

The common method of disposing of substandard produce on farm was to crush it back into the soil with a tractor or use it to feed chickens. This was an issue when conducting observations as there was uncertainty as to whether the tractor had already done the rounds. Observations were taken on one plantation whilst "tractoring" was taking place – and rows were selected where the waste had not yet been crushed.
The impact of recent rainfall events may further skew the observations as rainfall events tend to produce unappealing produce, this may account for the high proportion of edible waste left on farm.

One grower responded positively to local waste processing however did not want to see organic produce mixed with inorganic produce. Further concerns were raised regarding additional labour costs associated with collecting the waste and whether it could be sold at a profit.

Zucchini overview
The wasted produce was left to rot in the paddock. The growers generally agreed that a local processing facility to make use of waste was a good idea so long as the price for waste or seconds allowed continued profit.

Mango overview

Mango waste was generally collected using a bulldozer or something similar and fed to pigs (apparently the crackling is amazing). Alternatively people from Brickhouse Station came and collected the waste to use as cattle feed (no compensation was given).

4.5.2 Curtin University survey with Carnarvon stakeholders (February).

The compilation of this data is summarised in Table 7 (Section 4.7).

4.5.3 Annual Production Figures and Extrapolation
The compilation of this data is summarised in Table 7 (Section 4.7).

4.5.4 Calculation of Break Even Production Prices.
The compilation of this data is summarised in Table 7 (Section 4.7).

4.5.5. Summary of Production and Raw Material Availability Assumptions for Facility Design and Cost Benefit Analysis.

Table 7 in Section 4.7 summarises the harvest yield and grading assumptions the various consultative processes undertaken in the project. This data was used to underpin the pre-feasibility cost benefit analysis.

4.6 Design and costing of commercial processing facility

The final report and associated design drawings of the facility are shown in Appendix 3. Costings have also been completed but these remain under the jurisdiction of the GDC due to possible tendering implications.

The final design is shown below.

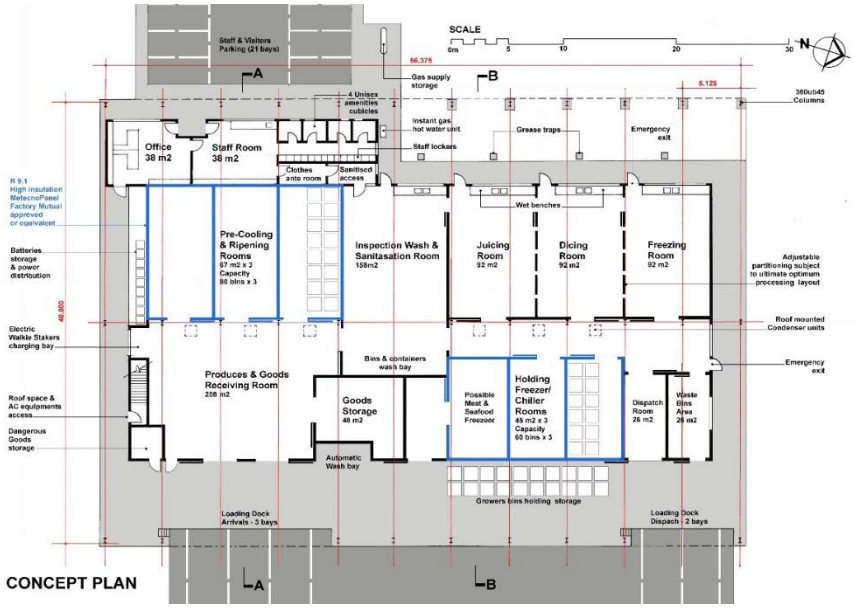

Figure 3: Design of processing facility.

4.7 Cost Benefit Analysis

A detailed Final Report for the Cost Benefit Analysis undertaken by Ridge Partners is attached as Appendix 4.

The executive summary is reproduced below.

This report presents the results of a prefeasibility study of a proposed investment in a greenfield ESLP (Extended shelf-life processing) horticultural facility to be establish at Carnarvon in WA.

The analysis is a prefeasibility study for commercial investment in this facility based on a preferred ownership, design scope, and throughput scale identified by the local industry producers and partners.

The Prefeasibility Analysis assumes two business case scenarios:

c. *A PILOT BASE CASE scenario (Base Case)* that value-adds existing 2nd grade and discard produce, to create ESLP consumer products and animal feeds,

d. *A Hi-Yield LONG TERM scenario (Hi-Yield Case)* that value-adds to existing 2nd grade, discard and traditionally unharvested produce to create ESLP consumer products and animal feeds.

A custom-built financial model has analysed the commercial prefeasibility at two levels, based on the following key assumptions:

- No capital or operating cost subsidies from government,
- Pretax Investment Discount Rate of 12% over a 15-year investment term,
- A conservative processing plant maximum throughput limit of 65% of available produce,
- A possible premium (up to 15%) above breakeven costs is paid to growers for input volumes supplied,

- 18 FTEs (Full time equivalent staff, excluding manager) of employed labour in the processing plant,
- Initial capital investment of $8.28 m, (Fixed Capital of $7.88 m; Working Capital of $400,000),
- Growers supplying the facility are paid a premium (range from 0% - 15%) above their breakeven price,

Table 7: Assumed waste availability, grading yields, breakeven prices and product prices.

Target Crops - harvested and unharvested	Tomato	Mango	Capsicum	Honeydew	Zucchini	Banana
1. % of harvested product (2nd grade) for processing	22%	30%	20%	0%	10%	15%
2. % of harvested product that is discarded as waste	16%	10%	5%	25%	30%	5%
3. % of harvested discarded product that is edible	60%	50%	50%	85%	90%	50%
4. Grower breakeven price, per Perth market $/kg	$0.58	$1.21	$1.66	$0.15	$0.58	$0.86
5. % of gross farm yield left on ground unharvested	32.3%	20%	24.4%	25%	10%	0%
6. % of unharvested waste on ground that is edible	72.5%	75%	48.5%	50%	50%	0%
7. Avg Final Product Sales prices (CIF Perth) $/kg	$1.75	$4.50	$3.40	$3.00	$2.00	$1.70

a. Pilot Base Case

Operating at 65% of its design capacity (Base throughput), the facility investment is viable above ~90% confidence level (i.e. probability of receiving forecast revenues), and able to pay breakeven price premiums up to 15%. If plant throughput is increased to 75% of design capacity, the net increase is NPV is around $1.5-3.4 m. Higher throughput levels combined with greater confidence in supply, will significantly boost investment returns.

		Confidence Level at 65% Throughput			Confidence Level at 75% Throughput		
NPV $m		75%	90%	100%	75%	90%	100%
Breakeven Premium	0%	$-13.0	$1.9	$9.0	$-12.7	$2.3	$12.4
	5%	$-14.6	$-1.4	$7.4	$-14.6	$0.5	$10.6
	10%	$-16.2	$-3.0	$5.8	$-16.4	$-1.3	$8.7
	15%	$-17.8	$-4.6	$4.2	$-18.2	$-3.2	$6.9

Figures in red are negative NPVs and indicate a return below the benchmark level specified in model assumptions.

b. 2. Hi-Yield Long Term Case

Operating at 65% of design capacity the facility investment is only viable above ~90% confidence and able to pay breakeven price premiums up to 15%. At 75% of design capacity the NPV returns would lift by around $0.9-4.0 m.

NPV $m		Confidence Level at 65% Throughput			Confidence Level at 75% Throughput		
		75%	90%	100%	75%	90%	100%
Breakeven Premium	0%	$-15.9	$6.9	$22.0	$-17.2	$8.7	$26.0
	5%	$-18.8	$4.0	$19.1	$-20.5	$5.3	$22.6
	10%	$-21.7	$1.1	$16.2	$-23.9	$2.0	$19.3
	15%	$-24.6	$-1.9	$13.3	$-27.2	$-1.4	$15.9

For both scenarios, the proposed processing facility investment is sensitive to:

- Confidence in cash inflow assumptions. It is recommended GDC and industry carefully review the assumptions used in this model and the facility design and forecast throughput.
- The wholesale prices achieved for processed products sold,
- The level of Breakeven Premium paid to growers to acquire their produce as input to the proposed facility,
- The level of product volume throughput processed by the proposed facility.

This Prefeasibility Study has undertaken a conservative analysis of investment performance of the proposed horticultural processing facility. The study finds that the venture will be viable at high levels of confidence and product throughput, based on the detailed assumptions described in this report.

4.8 Reporting

4.8.1. Community and Stakeholder Reporting

During the project the project team has requested ongoing feedback by email to stakeholders (6 requests for feedback) and also in several community/stakeholder events. This included a community invitation to view the products produced in the Abacus factory trials (Section 4.5.1) attended by 15 people and a presentation at the AGM of the Carnarvon Growers Association in March 2018 attended by more than 80 people.

At near completion of the project a seminar was held at Carnarvon on September 5th 2018 to present all the current status of results of the project and request feedback. The agenda for that seminar is summarised below. More than 40 people attended the presentation.

All feedback from the community session was incorporated into project reporting. In addition an on-line fora for comment is being developed and will be hosted by GDC to enable further comment.

AGENDA

2pm to 2.05pm GDC Welcome and introduction of project partners

2.05pm to 2.15pm GDC Priorities – economic development and job creation, supporting growth in the primary production sector

2.15pm to 2.35pm Dr Janet Howieson – Summary of results from different project stages

- Literature review and Initial Consultation;
- Product Development Trials (Carnarvon and Manjimup);
- Consultation on target products
- Waste stream quantification and raw material availability
- Prefeasibility cost benefit analysis
- Generic Facility design and preliminary costing

2.35pm to 2.50pm Ewan Colquhoun (Ridge Partners): Cost benefit analysis for Pilot operation

- Assumptions used to develop the Business case
- Draft CBA
- Grower/stakeholder comment on the assumptions?

2.50pm to 3.10pm AFTERNOON TEA

3.10pm to 3.20pm Herve Calmy (Calmy Planning and Design) - Pilot Horticultural Processing Facility Concept Design Principles and Design

3.20pm to 3.35pm Angus Borthwick (Borthwick Foods). Contract manufacturing opportunities.

3.35pm to 3.50pm Gerard Matera (Abundance Agriculture) Opportunities and Challenges

3.50pm to 4.10 pm Ewan Colquhoun (Ridge Partners): Possible Ownership, Organisational and Management models.

4.10 to 4.30pm Funding models and investment options for the Pilot facility (GDC)

4.30pm to 5pm General Discussion

5pm DRINKS AND REFRESHMENTS

4.8.2 Written Reporting.

This final report and associated appendices was presented to the GDC at the conclusion of the project.

5. CONCLUSIONS

The project has identified an initial range of value-added products produced from Gascoyne horticultural grading waste and seconds that have market appeal. A processing facility has been designed and costed and the results included in a cost benefit analysis which shows economic viability for the processing facility assuming ~90% confidence on the assumptions. These assumptions need further stakeholder engagement to be further tested.

A transferable framework has been developed to investigate the feasibility of developing new products from horticultural waste. In the Gascoyne case study, technical and economic pre-feasibility has been demonstrated, however this will need to be confirmed by a large scale technical trials and a more extensive business case. Gaining further community and end-user support remains a priority activity for such an initiative to succeed.

6. RECOMMENDATIONS AND NEXT STEPS

Should the initiative be further progressed, the following activities are recommended

- Undertake further consultation to proof the assumptions for the CBA (Section 4.7) thus far
    a. On Line Forum to give community and growers further opportunity to comment
    b. Major production/distribution businesses who have indicated support of the project and any product that may emerge from the facility.
    c. Equipment technical experts to review equipment list and prices.
    d. Revise pre-feasibility CBA based on results of a-c above, and concomitant increase in the confidence levels.
- Undertake a large scale (~20 tonnes) technical trial in an existing commercial facility to verify feasibility of processing large volumes.
- Confirm/seek semi-formal commitment from end-users in the form of contracts or off-take agreements.

- Undertake further engagement to try and increase support/opportunity as the project remains unsupported by a number of influences and is unlikely to succeed with the current level of negativity in the community. The stakeholder groups to be targeted would include
    a. Growers (including developing strategies for Vietnamese grower engagement)
    b. DPIRD (eg fruit fly team; head office horticulture team).
    c. Minister
    d. Indigenous stakeholders
    e. Community.
- Seek funding to undertake a more detailed business case, based on the present report and appendices, which can then underpin development of large scale infrastructure grant submissions. The detailed business case should further investigate and make recommendations about ownership, organisational and management models.