FEASIBILITY STUDY INTO RECYCLING WASTE PLASTIC OYSTER BASKETS IN THE SOUTH AUSTRALIAN OYSTER INDUSTRY

SAOGA SOUTH AUSTRALIAN OYSTER GROWERS ASSOCIATION

Regional Development Australia WHYALLA & EYRE PENINSULA INC.

EPA South Australia

Government of South Australia Department for Manufacturing, Innovation, Trade, Resources and Energy

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Prepared by:

Rawtec & EconSearch

www.rawtec.com.au

www.econsearch.com.au

EXECUTIVE SUMMARY

The South Australian Oyster Industry

The South Australian (SA) Oyster Industry is an important regional industry for South Australia. The Industry produces up to 100 million oysters annually, contributing over $100 million to Gross State Product (GSP), and creating jobs for 1,000 people[1]. This production is achieved across an area of 1,000 hectares in various locations on the Eyre and Yorke Peninsulas and Kangaroo Island (refer Figure 1 overleaf). Some of these locations are nearly 800km by road from Adelaide.

As the second largest aquaculture industry in the State, the SA Oyster Industry is acutely aware of the sensitive environment it operates in. Through the SA Oyster Growers Association (SAOGA), the Industry has successfully implemented a range of initiatives to ensure that growers proactively manage their farms in an environmentally sustainable manner. The Industry is therefore a living example of how South Australia is achieving its Strategic Priority of *"Premium food and wine from our clean environment"*[2]. The Industry also plays an important role in tourism marketing by some of these regional areas as premium tourism and culinary destinations[3].

The Waste Oyster Basket Problem

Oysters are grown in plastic baskets placed in intertidal or sub-tidal zones. The SA Oyster Industry uses approximately 2.5 million of these baskets, which come in different types, shapes and sizes. Each year about 5-10%, or 150-200 tonnes, of these plastic baskets reach their end-of-life (EOL) and must be disposed of. The disposal of these waste oyster baskets has recently become a pressing problem for the SA Oyster Industry. Instead of disposing the baskets to landfill, many oyster growers have been stockpiling them on their properties to enable more environmentally sustainable disposal by recycling. It is estimated that this stockpile (across the entire Industry) is currently 1,300-1,500 tonnes (see Figure 2 on page iii). This stockpile could reach 2,500 tonnes by 2020 if a cost-effective recycling option is not found.

This Study

This study was commissioned by the South Australian Environment Protection Authority (EPA) and South Australian Oyster Growers Association (SAOGA), with funding from the South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE). Administrative support for the study was also provided by Regional Development Australia – Whyalla & Eyre Peninsula, Inc. (RDA-WEP).

Its aim was to *"Identify cost effective oyster basket recycling options that will value add to the efficient operation of the industry as a whole."*

{Cont. on pg. iii (two pages overleaf)}

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[1] For more information on the economic impact of aquaculture on the SA economy: http://www.pir.sa.gov.au/aquaculture/aquaculture_industry/industry_profile/economic_impact_reports

[2] For information on the seven Strategic Priorities for South Australia's future: http://www.priorities.sa.gov.au/

[3] For example, see Brand Eyre Peninsula 2012/2013 Tourism Prospectus: www.exploreeyrepeninsula.com.au/files/download/495

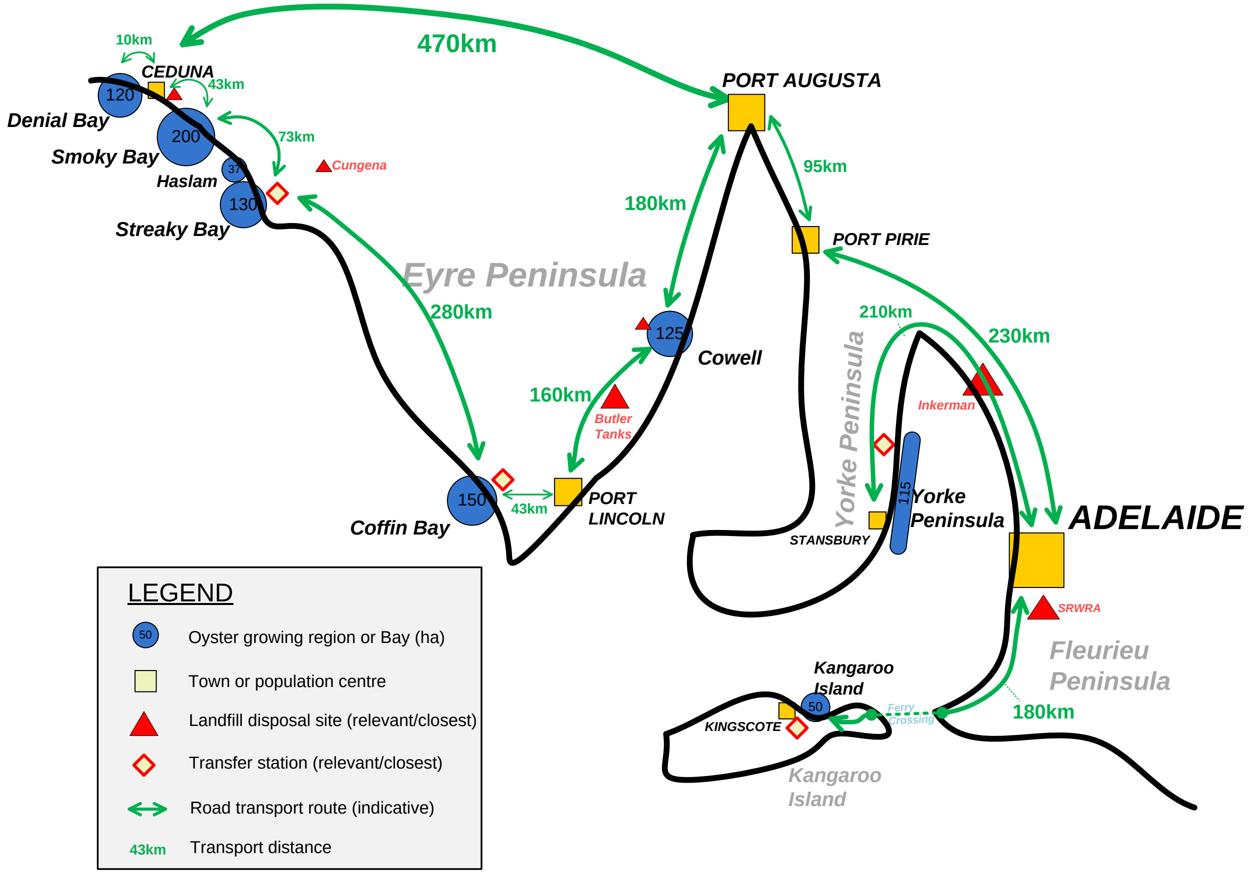

Figure 1: Main oyster farming areas in South Australia. *This figure includes the relative size (by lease area in hectares) of these oyster farming areas. The location of "relevant" transfer stations and landfill disposal options[4], and road transport distances between farming areas and major population centres are also shown.*

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[4] Only the transfer stations and landfill options considered "relevant" to this study are shown. There are other transfer station and landfill options that may be present in these areas, but there are not necessarily the nearest &/or are expected to soon be closed (and therefore not available in the future).

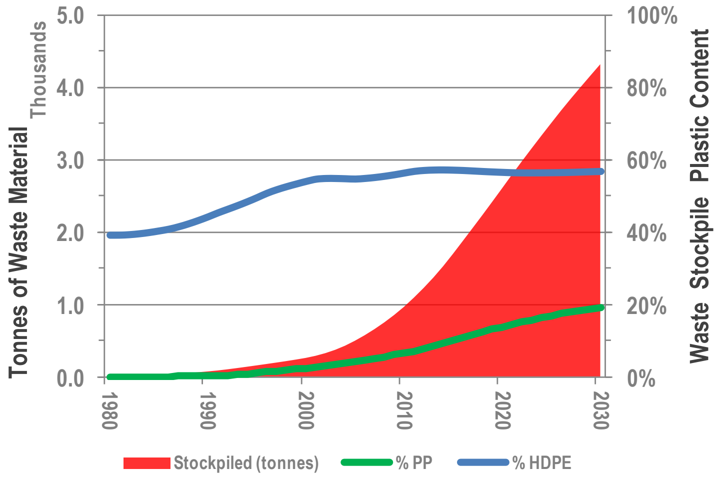

Figure 2: Estimated stockpile build-up across SA Oyster Industry from 1990 to 2030, including plastic content (%HDPE & %PP, by wt.)

Cost-Effective Recycling of Waste Oyster Baskets

Waste oyster baskets are principally constructed of plastic – either high-density polyethylene (HDPE) or polypropylene (PP) polymers (see Figure 2 above). These plastics, in their individual polymer form, have value as recyclable materials. As a consequence, there is opportunity for oyster farmers to receive a weight-based rebate from local recyclers for the waste oyster plastic baskets. However, there are a number of challenges for taking advantage of this opportunity to achieve cost-effective recycling:

- Waste oyster baskets can contain high-levels of other material components and contaminants, including biological fouling, which would need to be removed (to acceptable levels);
- Some oyster farmers dispose of their HDPE and PP waste oyster baskets together, which therefore may require separation first;
- Waste oyster baskets are a bulky or voluminous waste, which makes them very costly to transport unless baled or shredded first;
- Current oyster growing areas are located long distances from Adelaide, where most recyclers are located, which also contributes to a high freight cost.

In view of the above challenges, the following option for recycling disposal was identified as likely to be the most cost-effective. This option is also depicted pictorially in Figure 3 overleaf.

- Waste oyster plastic baskets could be accepted for recycling in Adelaide by Plastics Granulating Services (PGS), which would pay a rebate for plastic material recovered from the waste.
- To implement this option, the following preparation and logistics could be involved.
  - ***Cleaning & Sorting*** – The waste oyster baskets would need to be cleaned to remove biological fouling, and then sorted to remove contaminants and separate the plastic bodies into their individual polymer forms.
  - ***Shredding*** – The sorted waste material would be shredded to reduce volume for (& thus cost of) transportation to PGS in Adelaide.
  - ***Transport*** – The waste material would be transported by "back-loading" it on trucks returning to Adelaide (after making deliveries in regional areas).
- Plastic material from the waste oyster baskets would be processed by PGS into a granulated waste plastic product, and then sold to recyclers. Some products manufactured by these recyclers are already being used by the SA Oyster Industry and other aquaculture industries.

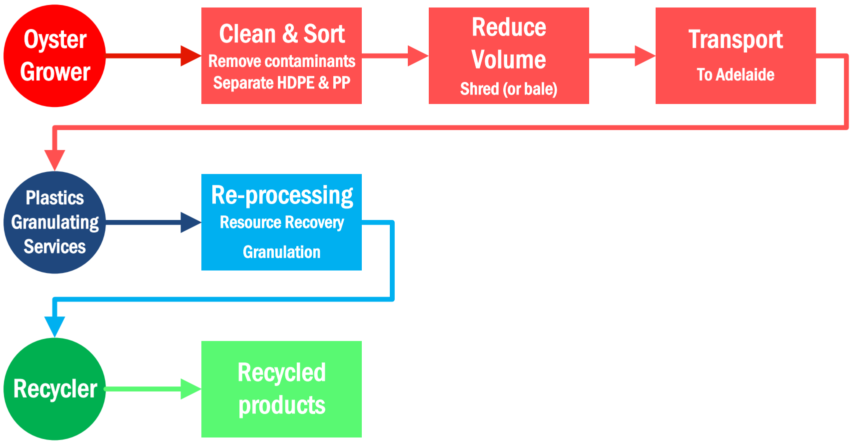

Figure 3: Key steps in the identified recycling option for waste plastic oyster baskets. *This figure also suggests which party might be responsible for each of these steps*

How much could recycling cost?

With a rebate of $100/tonne, the above recycling option could cost oyster growers in the range of $300-600/tonne of waste material, or 40-60¢/basket. The exact cost of this option would vary according to where growers are located and the volume and quality (i.e. plastic content and level of contamination) of waste baskets (see Figure 4 below).

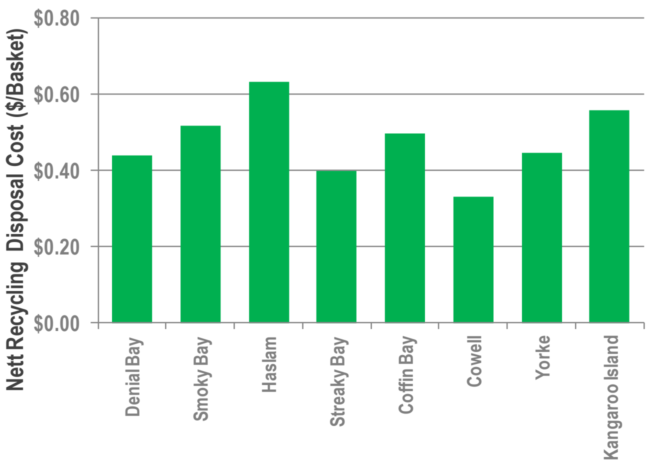

Figure 4: Net costs (in $/basket) estimated by this study for recycling disposal of the waste oyster basket stockpile in each main oyster grower area. *The recycling disposal costs for future waste oyster basket volumes would be similar. Note: There may be additional costs involved with managing the procurement and contracting arrangements for disposal by recycling*

Alternative disposal options

Alternative disposal options, including landfill disposal and Waste-to-Energy (WtE) (via SITA-Resource Co. in Adelaide), were also benchmarked against the above recycling disposal option. This assessment suggests that landfill disposal and WtE could be cheaper than recycling disposal of waste oyster baskets in some oyster grower locations. In both of these cases, it is expected that the waste material would still require shredding for volume reduction to make transport costs affordable.

Summary of Disposal Options by Grower Area

In recognition that the most cost-effective (but not necessarily environmentally sustainable) disposal option would be influenced by local factors, Table 1 (below) provides a summary overview of key findings from this study by each grower area.

Table 1: Key findings on potential most cost-effective disposal approach by grower area

Grower Area	Key findings
Denial Bay	*Growers in this area have access to the Council-operated landfill at Ceduna which is only 10-15km away. This landfill currently charges a relatively low gate fee for acceptance (so long as waste oyster baskets are pre-shredded). Landfill disposal could therefore be cheaper than recycling, which would require pre-sorting and sending this material all the way to Adelaide.*
Smoky Bay	*The nearest landfill for Smoky Bay growers is now at Ceduna, which is 40-50km by road. This further distance could make it just as cost-effective for growers to consider recycling disposal over landfill disposal, but this will strongly depend on freight costs applicable to each option. Wider use of two-setters in this area, which would have higher pre-sorting cost, may also make WtE a competitive option.*
Haslam& Streaky Bay	*Both of these areas will soon have access to a new landfill built by the local Council at Cungena, which will be located about 60-70km from Streaky Bay. Again, waste material for disposal at landfill should be shredded first to minimise the gate fee. Recycling and landfill disposal could be of similar cost depending on freight costs for each.*
Coffin Bay	*In this area, oyster growers must send their baskets to a local council-operated Transfer Station for transport and disposal to a landfill at Tumby Bay. This Transfer Station would charge a relatively high gate fee for acceptance of this waste material. In this circumstance, recycling disposal could be more attractive.*
Cowell	*Most growers are already sending the baskets to the local Council owned and operated landfill site near the town, which charges a relative low gate fee for acceptance. At the current time, landfill disposal would be more cost-effective than recycling disposal.*
Yorke Peninsula	*For landfill disposal, growers in this area would need to send material to a local council Transfer Station near Port Vincent, which is operated by a private contractor. The gate fee charges at the Transfer Station would be extremely high, and thus, recycling disposal would be more cost-effective given the relative closeness of this area to Adelaide. Due to greater use of pillow baskets in this area, WtE could also be a competitive option, which would avoid high pre-sorting costs.*
Kangaroo Island	*Disposal to landfill is via a local Transfer Station. The gate fee for acceptance of the waste at this Transfer Station is expensive as the waste must be transported off the Island to a landfill site near Adelaide. Recycling disposal would also have high freight cost for this reason, but should be more cost-effective.*

Recycling Implementation: Future Scenarios

To consider the best approach for the oyster industry to successfully move towards a recycling solution, a number of potential scenarios were identified (in consultation with the Project Steering Committee for the study). These scenarios are listed and summarised in Table 2 below. Further details on each scenario can be found in this report.

Table 2: Alternative recycling disposal scenarios assumed for Cost Benefit Analysis (CBA)

Option	Description
Base Case *(Do Nothing)*	■ Oyster industry continues to stockpile waste oyster baskets until until it is no longer feasible (e.g. as part of potential regulatory change) which is estimated to occur in 2018 ■ At this time all stockpiled oyster baskets and future waste baskets must be disposed of within a short time frame, which does not enable the industry to implement a recycling solution (i.e. all waste is disposed to landfill). ■ Delaying disposal could mean much higher future disposal costs, which are increasing at a rate greater than inflation. ■ Some growers may experience a future "financial shock" arising from unplanned disposal of a larger stockpile, which may cause them to exit the industry.
Option 1 *(Disposal at least cost)*	■ Disposal of stockpile by the Industry and ongoing future waste generation commences in 2014. ■ Oyster growers make individual choices about whether disposal is to landfill or recycling, which is generally dictated by lowest cost.
Option 2 *(Recycling Stewardship)*	■ Industry commits to recycling (i.e. stewardship) and works together to cooperate and implement a recycling disposal scheme (90% participation). ■ This scheme commences in 2015 and allows stockpiled and future waste to be recycled
Option 3 *(Recycling Stewardship plus Industry co-investment in a shredder)*	■ Industry introduces the above scheme to achieve majority recycling (90% participation). ■ The industry also cooperates with local government to co-invest in a mobile shredder to achieve more cost-effective volume reduction of waste oyster baskets and help minimize landfill disposal of other waste streams in regional areas.

Cost-benefit Analysis (CBA)

The scenarios in Table 2 (above) were subject to cost-benefit analysis (CBA). This CBA compares the accumulated financial cost and benefits of each Option (Options 1-3 in Table 2) against that of the Baseline Scenario and expresses the result as a Net Present Value (NPV) after 25 years. The three options ranked in order of preference based on the CBA were:

- ***Option 1, Disposal at least cost***: NPV_{25} = $0.43m (average annual net benefit of $37,000)
- ***Option 2, Majority of waste recycled:*** NPV_{25} = $0.41m(average annual net benefit of $35,500)
- ***Option 3, Majority of waste recycled with the purchase of a shredder***: NPV_{25} = -$1.78m

Options 1 and 2 demonstrate that there is a financial benefit to the SA Oyster Industry in moving away from the current practice of stockpiling. Furthermore, disposal at least cost is currently a better option for oyster growers than recycling disposal. However, this option appears to only have a relatively small financial advantage over implementation of an Industry-wide recycling scheme. At the current time, co-investing with local government to purchase a shredder has more costs than benefits because shredding services from private contractors are already available for most regional areas of South Australia.

Key Study Findings & Recommendations

In view of the above, the following main findings and recommendations from this study were proposed.

1. *Waste plastic has a value and there is a recycling solution for waste oyster baskets in South Australia that can be implemented – but it will not be "free" or at "no cost" for oyster growers.*
2. *Landfill disposal may be a more cost effective disposal solution in some oyster growing areas.*
3. *Commencing disposal immediately using the least cost option would be the most cost-effective approach to dealing with the current stockpile and future waste oyster basket disposal problem. This strategy is also important to minimise potential for future financial shock to oyster growers, which may cause some to exit the Industry, in the event that stockpiling suddenly becomes no longer allowed at some time in the future*
4. *The SA Oyster industry should be pro-active in facilitating this solution, which may include providing education and support to oyster growers, and helping them work together to achieve economies of scale and to adopt procurement strategies that minimise their costs.*
5. *Oyster growers should look to the market to deliver the best disposal solution by out-sourcing disposal of waste oyster baskets to a suitable third party, in order to achieve the best price and minimise their potential financial risk. This may involve additional costs for obtaining advice on and assistance with implementing the optimal procurement strategy, as well as administering the resulting waste disposal contract(s).*
6. *To deliver the most environmentally sustainable outcome, the SA Oyster Industry should carefully consider the opportunity to introduce a waste oyster basket stewardship scheme where recycling is promoted. There may be additional sustainability and marketing benefits from such a scheme, which were not quantifiable by this study. However, there could be considerable challenges for designing and successfully implementing such a scheme, which may need regulatory involvement for it to work and for it to be widely accepted and seen by oyster growers as equitable.*
7. *Table 3 below presents a three-point summary strategy for how the SA Oyster Industry could move forward with implementing the above findings and recommendations.*

Table 3: Three-point summary strategy for implementing study findings & recommendations

1. **The SA Oyster Industry should discuss and resolve the following key issues.**
   a. The extent of cooperation achievable between oyster growers in implementing a disposal option, e.g. industry-wide, within grower areas, etc?
   b. Which disposal strategy should be adopted, i.e. least cost option, industry-wide recycling scheme, etc.?
   c. How and who would be responsible for implementing the agreed disposal strategy (or strategies), i.e. individual grower, grower collective(s), SAOGA, etc?
2. **Based on the above decisions, growers should commence disposal of stockpiles or future waste oyster baskets at earliest possible date.**
3. **SAOGA should support &/or implement the agreed approach, which may include:**
   a. Helping to identify and develop an industry stewardship scheme for recycling disposal.
   b. Facilitating &/or administering procurement of disposal services on behalf of growers.
   c. Developing & providing information & support for the industry or individual oyster growers.
   d. Monitoring & reporting performance of the waste oyster basket disposal scheme.

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Document Verification

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		Name	Chris Colby	Chris Colby, Lisa Rippin	Chris Colby
		Signature			

CONTENTS

1 INTRODUCTION

1.1 Purpose

This report presents the key findings and recommendations of the:

- ***Feasibility Study into Recycling Waste Plastic Oyster Baskets in the South Australian Oyster Industry***

1.2 Context

Even though oysters have been grown since the early 1900s, a commercially viable South Australian (SA) Oyster industry has been operating for just over 20 years. Currently there are approximately 90 Growers with up to 1,000 hectares under cultivation, producing around 100 million oysters per year. These growers are based in two main growing regions:

1. The West Coast Zone – comprising the Eyre Peninsula; and
2. The Southern Zone –comprising Yorke Peninsula and Kangaroo Island.

These zones have seven main growing areas at (see Figure 1.1 overleaf):

- Denial Bay
- Smoky Bay
- Streaky Bay/Haslam
- Coffin Bay
- Cowell
- Stansbury/Port Vincent
- Kangaroo Island

The economic value of the industry to the South Australian economy is in excess of $109 million per year (PIRSA Fisheries and Aquaculture, 24 May 2013). In addition the industry provides over 1,000 jobs in South Australia, which delivers valuable employment opportunities in these regional areas.

Oyster baskets are an important outlay that growers need to make for their businesses. The SA Oyster Industry is estimated to have up to 2.5 million baskets in active use, which reflects a total investment of approximately $25-30 million. These baskets will generally last between 10 and 20 yrs before reaching end-of-life (EOL) and needing replacement. Consequently, 100-200 thousand decommissioned oyster baskets can require disposal each year.

Historically (i.e. 10-20yrs ago), growers may have disposed of these decommissioned oyster baskets to local landfills or even by burying or burning the baskets on-property themselves. However, landfill disposal costs have increased substantially in the past two decades. Some local landfills also no longer accept the baskets because of their bulky nature, in order to conserve landfill space and extend the longevity of the landfill. On-property disposal options like burning or burying are no longer accepted or permissible. Many growers are also looking to operate their businesses more sustainably, which has created interest in whether a cost-effective recycling option for waste oyster baskets could be found.

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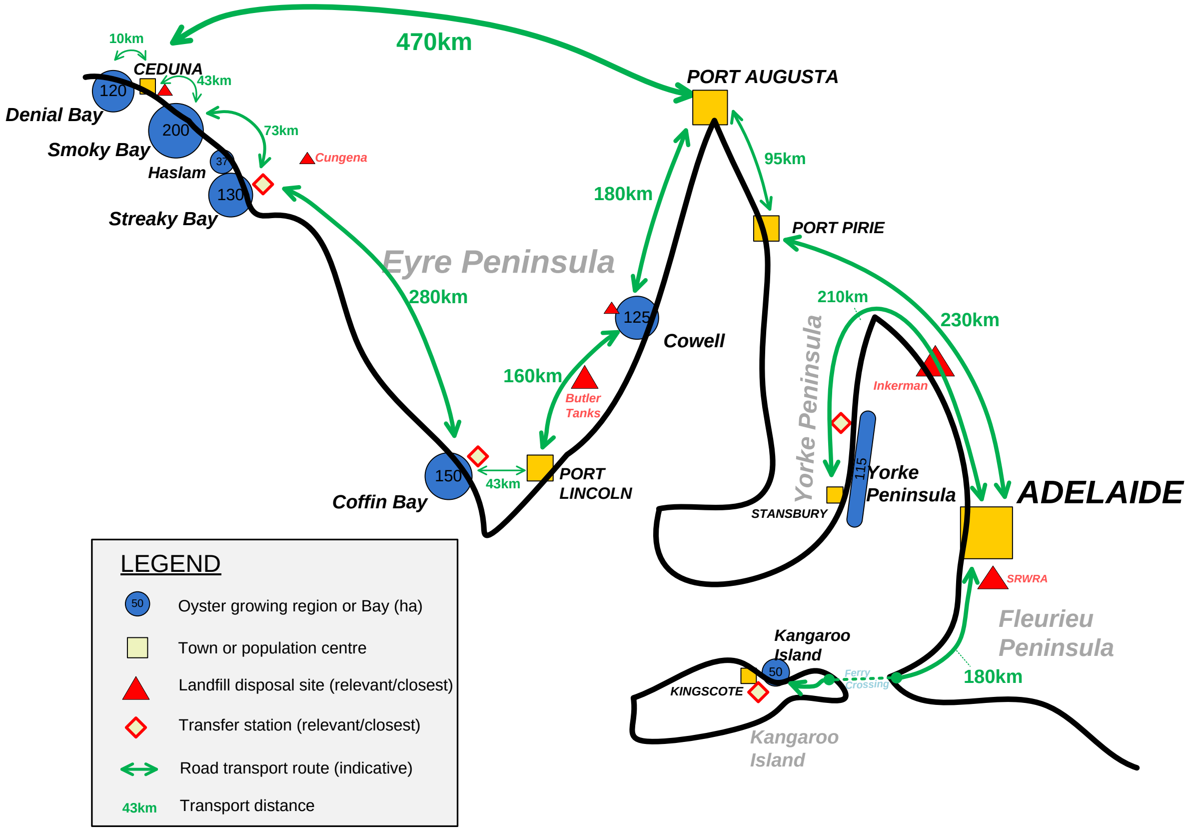

Figure 1.1: Main oyster farming areas in South Australia. *This figure includes the relative size (by lease area in hectares) of these oyster farming areas. The location of "relevant" transfer stations and landfill disposal option, and road transport distances between farming areas and major population centres are also shown[5].*

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[5] Only the transfer stations and landfill options considered "relevant" to this study are shown. There are other transfer station and landfill options that may be present in these areas, but there are not necessarily the nearest &/or are expected to soon be closed (and therefore not accessible in the future). This data was identified from oyster growers and discussions with local government and waste industry operators.

As a result of these factors, many growers in the SA Oyster Industry have been stockpiling waste oyster baskets – waiting until a viable recycling disposal option becomes available. In some growing areas these stockpiles were started nearly two decades ago, and they now present a significant waste disposal problem for the industry.

In this respect, the SA Oyster Industry is very aware of the sensitive environment it operates in, and understands the need for growers to proactively manage its farms in the most sustainable manner with minimal environmental impact. As an example the Industry is part of a clean a beach program, where local growers have taken on the responsibility of keeping the beach it uses in each of the bays clear of rubbish & debris. The SA Oyster Industry in conjunction with the State government also runs the South Australian Shellfish Quality Assurance Program (SASQAP). This program includes water testing to ensure that marine waters in oyster growing areas are maintained in a pristine condition.

Oyster growers have therefore indicated they are keen to look at an environmentally responsible way to manage the disposal of their waste baskets. From a business perspective the financial cost of disposal is very important but growers they also want to be able to consider a sustainable disposable method by recycling. This study is important in providing them current accurate information on the costs and options for recycling disposal.

1.3 Aims & objectives

The aim of this study under the Terms of Reference (TOR) in the Project Brief (RDA Whyalla & Eyre Peninsula, March 2013) was to:

- ***Identify cost effective oyster basket recycling options that will value add to the efficient operation of the industry as a whole.***

More specifically, the study objectives were to identify:

- *The different materials being used in the manufacture of oyster baskets;*
- *The effective life cycle of the materials;*
- *The scale of the oyster basket waste – where it is being stockpiled and how much waste is being generated;*
- *Who could receive and recycle the waste and the conditions that might apply to recycling;*
- *Technologies that could minimise the space of the waste for transport purposes; and*
- *The logistics and coordination of getting the waste to the recycler;*
- *By cost-benefit analysis the best possible options for the oyster industry for the disposal and recycling of the oyster basket waste.*

1.4 Stakeholders & participants

This study was undertaken by Rawtec and EconSearch. The study was commissioned by the South Australian Environment Protection Authority (EPA) and South Australian Oyster Growers Association (SAOGA), in response to a growing awareness that EOL oyster baskets were causing a significant waste problem for the SA Oyster Industry. Funding for the study was provided by the South Australian Department for Manufacturing, Innovation, Trade, Resources and Energy (DMITRE) through its Clever Green Eco-Innovation Program. Project management and administration support was provided by the Regional Development Australia – Whyalla & Eyre Peninsula, Inc. (RDA-WEP).The study was overseen by a Project Steering Committee comprised of representatives from the South Australian Oyster Industry, SOAGA, EPA, RDA-WEP and DMITRE. Extensive consultation was also undertaken during the study with various stakeholders, including: South Australian oyster growers; local government; State Government agencies (EPA, PIRSA, DMITRE, etc.); relevant landfill operators; waste contractors; and recycling providers.

1.5 Study approach

The study was conducted in line with the Terms of Reference (TOR) in the Project Brief (RDA Whyalla & Eyre Peninsula, March 2013).The main steps in the study involved:

- ***Consultant briefing meeting*** in Port Lincoln with the Project Steering Committee – to refine the project requirements and determine the consultation schedule.
- ***Research and consultation*** with oyster industry producers and recycling providers – including site visits to oyster growing areas on the Eyre Peninsula.
- ***Analysis*** of consultation outcomes, including:
  - Identification of materials used in oyster baskets and their life cycle;
  - Scale of the oyster basket problem;
  - Options for volume reduction, transportation and recycling of the waste oyster baskets;
  - Analysis of these options by Cost-benefit Analysis.
- ***Preparation of draft project findings & report***.
- ***Presentation and discussion of draft findings& report*** with the Project Steering Committee.
- ***Review of Industry comments & preparation of final project report***.

In addition, draft project findings developed during the study were presented to and discussed with oyster growers at the SAOGA Annual Seminar on 8 August 2013 at Smoky Bay.

1.6 Report organisation

This report presents the key findings of the study as follows.

Section 2 – Waste Oyster Baskets	• Introduces the different types of oyster baskets used in the South Australian Oyster Industry. • Identifies the materials used in oyster baskets. • Discusses the life cycle attributes of oyster baskets, including current disposal practices. • Estimates current waste volumes and size of existing waste stockpiles.
Section 3 – Recycling	• Identifies and analyses different recycling options for waste oyster baskets • Considers the logistics of preparing and transporting waste oyster baskets to recyclers. • Assesses the potential costs or savings which recycling may achieve.
Section 4 – Other Disposal Options	• Describes and assesses other waste oyster basket disposal options which the South Australia identified during the study which should also be considered.
Section 5 – Future Industry Scenarios	• Identifies future scenarios for implementation of recycling options for waste oyster baskets which would be subject to cost-benefit analysis
Section 6 – Cost-Benefit Analysis	• Presents the findings of the cost-benefit analysis for the above scenarios
Section 7 – Key findings & recommendations	• Sets out the key findings and recommendations arising from the study
Section 8 – References	• Lists reference documents cited in this report
Appendices	• Includes relevant additional and supporting information developed or used during the study

2 WASTE OYSTER BASKETS

2.1 Types of oyster baskets

There are a range of different types of oyster baskets that have or are being used by growers in the South Australian Oyster Industry. Based on consultations with oyster farmers, these different types of oyster baskets can be said to fall into the following four classifications. Photo examples for these basket classifications are shown in Figure 2.1 below, and additional descriptive details for each are given in Table 2.1 overleaf.

1. ***Two-setter or Rail***– a traditional but still popular home-made basket of high-density polyethylene (HDPE) mesh with wooden stakes (rails) which is suspended in the ocean on wooden racks (but can also be suspended on adjustable long lines).
2. ***Pillow basket*** – another form of home-made type of basket of HDPE mesh that is suspended in the ocean from height-adjustable lines, which is a new farming practice introduced to the industry about 20 yrs ago.
3. ***Manufactured basket*** – a more recently developed basket technology manufactured from extruded HDPE or polypropylene (PP), and also designed to be suspended from height-adjustable lines (interchangeably with pillow baskets).
4. ***Aqua-tray*** – an extruded PP basket that looks like an open tray that is only used by one grower on Kangaroo Island.

Classifications 1-3 above represent the most popularly used basket types and each are still in common use throughout the South Australian Oyster Industry – as illustrated in Figure 2.2 overleaf.

The past two decades have seen a transition away from the traditional two-setters or rail type baskets, first to pillow baskets, then to manufactured baskets. This transition has principally taken place in response to adoption of new oyster farming practices that use height-adjustable lines to suspend basket units, and the robustness and longer life that manufactured baskets offer. The extent of this transition has varied between different oyster growing areas. Consequently, some areas still use substantial numbers of two-setter baskets, whilst other areas now principally use pillow and/or manufactured baskets.

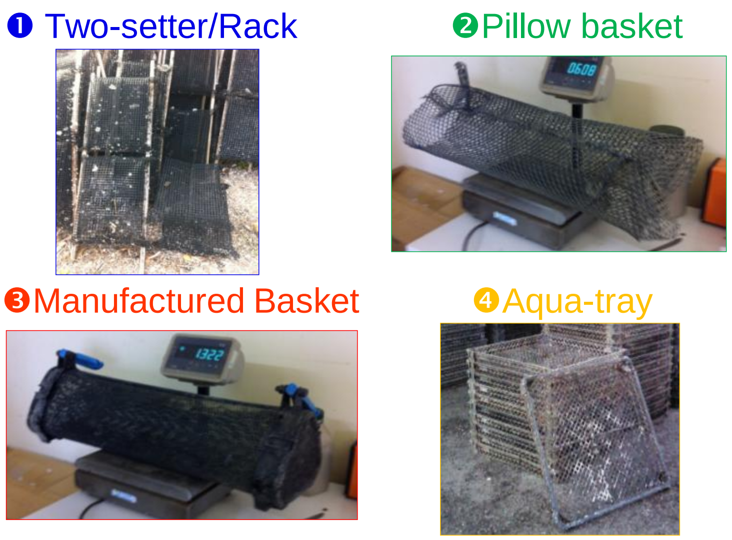

Figure 2.1: Examples of different types of plastic oyster baskets used by the South Australian Oyster industry

Table 2.1: Additional descriptive details for main oyster basket classifications

Main Oyster Basket Classifications	
1. Two-setter or Rail	*These baskets are made by oyster farmers using extruded high-density polyethylene (HDPE) mesh. The mesh is folded into a flattish, rectangular basket which can be totally enclosed or partially open on one face. Metal staples or plastic ties may be inserted to help secure and maintain the shape of the basket. Wooden stakes (or rails) are then inserted through two (or more in occasional cases) of the pillows on either side. The wooden rails are used to mount the baskets on racks located in intertidal zones. Nylon cable ties are used to repair holes in the mesh which might occur during use. Life of the basket can strongly depend on quality of HDPE mesh used.*
2. Pillow basket	*The pillow basket also uses extruded HDPE mesh. It is a totally enclosed basket made by oyster farmers, where the mesh is folded into a longish, rectangular pillow. Plastic (Bayco) wire is used to secure and maintain the shape of the basket and on which to mount plastic (or metal) clips so the pillow can be attached to lines suspended in intertidal zones. Nylon cable ties are also used to repair holes in the mesh which might occur during use.*
3. Manufactured basket	*These plastic baskets are partially or wholly made injection moulded components available from various manufacturers, which growers buy, then assemble. The plastic used can be HDPE or polypropylene (PP). The baskets include mounts for plastic clips so the baskets can be attached to lines suspended in intertidal zones. These baskets can come in a range of sizes and mesh aperture. They are more robust but heavier than the pillow baskets above.*
4. Aqua-tray	*The aqua-tray is a basket type only used on Kangaroo Island (at the current time). It is a legacy of a previous large-scale oyster farmer that went out of business in the 1990s, with remaining basket stock purchased and continuing to be used by a local grower. It is a square or rectangular open tray made from injection moulded polypropylene. In use, the baskets are stacked, one on top of the other.*

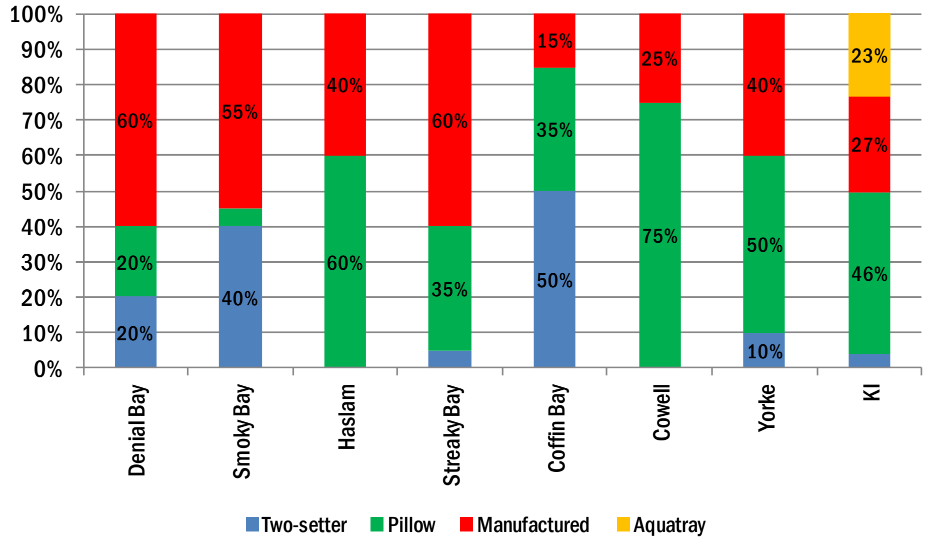

Figure 2.2: Approximate distribution of different basket types in current use by grower area. *Data obtained from consultation with SA Oyster Industry Bay representatives.*

2.2 What are oyster baskets made of?

Oyster baskets are substantially made of plastic – either HDPE or PP – except for two-setters which contain more timber (by weight). Other material components can include timber, metal and other plastics (e.g. nylon, acetal).Some of these material components are present in the basket when made or first used; others are incorporated into the basket as it is maintained &/or repaired during its service life.

Figure 2.3 (below) presents a high-level assessment of material composition by different basket classification (refer previous section). This figure also includes an estimate of the typical basket weight in each case. This assessment was based on information and data provided by oyster growers and manufacturers of oyster basket materials and components.

It should be recognised that the composition and weights suggested in Figure 2.3 are approximate as in reality oyster baskets come in all shapes and sizes and with different types and levels of material components. In this respect, each oyster farmer has their own unique approach to selection of the types and sizes of baskets and the material components they will use. This approach can be dictated by the: marine environment they are growing oysters in; size of oyster (or growth stage); the scale and type of oyster farm; their own experiences with different baskets; and personal preferences on what baskets they believe work best for them.

In the case of manufactured baskets, it should also be noted that this technology is still rapidly evolving. New generation designs are emerging which, by reducing the type and number of different material components, have improved their suitability for recycling (when they reach EOL).

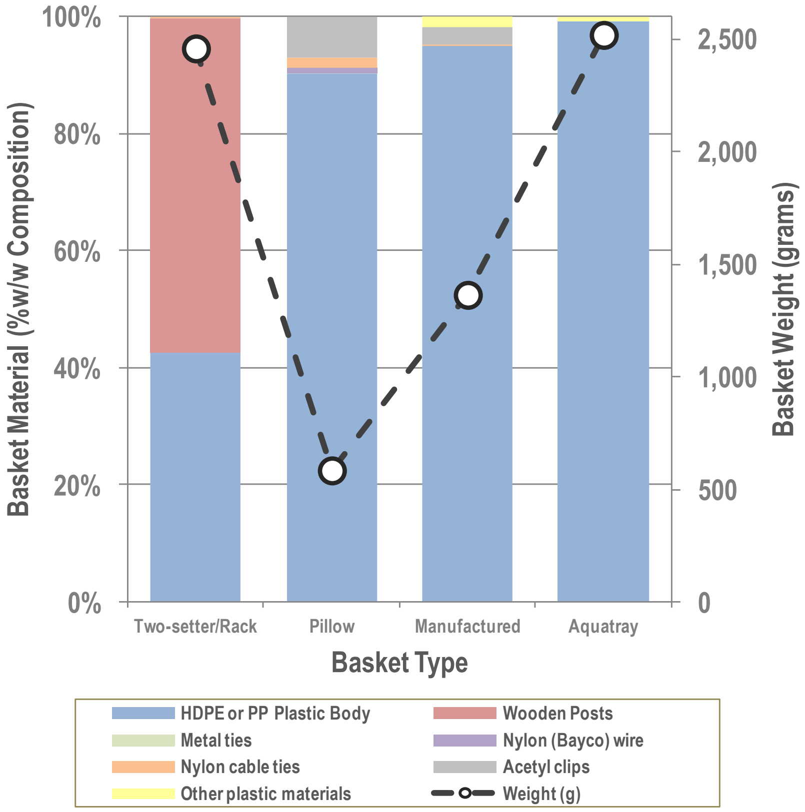

Figure 2.3: Estimated composition of different oyster basket types, including HDPE or PP plastic content.

2.3 Life cycle of oyster baskets

Oyster baskets usually last between 10 and 20yrs, but some can fail earlier and others will last longer. The life of a basket depend a range of factors, including:

- Type of basket,
- Quality and strength of plastic body material,
- Quality of construction,
- Marine conditions (which can affect wear rates for different basket components), &
- Handling & maintenance practices.

All of the above factors are often unique to individual circumstances experienced by a grower, who will ultimately judge when a basket has reached EOL. This EOL decision will be influenced by a number of considerations, including:

- The time and cost of repairing the basket *vs.* replacing it;
- Potential for subsequent failure during service which may result in loss of valuable product;
- Changes in oyster farming practices taking place.

EOL events for different types of oyster baskets across the South Australian Oyster Industry, therefore, cannot be identified by a single time point (e.g. all fail at 5yrs, 10yrs, etc.)

Instead, a "probabilistic" description was developed in consultation with oyster growers and basket manufacturers. This description is represented graphically in Figure 2.4 overleaf. This description allows for the fact that when baskets are new some may fail, but not many. As time passes, the failure rate increases, until at some point in the future, all of the baskets have reached EOL. Furthermore, it takes into account that this EOL behaviour could be different depending on growing area and grower circumstances. Figure 2.4 shows the number of baskets (for each classification) assumed to be left out of 100 new baskets, with service life. This figure suggests:

- Two setters and pillow baskets have a similar life cycle and most (e.g. 50-70%) will last for 10 yrs at least (but some may last up to 15 yrs).
- Manufactured baskets last longer and most are able to remain in service until 20 yrs.
- The Aquatray would be the longest-lasting, with most basket units reaching a life of 20-25 yrs.

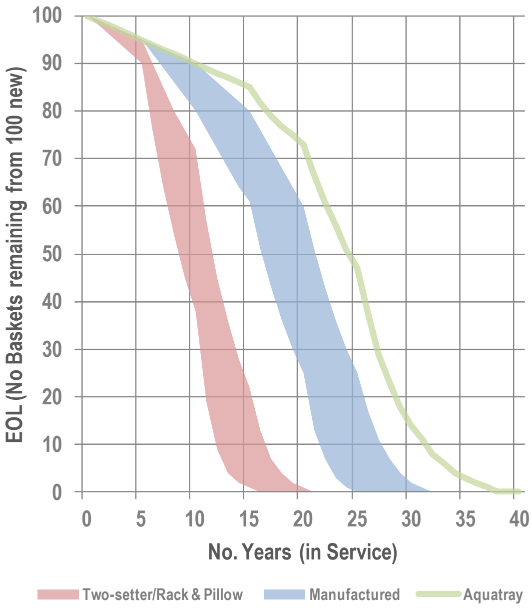

Figure 2.4: Expected life cycle or EOL outcomes for different baskets classifications

2.4 What happens when oyster baskets are disposed of?

The manner in which oyster baskets are disposed also varies according to growing area and depends on individual grower practices. In general, oyster growers are currently handling waste oyster baskets by the following two methods.

- ***Sending it for landfill disposal***
  - This disposal would usually occur to the nearest available landfill – either directly (to landfill) or via a local Transfer Station; or
- ***Stockpiling for disposal at a later date***
  - These stockpiles can be located on-property or at a third-party location.
  - Some growers have conducted shredding trials to reduce the volume of these stockpiles, which was intended to make it more cost-effective for potential transport to a recycler.
  - There has also been a baling trial at one site, which again was intended to make the waste more compact for potential transport to a recycler.

Table 2.2 overleaf provides more details on disposal practices understood to be currently occurring in each grower area (see also Figure 1.1 for location and size of each area). This information was obtained from consultations with the SAOGA Bay Representative for each grower area.

Figure 2.5 below provides photo examples from site visits that illustrate how this material looks when it reaches EOL and is stockpiled. Pictures of oyster baskets after the shredding or baling trials (mentioned above) are also shown. Photo 1 in Figure 2.5 indicates how baskets can look when they immediately reach EOL. This photo shows that the baskets can contain a large amount of biological fouling, most notably attached barnacles and enmeshed oyster shells. Most of this biological material will disappear from the baskets if left exposed to the environment for a period of time; usually at least 6-12 months (or longer) is required. Photo 2 in Figure 2.5 shows how clean the baskets can become after being stockpiled for such a period of time. Many oyster growers already use this natural approach to cleaning for removal of biological fouling from their oyster baskets (where others rely on high-pressure cleaners).

Figure 2.5: Photo examples of waste oyster baskets observed in different states following disposal or after shredding or baling

Table 2.2: Summary of current oyster basket disposal practices occurring in each growing area (refer Figure 1.1 for location and size of each area)

Grower Area	Current disposal practice
Denial Bay	*Most of the growers (>90%) are currently stockpiling their oyster baskets. The practice of stockpiling commenced around 2000 and rapidly took the place of disposal to the landfill at Ceduna, which is operated by the local council. A grower in Denial Bay was the site of one of the recent shredding trials.*
Smoky Bay	*Smoky Bay growers have been stockpiling their oyster baskets since around 2000, after their local landfill was closed.*
Haslam	*Growers in Haslam are generally disposing to their local landfill operated by the Streaky Bay District Council. This local landfill, however, is scheduled to be closed and replaced by a landfill at Cungena, at least 60km away.*
Streaky Bay	*Some limited stockpiling is occurring in this area but Streaky Bay oyster growers have largely been disposing their oyster baskets to a local landfill. This local landfill is also scheduled to be closed and replaced by the new Cungena landfill 60km away from the town.*
Coffin Bay	*In this area, growers at Little Douglas, which is about 15-20km away from the township, are stockpiling. Most growers based in the Coffin Bay township, however, are taking their baskets to a local council-operated Transfer Station, which sends the baskets for disposal at a landfill near Tumby Bay.*
Cowell	*Most growers are sending the baskets to the local Council owned and operated landfill site near the town. However, the Council has started stockpiling some of these baskets with a view to finding an alternative disposal option. The Council has had some of these stockpiles shredded so they would take up less space if disposed to landfill.*
Stansbury/Port Vincent	*Growers in this area have been stockpiling as the cost of disposal at a local council Transfer Station, which is operated by a private contractor, is seen as prohibitive.*
Kangaroo Island	*Nearly all growers have been stockpiling. Disposal to landfill via a local Transfer Station is considered expensive as the waste must be transported of the Island to a landfill site near Adelaide.*

2.5 How much waste is being generated?

To estimate the volumes of waste oyster baskets being generated a model of the South Australian Oyster Industry was developed. This model employed the following parameters to estimate past, present& future annual generation rates of waste oyster baskets in each oyster growing area and in total for the whole Industry.

- Lease area
- Development history
- Basket types being used
- Basket density (or number of baskets per area under cultivation or development)

Relevant data for these parameters were obtained from consultations with South Australian Oyster Industry Bay representatives and other individual oyster growers. Figure 2.6 overleaf shows the estimated annual generation rate of waste oyster baskets from 1990 to 2030 obtained from this model for the entire SA Oyster Industry. Figure 2.7 also overleaf, gives the annual generation rates predicted by the model by grower area for 2013.

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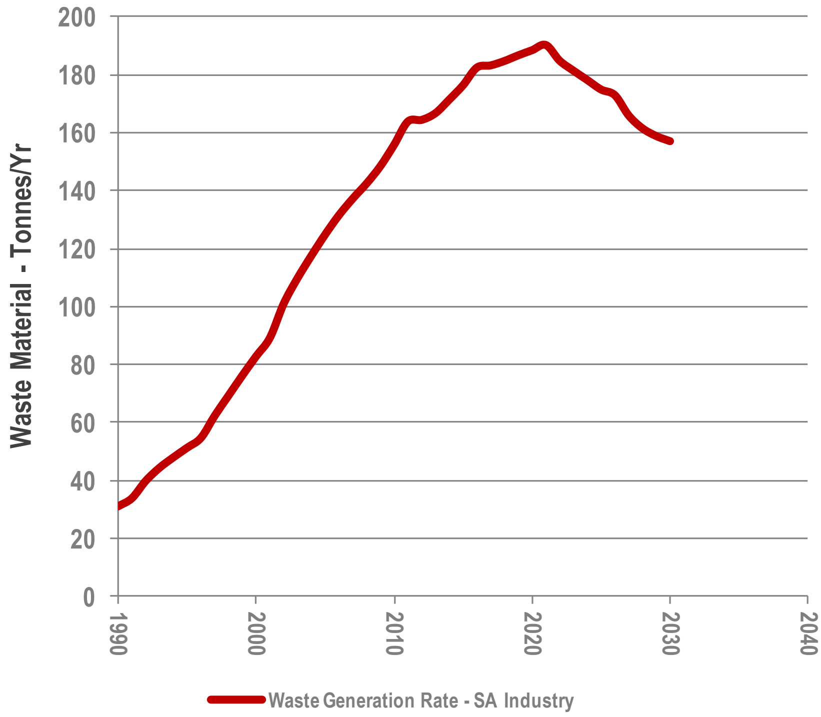

Figure 2.6: Estimated waste oyster basket generation rates in the South Australia Oyster Industry – from 1990 to 2030

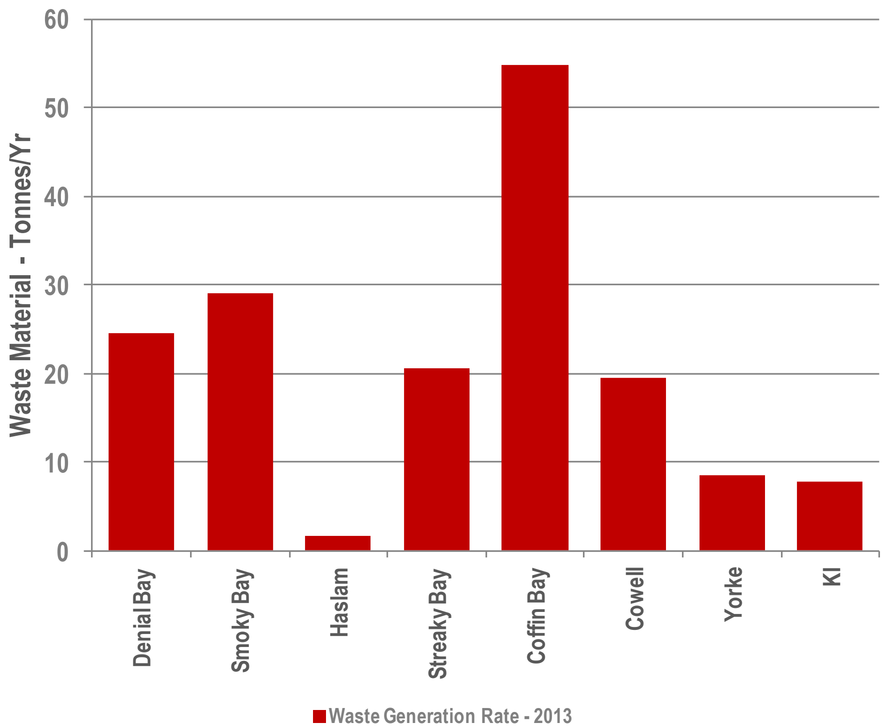

Figure 2.7: Estimated waste oyster basket generation rates in 2013 by grower area

Figure 2.7 shows that waste oyster basket generation rates in the industry have gradually been escalating. This escalation has occurred because most of the current industry was established during the early 1990s. It continued to expand over the next decade and a half (1990-2005), but then consolidated to around its current size. During this time, oyster baskets in service were relatively new and not many needed disposal. Many of these new baskets have started reaching their EOL during the past 10 yrs, and as a consequence, generation rates have increased in response.

The rate of generation is expected to peak at between 180-200 tonnes/yr around 2020, which is equivalent to 150-200 thousand waste baskets each year. After this time, the effect of newer and longer lasting basket technologies which have since been introduced will be seen. A future contraction of the industry is also expected (based on grower reports). These factors will act to reduce generation rates of waste oyster baskets to between 140-160 tonnes/yr by 2030.

Figure 2.7 shows the relative rates of waste generation expected between the grower areas. Rates of generation are generally proportional to the area under development but also affected by type of baskets being used and when these areas were first established.

2.6 How much waste is being stockpiled?

The volume of waste stockpiled is different to the total volume of waste that has been generated, because in the past some of the waste has already been disposed to landfill (or via alternative routes). By taking into account these previous, as well as future expected, disposal practices the above model was used to assess the volume of waste oyster basket material that has and will be stockpiled by the SA Oyster Industry.

Figure 2.8 overleaf shows the results of this assessment. This assessment estimates the total tonnes of waste oyster basket material that has been or is expected to be stockpiled across South Australia since 1980. It suggests that the current stockpile (2013) is about 1,300 tonnes (which is approximately 1 million oyster baskets). This stockpile will continue to grow rapidly and could reach nearly 2,500 tonnes by 2020 if there is no change in current disposal practices.

Figure 2.8 also provides an estimate of the plastic content – HDPE & PP – present in the stockpile. These estimates indicate the stockpiles contain substantial plastic material that could be recycled.

Figure 2.9 overleaf suggests the distribution of the current stockpile (2013) between grower areas. The stockpile present in each area is reflective of its waste oyster basket generation rate and past disposal practices. Some areas that have been until recently disposing to landfill have very small stockpiles whereas other areas with larger stockpiles have already been stockpiling for more than 10-15yrs.

Figure 2.9 also shows that the plastic content of the stockpile varies between grower areas. This variation is due to the different mix of basket technologies that have or are being used in these grower areas. Areas that that have continued to use two-setter type baskets have lower plastic content in their stockpiles, whereas stockpiles in areas that have adopted pillow or manufactured baskets generally have higher plastic content.

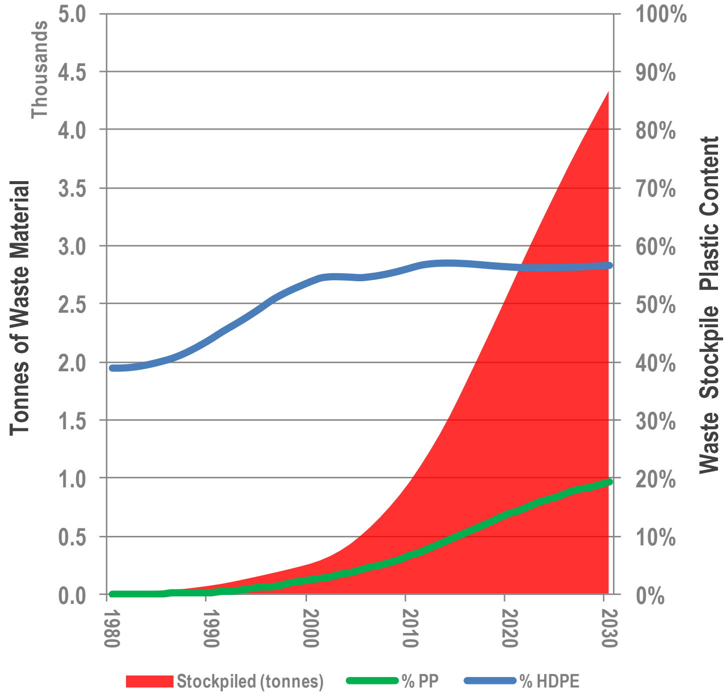

Figure 2.8: Estimated stockpile build-up across SA Oyster Industry from 1990 to 2030, including plastic content (%HDPE & %PP, by wt.)

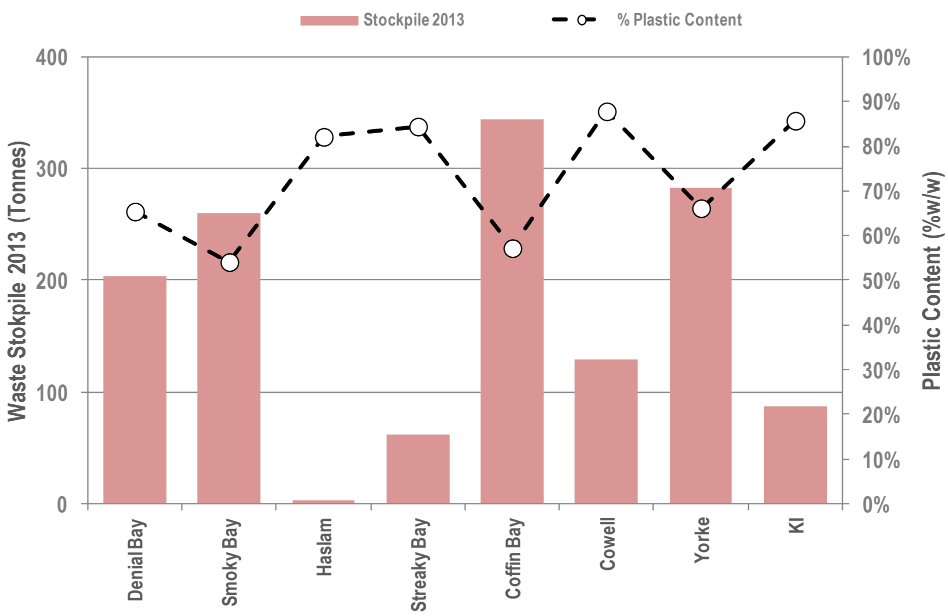

Figure 2.9: Estimated stockpile (2013) distribution by Bay, including plastic content (% by wt.)

3 RECYCLING

3.1 Key steps in recycling of plastic materials in waste oyster baskets

The main component in waste oyster baskets that has value for recycling is the plastic material, specifically HDPE and PP. In this respect, the recycling of these plastic materials can be seen as a supply chain (see Figure 3.1 below), which involves the following steps.

1. ***Source separation*** – where the plastic materials are separated out of the waste material so they are suitable for resource recovery into a form that can be recycled.
2. ***Preparation for collection*** – this can involve pre-processing, usually to reduce volume, of the plastic material so it is suitable for cost-effective transport to a resource recovery facility
3. ***Collection& transportation*** – the plastic materials must be collected and transported to the resource recovery facility.
4. ***Aggregation*** – plastic materials from various sources may be aggregated together to create sufficient volume to achieve economies of scale in resource recovery
5. ***Resource recovery*** – This step provides additional separation and removes any residual contaminants, then converts the material in a form (e.g. granular) suitable for recycling.
6. ***Recycling*** – The resource recovered material is recycled by being used to manufacture a product.

In this supply chain it is important to recognise that the oyster grower is not the customer but the supplier. As a consequence, the form (and also value) in which the waste material will be accepted by the supply chain is usually dictated by the party responsible for aggregation, resource recovery &/or recycling. The first necessity is therefore to identify who these parties are and what their requirements might be for accepting the waste oyster baskets for recycling purposes.

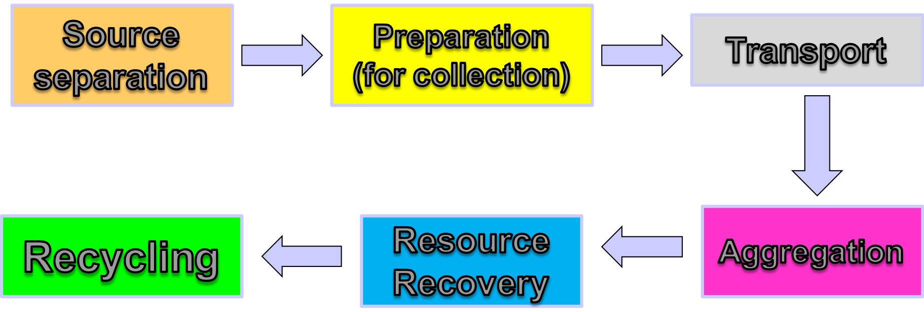

Figure 3.1: Key steps in supply chain concept for recycling of plastic materials

3.2 Who could recycle plastic materials in waste oyster baskets?

Various companies or organisations involved with directing waste HDPE and PP collected in South Australia for recycling were contacted. A list of these companies or organisations is included in Table 3.1 overleaf. Each company or organisation was provided with much of the information presented in Section 2 of this report, and asked to provide feedback on whether they would be willing to accept this waste oyster material, in what form, and whether they would pay oyster farmers for it.

{Cont. below Table 3.1 overleaf}

Table 3.1: Overview of companies or organisations involved with directing waste HDPE and PP collected in South Australia to recycling that were contacted by this study

Company/ organisation	Nearest Potentially Relevant or Key Location(s)	Role in HDPE & PP plastic recycling supply chain	Destination for materials received
Advanced Plastics Recycler	Kilburn (Adelaide)	Recycler	N/A: Does not received waste plastic directly, uses re-processed material supplied by others to manufacture recycled products.
Plastics Granulating Services	Kilburn (Adelaide)	Aggregator; Resource recovery	Converts waste HDPE and PP into granulated material that it sells locally and/or overseas for recycling
Plastic Recyclers Australia (PRA)	Port Pirie	Aggregator; Resource recovery; Recycler	Collects relatively clean waste plastics from around South Australia, re-processing and recycling some locally, but also on-selling material to others.
SITA	Wingfield (Adelaide)	Aggregator	Collects or accepts waste material containing plastics and aggregates for sale to others or sends to recovery facility
Transpacific	Port Augusta, Inkerman, Adelaide and other regional locations	Aggregator	Collects or accepts waste material containing plastics and aggregates for sale to others or sends to recovery facility
Veolia	Port Lincoln, Port Augusta, Whyalla, Port Pirie, Adelaide and other regional locations	Aggregator; also operates a residential MRF at Whyalla	Collects or accepts waste material containing plastics and aggregates for sale to others or sends to recovery facility
YCA Recycling	Adelaide	Aggregator	Collects or accepts relatively clean plastic materials and exports to China for recycling

The key findings from this feedback were as follows.

- Most of these companies or organisations were “aggregators” and did not necessarily have in-house or local capabilities for advanced resource recovery of HDPE or PP material from the waste oyster baskets.
  - In essence, these parties collected relatively clean forms of single polymer plastic waste material that they could easily aggregate and directly on-sell to others, including exporting overseas, for resource recovery &/or recycling.
  - There was very little interest from these parties in the waste oyster baskets due to potential contamination by other materials and biological fouling.
- Two of the companies with local resource recovery &/or recycling capabilities expressed interest in the waste oyster baskets.
  - One of these companies subsequently expressed reluctance to accept the waste oyster baskets.
    - They had previously seen a relatively clean pile of pillow baskets that had been pre-sorted and baled by a grower, which had generated initial interest.
    - But they become reluctant once the wider range of contaminants and mixed nature of the whole-of-Industry waste stream was identified to them.
    - They had limited resource recovery &/or recycling capabilities which would probably not be able to handle this whole-of-Industry waste stream.

- The other company, which was Plastics Granulating Services (PGS), expressed strong interest in working with the oyster industry to find a way of accepting the material.
    - PGS had a more advanced resource recovery facility that could handle the potential contaminants that might be present in the waste oyster baskets.
    - They were also willing to pay a rebate (potentially up to $200/tonne was mentioned) to growers for the waste based on the quality, type and amount of plastic content.
- For PGS to accept the material, however, the following was required.
    - Biological fouling would need to be minimal but some slight contamination could be tolerated.
    - The waste needed to first be sorted into single polymer form: PP or HDPE.
    - Major contaminants, including timber, plastic wire and plastic clips, had to be largely removed (if present), e.g. to <1-2% by wt.
    - Preference by PGS was for supply of (the pre-sorted) material in a baled or “as-is” form but shredded material could be okay if presented sorted, “clean” & as single polymer.
    - Oyster growers would be expected to organise their own transport to send the waste material to the PGS Kilburn site in Adelaide.
    - PGS would re-process the material and on-sell it to recyclers.

PGS therefore provides the main opportunity for the SA Oyster Industry to successfully achieve recycling of its waste plastic oyster baskets.

In this respect, PGS has a relatively modern resource recovery and waste plastic re-processing facility, which is consistent with “best-practice” recycling of waste plastic materials. The granulated waste plastic products PGS produces from this facility are sold locally and exported overseas for manufacturing of diverse products used in other industries for a range of purposes.

Current customers of PGS include South Australian company Advanced Plastic Recyclers (APR), which takes granulated HDPE from PGS and uses it to manufacture wood-plastic composite products. Some of these APR products are already finding application in the SA Oyster Industry and other aquaculture industries. There are also believed to be other Australian companies that re-processed HDPE and PP from PGS that are manufacturing similar recycled plastic products for the aquaculture industry. Consequently, the above recycling approach offers the SA Oyster Industry an avenue to contribute to “closing-the-loop” in its disposal of waste oyster baskets, albeit indirectly.

3.3 How could recycling be achieved in practice?

In view of the above feedback, the steps in Table 3.2 below are recommended in order to successfully send the waste oyster baskets to PGS for recycling. These steps are also visualised in Figure 3.2below. This figure also demarcates those steps which the SA Oyster Industry would need to be responsible for organising.

It should also be noted that Step 1 of this recommended approach would likely require disposal to landfill of residual material resulting from sorting of baskets to remove contaminants. This residual material will be greater in those areas which have a significant proportion of two-setters in their waste stream due to the high timber content.

Table 3.2: Recommended steps for recycling of waste oyster plastic baskets

1. Cleaning &/or sorting	• Biological contaminants removed, e.g. high-pressure cleaned or stockpiled for 'natural cleaning'
	• Baskets sorted to:
	  o Remove major contaminants, e.g. timber, plastic clips & wire
	  o Separate HDPE and PP basket materials
	• Residual material from above sorting would be disposed of to landfill.

2. Volume reduction for transport	• Baskets may need to be baled or shredded to reduce volume for cost effective transport
3. Transport	• Pre-sorted and baled or shredded baskets would be loaded onto trucks and sent to PGS in Adelaide • A rebate would be paid by PGS to the grower depending on weight and quality of material
4. Re-processing	• PGS would undertake final resource recovery and re-process material into form suitable for recyclers • PGS would also have a small residual from this process that would need to be disposed to landfill.
5. Recycling	• Recyclers would buy the re-processed plastic material and use it to manufacture products

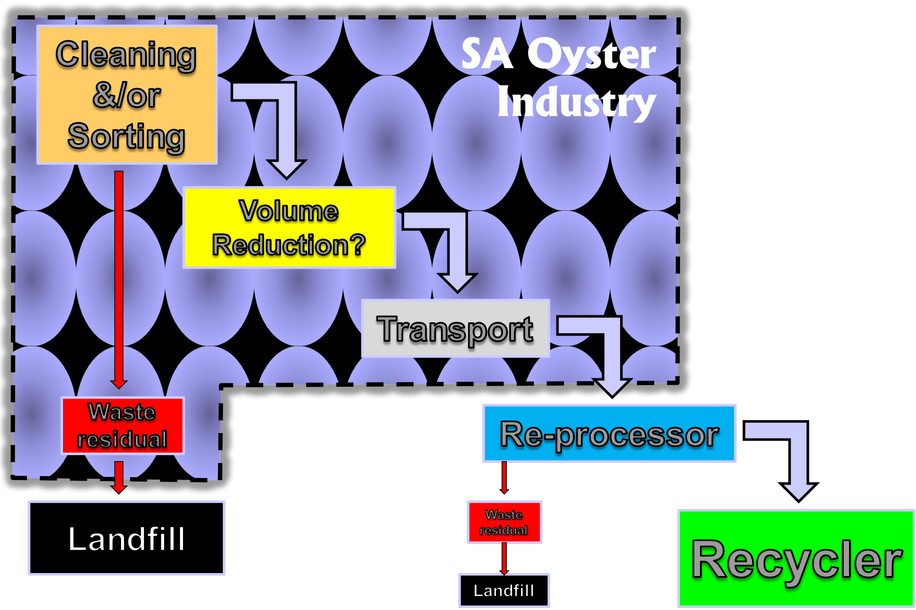

Figure 3.2: Visualisation of key steps required to achieve recycling of plastic content in waste oyster baskets

3.4 Logistics & transport issues

This section addresses the potential logistical and transportation challenges of implementing the recommended approach identified above. The possible permutations in logistical and transport arrangements for dealing with this waste material across the different grower areas are multiple and considerable time was spent assessing these challenges. The following therefore provides a summary overview of the assessment conducted, focussing on explaining the approach that was reasonably adopted for cost assessments (presented in the next section). Actual implementation of a recycling solution could reasonably occur via an alternative approach.

3.4.1 Cleaning to remove biological fouling

This process could be conducted by using a high pressure cleaner or stockpiling for 6-12 months and using exposure to the environment to allow natural cleaning to occur. These approaches are the same as already practiced by oyster growers.

3.4.2 Sorting

This sorting step could be undertaken by the oyster grower or employees, or by using contract labour. If the latter, there could be advantage in growers cooperating to coordinate and organise sorting in growing areas or across the Industry to achieve cost-efficiencies.

There could potentially be significant labour requirements to sort existing stockpiles, as well as future waste material. Figure 3.3 below shows the results of a high-level assessment for the total labour time inputs needed to sort the existing (2013) stockpiles in each growing area. The equivalent of 3 yrs of one person working five days a week, eight hours a day, was estimated. In practice, the task would most likely be handled by teams of multiple people, but this estimate reflects the scale of effort that would be needed.

The amount of labour input to sort existing stockpiles or future oyster basket waste is strongly dependent on the types of baskets used by a grower. For instance:

- Manufactured baskets are much quicker to sort than two-setters and pillow baskets;
- Aquatray baskets require little or no sorting at all.

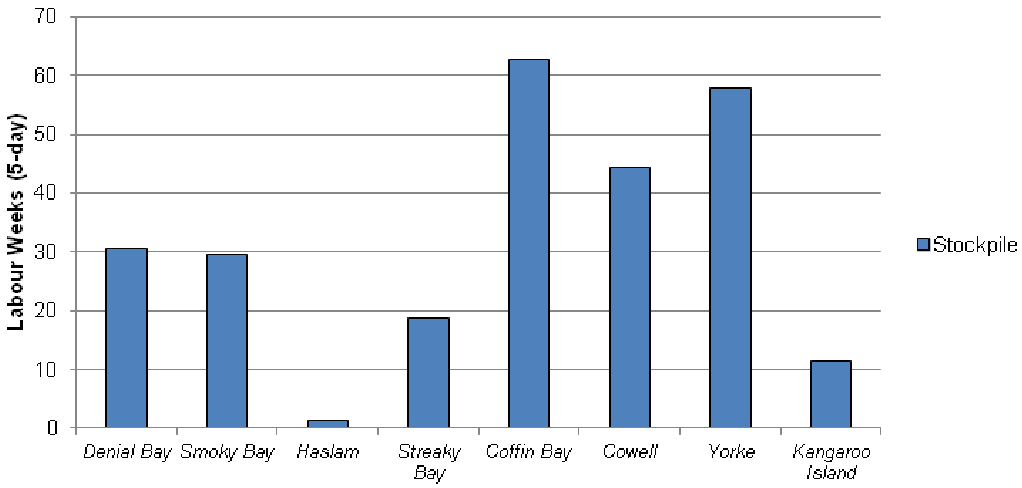

Figure 3.3: High-level assessment of labour time inputs for one person working 5-days per week, eight hours per day, to sort the existing (2013) stockpile

3.4.3 Volume reduction

During this study, a number of companies involved with regional freight from Adelaide, Eyre and Yorke Peninsulas and Kangaroo Island were contacted to identify the best way of transporting the waste oyster baskets from grower areas to a potential recycler in Adelaide (or elsewhere). A common message received from these companies was that, due to the bulky nature of the oyster baskets, lowest cost transportation outcomes were likely to be achieved if the baskets were first processed to reduce their volume.

There a number of potential technologies available to reduce waste volume, which include chipping, shredding &/or granulation, and baling. These technologies, which are readily available from a range of companies in South Australia, can come with different 'sizes' and capabilities, which influence potential processing rate or time (and hence economics). These machines can be mobile or static. Some of these companies lease machines to customers &/or use them to provide commercial volume reduction services on a contract basis (including in regional areas where oyster farmers are located).

In this respect, volume reduction of waste oyster baskets has been investigated and the subject of shredding and baling trials undertaken by the some growers in the Industry. Based on consultations with relevant parties the following results were reported from these trials.

- ***Shredding trials*** –
    - Due to their bulky nature and plastic structure, the waste oyster baskets were not able to be easily or rapidly shredded using standard mulching or shredding equipment commonly used in regional areas for garden organics. Instead, an industrial-grade type shredder suitable for shredding tyres or timber was employed during the trials at Denial Bay and the Cowell waste depot. A photo of the shredder used at Denial Bay, obtained from the private contractor that undertook this trial, is shown in Figure 3.4 below.
    - These trials suggested that the waste oyster baskets could be processed at rates of up to 5-tonnes/hr.
    - Some problems, however, were experienced during the trials with the presence of the Bayco wire in pillow baskets, which would wind around the shredder shaft and had to be removed periodically by stopping the machine. This observation would suggest that this material needed to be first removed from baskets before shredding.
    - This type of shredding equipment was currently only available from private contractors. These private contractors charged for use of the shredder on an hourly or per tonne or m^3 rate. These private contractors were already periodically providing shredding services to local Councils for timber, tyres and other waste materials at waste depots on the Eyre Peninsula (and also in other regional areas).

Figure 3.4: Picture of industrial-grade shredder that was employed for waste oyster basket shredding trials at Denial Bay. *Source: Chris Curran, Integrated Recycling (Mildura, Victoria)*

- ***Baling trials*** –
    - The baling trial was conducted by an oyster grower and with the involvement of a recycler looking to take the waste oyster baskets.
    - The trial is believed to have involved a mobile horizontal baling machine 'borrowed' from a local council and commonly used for cardboard.
    - Problems were experienced during the baling trial due to the bulky and "springy" nature of the waste oyster basket material. After a compression cycle, the baskets would re-expand, substantially reducing the baskets that could be added for the next compression cycle. This caused time delays and made loading of the baskets more manually intensive. It apparently took a couple of hours to load and form 2-3 bales – a processing rate of < 1 tonne/hr.
    - The baling trial was therefore not considered to be successful from a practical perspective. However, it was proposed that the performance could have been improved by increasing the capacity of the loading chamber.
    - However, it was noted that baling equipment was considered less expensive than shredding equipment and could have wider application for use with other waste materials.

From the above, it is evident that either shredding or baling could work for reducing volume of the oyster baskets. An assessment was therefore conducted to compare the relative performance of each in potentially reducing the volume of different waste oyster basket types. The results of this assessment are shown in Figure 3.5 below. This figure indicates the volume in cubic meters (m^3) needed to hold 1,000 waste oyster baskets (e.g. during transportation) if "as-is" or unprocessed, shredded or baled. It suggests that:

- Both baling and shredding could significantly reduce the volume (by a factor of 3 to 4) needed to transport waste oyster baskets (except for baling in the case of Aquatrays).
- Shredding was projected to achieve a better (two-setters, manufactured baskets, aqua-tray) or equivalent (pillow baskets) volume reduction outcome to baling.

These results, when relative processing rate is considered, suggest that shredding might be the preferable approach for volume reduction where needed.

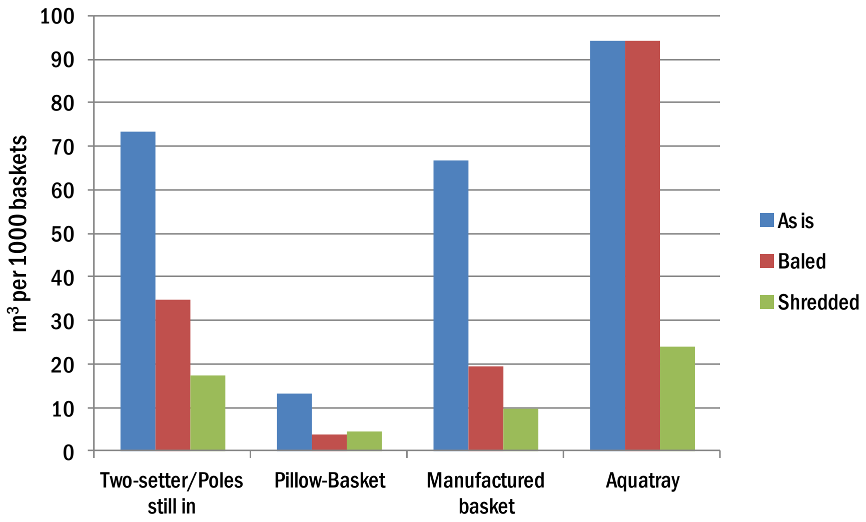

Figure 3.5: Relative volume reduction predicted for shredding and baling for different types of waste oyster baskets.
Note: Volume reduction achieved with two-setters without poles (i.e. after sorting) was also assessed but is not shown in this figure.

3.4.4 Transport to recycler

The above-mentioned discussions with transport or freight companies also addressed the optimal logistical approach for transportation of waste oyster basket material. Key outcomes included:

- Transport costs from regional locations to Adelaide could be highly variable and were very dependent on trailer type, load size, distance and timing.
- The lowest freight cost could be achieved where there was opportunity for "back-loading", where a truck, having delivered its load to a regional location, would otherwise have to return to Adelaide empty.
- These "back-loading" opportunities depended on timing, an area where the SA Oyster Industry had an advantage as it had flexibility in scheduling the disposal of waste oyster baskets.
- In this respect, it was suggested that seeding events by farmers offered a significant opportunity for cost-effective transport.
    - At these times, super-phosphate was delivered from Adelaide to practically every regional location where oyster growers were currently located.
    - These deliveries were made by road trains that used "tipper" trailers – see Figure 3.6 below – which was considered ideal for off-loading the waste oyster basket materials on return trip to a recycler in Adelaide.

Figure 3.6: Picture of a road train with two "tipper" trailers. *Source: Freightmaster Semi-trailers (Burton, South Australia)*

Data was also collected from these transport and freight companies to model expected transport costs. This data was used in this study to estimate the transport costs that might be incurred for sending waste oyster baskets from each of the main growing areas to a recycler in Adelaide under different scenarios. Figure 3.7overleaf shows an example of these estimated transport costs. This figure compares the relative $/tonne cost of transporting (sorted) waste oyster baskets from a grower area to Adelaide depending on whether the baskets are "as-is" (i.e. not shredded) or shredded first. In this figure the following can be observed.

- Transport costs to send waste baskets "as-is" were estimated to be significantly more than if the material was shredded first.
- The estimated transport cost is generally proportional to the road transport distance from that location to Adelaide, but is also affected by the type of baskets used at that location.
- An important exception to the above is Kangaroo Island, where there is a substantially higher transport cost due to the ferry crossing from the Island to Jervois Peninsula.

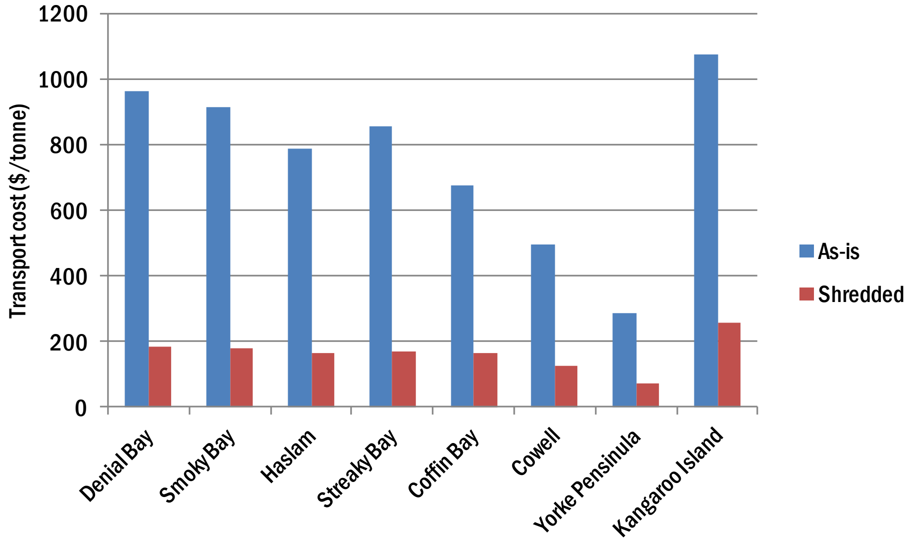

Figure 3.7: Comparison of relative transport costs (in $/tonne) for "as-is" *vs.* shredded (pre-sorted) waste oyster baskets from different grower areas.

3.4.5 Waste residual disposal

The above recommended approach essentially involves pre-sorting the baskets to remove non HDPE or PP plastic components and other contaminants. Pre-sorting would leave a residual that requires disposal. It is expected that this disposal would occur to the nearest local landfill – either directly or via a transfer station. Given the volumes of this material would be substantially lower, transportation could be achieved directly by growers or by local transport contractors. Consultations were undertaken with local Councils and private waste contractors on Eyre and Yorke Peninsulas and Kangaroo Island to identify local waste disposal costs. Figure 3.8 below provides an estimate of the relative costs for disposal of this waste residual in $/tonne by grower area. These costs include both cost of acceptance at the landfill or transfer station and an allowance for transport. The waste residual disposal costs for Yorke Peninsula and Kangaroo Island were greater than for other locations due to the high "gate rate" charged for acceptance of waste material at transfer stations in these locations.

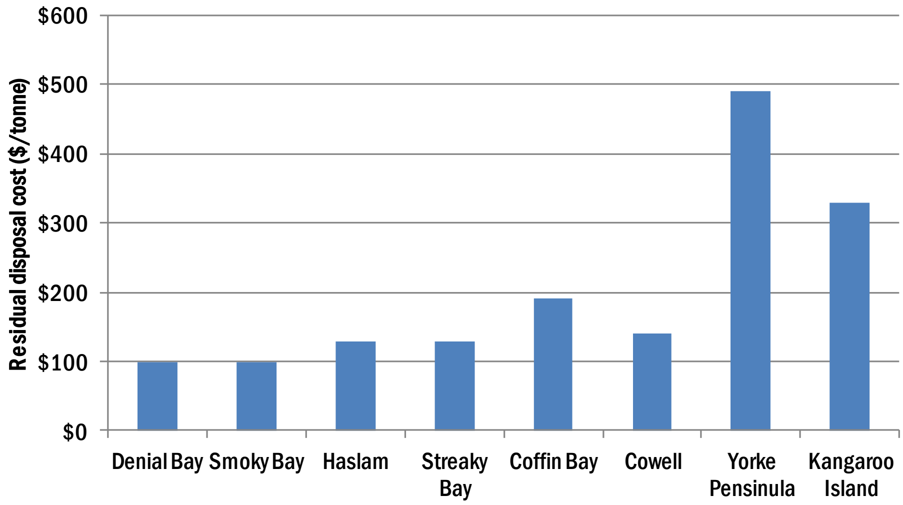

Figure 3.8: Estimated disposal costs (in $/tonne) for waste residual from pre-sorting of waste oyster baskets

3.5 How much could recycling cost?

To assess the potential costs of recycling disposal the waste oyster baskets, individual costs and savings for oyster growers to undertake individual activities in Steps 1-3 of Table 3.2 were assessed for each grower area for the following scenarios.

- ***Scenario 1*** – Disposal of current stockpile (commencing in 2014/15);
- ***Scenario 2*** – Disposal of future waste volumes (on a periodic basis every 2-3yrs).

The following set of individual activities for recycling disposal of the waste oyster baskets were assumed for each scenario.

- ***Pre-sorting*** – to remove non HDPE and PP components & separate into HDPE or PP piles
- ***Pre-processing*** – by shredding to reduce volume for transportation
- ***Freight*** – collection at grower locations and transport to PGS in Adelaide using road trains with tipper trailers
- ***Gate rate/rebate*** – Payment of rebate by PGS at $100/tonne of HDPE or PP material, which takes into account that a lesser rebate may be received for shredded material.
- ***Residual disposal*** – Cost of disposing of residual material (from pre-sorting) to local landfill or transfer station

Note: It is recognised that the above approach is not the only one for recycling disposal that could be taken, but based on consultations and earlier analyses it is believed to be one of the most cost-effective. For example, it could be possible to sort the baskets but not shred them; however the cost saving from avoiding shredding would likely be outweighed by significantly higher freight costs.

The results of this assessment are summarised in Table 3.3 and Table 3.4overleaf. These results are expressed as $/tonne of the original waste material by individual activity and for the Nett Total Cost. In this respect, the rebate value of $100/tonne assumed for each tonne of plastic from PGS was nominally discounted to reflect the amount of plastic that would be recovered from the waste oyster baskets and actually received by PGS. Similarly, the residual disposal costs (in Figure 3.8) were discounted for percentage amount of waste residual generated from pre-sorting which would be sent for disposal.

These tables suggest:

- The costs for recycling disposal could substantially outweigh the potential rebate or value of material that would be recovered for recycling.
- Recycling disposal costs could vary substantially between grower areas, but were generally in the range of $300-600/tonne (of waste material).
    - The reason for this variation is principally due to different types of baskets being used, number of sites and volumes of waste material at each location, and different location-specific transport and residual disposal costs.
    - For example, Haslam produces much smaller volumes of waste than other areas, and therefore, does not achieve the same economies of scale for pre-sorting and pre-processing activities.

{Cont. overleaf below Table 3.4}

Table 3.3: Approximate cost in $/tonne for recycling disposal of waste oyster baskets for Scenario 1: Current stockpile (commencing in 2014/15)

Recycling Step	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-sorting	$121	$93	$221	$186	$138	$265	$194	$110
Pre-processing (Shred)	$98	$85	$408	$158	$87	$138	$97	$135
Freight	$124	$100	$136	$146	$95	$113	$48	$225
Gate Rate/Rebate	-$67	-$56	-$85	-$86	-$58	-$89	-$67	-$87
Residue Disposal	$33	$44	$17	$18	$79	$16	$161	$42
TOTAL NETT COST	**$308**	**$266**	**$696**	**$422**	**$341**	**$442**	**$433**	**$425**

Table 3.4: Approximate cost in $/tonne for recycling disposal of waste oyster baskets for Scenario 2: Future waste volumes (on a periodic basis every 2-3yrs)

Year	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-sorting	$103	$84	$187	$123	$131	$228	$198	$79
Pre-processing (Shred)	$124	$128	$255	$156	$103	$157	$229	$179
Freight	$138	$123	$135	$141	$100	$113	$66	$247
Gate Rate/Rebate	-$81	-$73	-$90	-$90	-$66	-$92	-$83	-$96
Residue Disposal	$20	$27	$15	$14	$66	$11	$80	$15
TOTAL NETT COST	**$304**	**$289**	**$502**	**$344**	**$334**	**$417**	**$489**	**$423**

- Recycling disposal costs for each area were similar in each scenario, i.e. for disposal of current stockpile and future volumes.
    - However, future disposal costs are generally less than current stockpile disposal costs except for Yorke Peninsula.
    - In the case of Yorke Peninsula the future disposal cost was more expensive because the volumes of waste material in the future would be much less than the current stockpiled volume that had built up (and hence, there were reduced economies of scale and higher per unit costs for disposal activities).
- These recycling disposal costs presented in Table 3.3 and Table 3.4suggest:
    - It could cost the SA Oyster Industry up to $500-$700kto dispose of the current stockpile of 1,300-1,700 tonnes.
    - Future costs would be in the order of $70-$120k/yr on average (at current cost and rebate values) for the 150-200 tonnes/yr of waste that might require disposal.
- These recycling disposal costs are dependent on the rebate achieved from PGS for the plastic material.
    - $100/tonne has been assumed in this assessment, but it could be greater or less than this value depending on quality of waste material, which in turn could vary between growers and/or grower areas.
- There may also be additional costs on top of these values depending on how the SA Oyster Industry organises the recycling disposal activities, e.g. grower-organised, outsources, manages it itself, etc.

3.6 What does this recycling cost mean to oyster farmers?

To put the assessment above into a practical context, it is easy to express these potential recycling disposal costs on a per basket basis and also compare them to other metrics, e.g.

- $300-600/tonne for recycling disposalis equivalent to about 40-60¢/Basket (see Figure 3.9 below).
- 40-60¢/Basket is equivalent to about 4-8% of the basket replacement cost for an oyster farmer (which can be between $10-$20/basket depending on size and type of basket).
- Annual recycling basket disposal costs at $70-$120k/yr for the SA Oyster Industry would constitute <0.5% of its current farm-gate product value (which is *ca.* $35 million).
- However, the recycling disposal cost of $500-$700k for the current stockpile could represent 1.5-2% of the SA Oyster Industry's current farm-gate product value, which could be a significant cost burden if it is incurred by oyster growers as a single cost event.

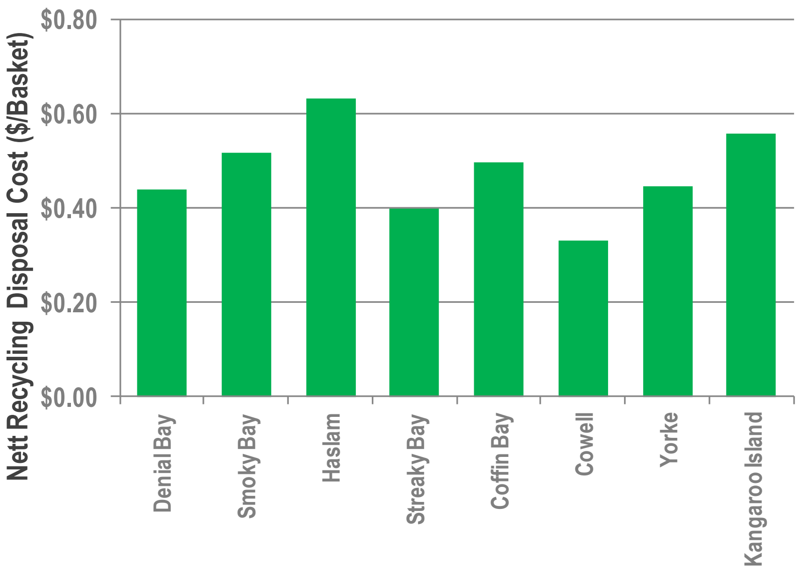

Figure 3.9: Nett recycling disposal costs (in $/basket) for waste oyster basket stockpile based on cost data in Table 3.3. *Note: Weights of baskets can vary substantially, therefore conversion of $/tonne to $/basket depends on the different types of basket technologies employed in each grower area*

3.7 Getting the best disposal price & minimising commercial risk

As noted in the above assessment, a singular recycling disposal approach across all main growing areas has been assumed to estimate potential disposal costs. This approach has been based on feedback obtained during consultations from transport companies, waste contractors and recycling companies, and our own assessments. However, we should recognise that this approach may not necessarily constitute the optimal scheme, and this optimal scheme may change with time depending on local circumstances and commercial factors, which are dynamic (and not static).

For example:

- Where some growers have smaller volumes of waste, and there is a local baler available, it might be more cost-effective for them to bale the waste material rather than shred it.
- Alternatively, there may be opportunity in some areas for local waste depots to provide aggregation points for waste oyster baskets where they can all be shredded at once.

- Timing may significantly influence the recycling disposal cost. For instance it may be cheaper to obtain contract shredding or freight at certain times of year in some regional areas, than at other locations.
- Individual oyster growers in an area working together might achieve greater economies of scale for procurement of labour, equipment hire &/or freight, thereby reducing their per unit disposal cost.

There is also the issue of how individual growers and the SA Oyster Industry should minimise their commercial risk. In this respect, oyster farmers are not necessarily waste management or recycling experts. For example, let's say:

- A group of oyster farmers organise the sort and shred their own waste oyster baskets, then pay for it to be transported to PGS.
- However, the sorting was not performed correctly (for whatever reason), and this material was then rejected by PGS.
- A significant adverse consequence of this situation could be that the oyster farmers might have to additionally pay for this material to be disposed of to landfill (or even worse accept it back).

In view of the above, we would recommend that the best outcome for oyster farmers and the SA Oyster Industry would be to work together and outsource the recycling disposal of the waste oyster baskets to a third party in a manner that minimises this commercial risk. This process would work as follows.

- ***Develop specification***
  - This specification would outline the location, amount and type of waste oyster basket volumes to be disposed of.
  - However, it would keep open which steps or activities should be employed as this would maximise flexibility for the tenderer to identify the optimal strategy to minimise the disposal cost for growers.
  - The specification would place the responsibility on the contractor to achieve recycling disposal of the waste material, for which the SA Oyster Industry would pay the contractor a specified amount. This approach would minimise the Industry's commercial risk.
  - The third party would need to identify all costs and rebates involved with recycling disposal, and may also have to differentiate what costs apply to specific growing areas.
- ***Tender out the recycling disposal requirement***
  - The specification would be put out to competitive tender.
  - This approach would enable the SA Oyster Industry to test the market and achieve the most competitive pricing for recycling disposal.
  - Furthermore, the tender process would not necessarily oblige the SA Oyster Industry to accept a tender, allowing it to not proceed if the market at that time was not able to deliver a cost-effective outcome.
- ***Manage the contract***
  - The SA Oyster Industry would still need to manage implementation of the contract, which could include coordination of oyster growers and the contractor's activities.

The above strategy should embed the following principles of how the industry could best move forward with successfully implementing a recycling disposal solution for waste oyster baskets.

1. ***Cooperate to maximise economies of scale & market purchasing power***
2. ***Retain flexibility in recycling disposal approach & let market find optimal solution***
3. ***Contract out to minimise risk***
4. ***Use the market to achieve best price outcome***

The above tender process could also permit other disposal options besides recycling, which might be more cost-effective for oyster farmers in some areas. Such alternative disposal options are discussed in Section 4 (the next section).

3.8 Additional costs for recycling disposal

It is also important to recognise that outsourcing and/or managing the recycling disposal for the waste oyster baskets could incur additional costs. For example, this may include:

- Head contractor's profit margin & overheads, e.g. potentially up to 20-30%;
- Consultant's fees for preparing specification& advising on tender process, e.g. $20-40k;
- Oyster growers' time inputs;
- SA Oyster Industry internal project and contract management costs.

These additional costs should or could need to be factored in depending on what approach is eventually taken.

4 OTHER DISPOSAL OPTIONS

4.1 What are they?

Whilst the objective of this study was to identify a recycling solution, a range of other potential and practical disposal options for waste oyster baskets exist. In summary, these alternative disposal options include the following.

- ***Landfill disposal***
  - In some locations, disposal to a local landfill may be a more cost-effective option than pre-processing and sending the material all the way for recycling disposal in metropolitan Adelaide.
- ***Waste-to-Energy (WtE) recovery***
  - A range of potential options were identified, including:
    - Disposal to SITA-Resource Co in Adelaide for manufacture into a process engineered fuel (PEF) that is used as a fuel in the Adelaide Brighton Cement (ABC) cement kiln at Birkenhead.
    - Shredding and granulation to allow direct disposal at ABC cement kilns at Angaston or Birkenhead.
    - Co-disposal with tyres that are already being exported overseas to Asia, where they are processed and used as a fuel.

Another energy recovery option suggested during the study was waste plastic conversion to diesel, which could be achieved by a plant located on the Eyre Peninsula. This option is considered a relatively emerging technology which has future potential but is not fully commercialised yet. One of the challenges identified with this technology is that the diesel produced by these systems may not be immediately acceptable for use in agricultural machinery due to engine warranty requirements. Another issue could be that volumes of suitable waste plastic material on the Eyre Peninsula for such a waste-to-diesel plant may not be sufficient for it to be commercially viable.

4.2 Are they cheaper or more expensive?

In view of the above, cost assessments similar to those for recycling disposal were developed for landfill disposal and WtE options, to enable comparison. These cost assessments assumed the following (Table 4.1) applied in each case and extrapolated from the same cost data used earlier in the recycling disposal cost assessments.

Table 4.1: Key assumptions for disposal of waste oyster baskets to nearest landfill/transfer station or to WtE at SITA-Resource Co.

Landfill disposal	WtE
• All waste material shredded to minimise freight and landfill disposal cost. • Material freighted in semi-trailer tipper trucks directly to nearest landfill. • Relevant gate rate paid at nearest landfill or transfer station for disposal of waste material.	• All waste material shredded to minimise freight cost. • Material freighted in road trains, tipper trailers, to Sita-Resource Co at Wingfield. • Gate rate of $100/tonne paid for disposal of material.

Figure 4.1 and Figure 4.2 below compare the results of this cost assessment for alternative disposal of waste oyster baskets with recycling disposal costs (from Figure 3.9) for disposal of the current stockpile. Appendix A includes tables providing additional cost data from these assessments (similar to that provided in Table 3.3 and Table 3.4 for recycling disposal).

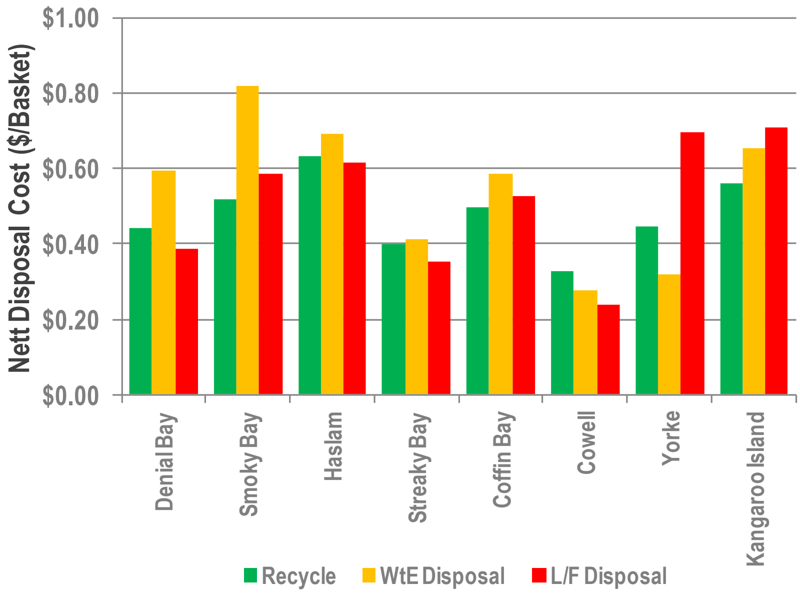

Figure 4.1: Nett disposal costs (in $/basket) for waste oyster basket stockpile: Recycling disposal option; WtE disposal option; L/F disposal option

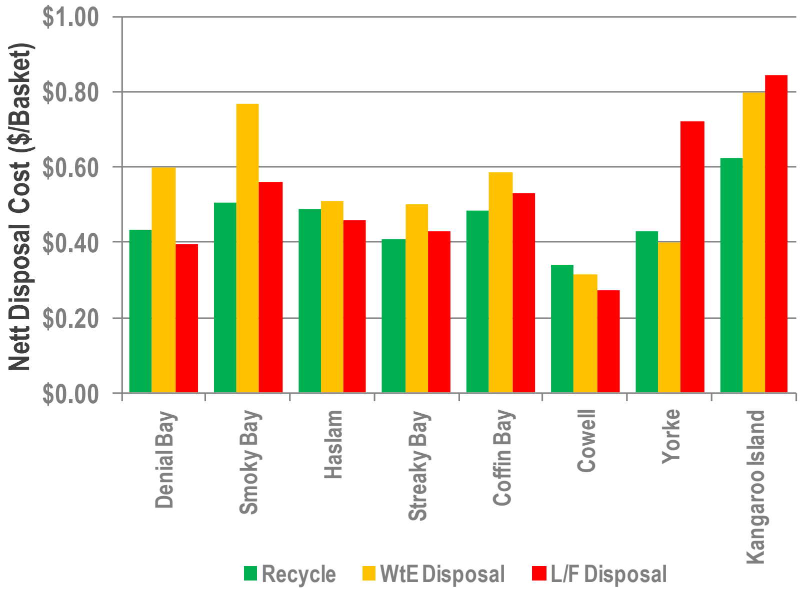

Figure 4.2: Nett disposal costs (in $/basket) for future waste oyster basket: Recycling disposal option; WtE disposal option; L/F disposal option

Figure 4.1 and Figure 4.2 (on the previous page) suggest the following observations from this additional cost assessment.

- ***Recycling vs. WtE?***
    - Recycling disposal generally appears to be more cost-effective than WtE except perhaps for Cowell and Yorke Peninsula, which are closer to Adelaide.
    - However, the outcome of this assessment is very dependent on the gate rate charged by SITA-Resource Co for accepting the waste material.
    - In this respect, there could be an opportunity to deliver the shredded material directly to Adelaide Brighton Cement at Angaston or Birkenhead, where it might be accepted for nil cost.
- ***Recycling vs. landfill disposal?***
    - Landfill disposal could be cheaper or the same cost as recycling disposal in all grower areas except for Yorke Peninsula and Kangaroo Island.
    - In the case of Yorke Peninsula and Kangaroo Island, these areas do not have a local landfill and instead send their waste via a transfer station that is operated by a private operator. The gate rates charged at these transfer stations for acceptance of waste for landfill disposal are two to four times that for disposal to local landfill in other grower areas.

The above observations reiterate that the most cost-effective disposal strategy for waste oyster baskets may not necessarily be recycling disposal. Furthermore, the lowest cost waste oyster basket disposal strategy for the SA Oyster Industry would be best identified by adopting a procurement strategy that enables the market to determine the optimal disposal options in each grower area, and the approach to implementing these options (per comments in Section 3.7 of this report).

5 FUTURE INDUSTRY SCENARIOS

5.1 Overview

It consultation with the Project Steering Committee, it was decided to investigate the effectiveness of different strategies for implementing a recycling disposal solution for the South Australian (SA) Oyster Industry, which would be subject to Cost Benefit Analysis (CBA).

The starting point for this assessment was to develop the 'base case' scenario, that is, the benchmark against which other options could be compared. The other options were then developed to reflect 'future' scenarios for how a recycling disposal solution for waste oyster baskets could evolve and be implemented.

The sections below briefly explain these scenarios that were developed. The CBA assessment of these scenarios is presented in Section 6.

5.2 'Base Case' Scenario – Do Nothing

The base case scenario is the 'do nothing' or 'business-as-usual' scenario for the SA Oyster Industry. It assumes that the oyster industry would continue the current practice of stockpiling waste oyster baskets until such time as it is no longer feasible. For the purpose of this analysis it was presumed that this event would occur by 2018. The catalyst for this event is reasonably expected to be regulatory change. This regulatory change may arise from a number of sources, e.g.

- Stockpiling of waste oyster baskets on properties may start to be seen as waste disposal (under the South Australia Environment Protection Act 1993) which may result in controls to limit this practice.
- Councils could reasonably act to control this practice where not permitted under a planning approval or if construed as a fire risk or causing visual or other environmental nuisance.
- Current application of the South Australia (Waste-to-Resources) Environment Protection Policy (EPP) 2010 may be extended from metropolitan to regional areas. This event could prevent aggregation of recyclable plastic materials if the intended disposal is not for recycling. This EPP would also limit disposal of these materials to landfill where not first subject to resource recovery.

Regulatory change cannot always be predicted well in advance, and this may create a time imperative for disposal to occur when the industry becomes aware this event will occur. It is likely that the industry would not be able to organise a recycling disposal solution in time, and thus, would need to send this stockpile material to landfill. Furthermore, future (landfill and resource recovery) disposal costs will have substantially increased (at a rate greater than inflation) and the time imperative may also make disposal more costly (i.e. there will be a cost premium).

In 2018, the total industry waste oyster basket stockpile is expected to have reached between 2,000 and 2,500 tonnes. This is more substantial than today's stockpile, and the added disposal cost could create a "financial shock" that could be unsustainable for some of the less profitable oyster farmers. The result of may include:

- Some of the less profitable operators to abandon the industry; and
- Government may have to pay for disposal of some abandoned stockpiles

5.3 Alternative Scenarios: Recycling Disposal

5.3.1 Option 1: Disposal at least cost

Under Option 1, the industry would almost immediately commence sending waste baskets (current stockpile and future waste) for disposal. The type and destination of disposal would be decided by individual oyster growers and most likely dictated by cost. Therefore, some growers would direct waste material to recycling whereas others would send it to the nearest landfill (directly or via transfer station) disposal but the majority would still end up in landfill. An advantage of this option compared to the base case is that there will be a lower disposal cost for the stockpile and future waste between now and 2018. Also, there will be no future sudden stockpile disposal “financial shock” to industry.

5.3.2 Option 2: Disposal to recycling

Option 2 would involve the Industry introducing a scheme to achieve majority recycling (90 per cent). This scheme would involve growers in the industry working together and cooperating. Disposal cost under the scheme could be paid at the time of disposal, when an Industry-wide clean-up was organised, or there could be an opportunity to create a “sinking fund” for this purpose, e.g. through an industry levy that would be paid on an annual basis. Under this option, it would take some time to set up the scheme and so disposal would not commence immediately, beginning over a two year period between 2015 and 2016. The key advantage of this option would be that nearly all waste oyster baskets would be recycled – achieving the key outcome intended by this study. Like Option 1, it would also avoid the potential future stockpile disposal cost “financial shock” to industry. There is also the opportunity through a levy type scheme to amortise periodic disposal costs into more regular payments that are more easily affordable to oyster growers. However, it should be recognised that an acceptable levy type scheme could be difficult to design and problematic to implement given the differences in waste attributes and disposal logistics between individual growers and grower areas.

5.3.3 Option 3: Recycling disposal with regional co-investment in mobile shredder

Option 3 is identical to Option 2 in that industry introduces a scheme to achieve majority recycling (90 per cent). However, it also proposes that the oyster industry co-invest with local government in a suitable industrial-grade mobile shredder. This shredder would be used by the industry for volume reduction of waste oyster baskets. It would also be (majority) used by local government and other industries in regional areas to improve volume reduction of waste materials, which would have the following benefits.

- Reduce volume of waste disposed to landfill;
- Convert some waste materials into a form suitable for local recycling (e.g. timber, garden waste);
- For some recyclable materials currently being landfilled (e.g. tyres, plastics), make it more cost-effective to transport material elsewhere so they can be subject to resource recovery and recycling;
- Through the above reduce amount and volume of waste disposal to landfill, thereby increasing the longevity of local landfills.

For both the SA Oyster Industry and other users, the shredder would also be more readily accessible and convenient to use, as well as cost effective (than private contractors that provide shredding services to these areas). The employment of local people to manage and operate the shredder would also add to economic benefits achieved.

6 COST-BENEFIT ANALYSIS (CBA)

6.1 Overview

Cost-benefit analysis (CBA) has been used in this study as a technique for rationally comparing the economic merits of different future options for recycling disposal of oyster baskets against the 'base case' scenario, which were described in the previous section.

In this respect, CBA is a method for organising information to aid decision makers in the allocation of scarce capital. The technique provides a quantitative comparison of alternative options.

There are two main perspectives from which this analysis and evaluation may be undertaken:

- An economic perspective, in which the focus is on the overall impact on the material well-being of the society as a whole
- A financial perspective, in which the focus is on the monetary return to the proponent of the project

Although there is considerable common ground in the techniques that are applied in undertaking these two forms of analysis, they are distinctly different. This analysis has been undertaken from an economic perspective.

It is also important to distinguish between economic evaluation and economic impact analysis. Economic evaluation is designed to assess whether or not a project will, on balance, improve economic welfare. Whereas, economic impact analysis is intended to describe the effect that a project will have on certain measures of economic activity, but provides no direct guidance on whether or not a project is worthwhile.

This section of the report summarises the CBA assessment that was undertaken. A more detailed report for the CBA assessment performed in this study is available from SAOGA.

6.2 Methodology

The cost benefit analysis conducted for this project conforms to South Australian and Commonwealth government guidelines ((Department of Treasury and Finance, 2007) & (Department of Finance and Administration, 2006)) for conducting evaluations of public sector projects.

The starting point for the economic analysis was to develop the 'base case' scenario, that is, the benchmark against which the options were compared. For the purpose of this analysis the 'base case' was defined as the 'do-nothing' scenario.

Given that costs and benefits were specified in real terms (i.e. constant 2013 dollars), future values were converted to present values by applying a discount rate of 7 per cent. Sensitivity analyses were conducted using different discount rates.

The analysis was also conducted over a 25 year time period and results were expressed in terms of net benefits, that is, the incremental benefits and costs of the option relative to those generated by the 'base case' scenario. The evaluation criteria employed for these analyses were as follows.

- Net present value (NPV) – discounted[6] project benefits less discounted project costs. Under this decision rule an option was considered to be potentially viable if the NPV was greater than zero. The NPV for option *i* has been calculated as an incremental NPV, using the standard formulation:

  NPV_i = (PV (option$_i$benefits – 'base case' benefits) – (PV (option$_i$ costs– 'base case' costs))

- Benefit-cost ratio (BCR) – the ratio of the present value of benefits to the present value of costs. Under this decision rule option *i* was considered to be potentially viable if the BCR was greater than one. The ratio was expressed as:

  BCR_i = PV (option$_i$ benefits – 'base case' benefits) / PV (option$_i$ costs– 'base case' costs)

- Internal rate of return (IRR) – the discount rate at which the NPV of a project is equal to zero. Under this decision rule an option was considered to be potentially viable if the IRR was greater than the benchmark discount rate (i.e. 7 per cent for the economic analysis).

6.3 Scenarios

A key objective of the project was to undertake a cost benefit analysis (CBA) to determine the net economic impact to the community of the oyster basket recycling options. Three options were compared against a base case scenario and are described inTable 6.1. For more detail on the options see Section 5 of this report.

Table 6.1: Scenarios for the cost benefit analysis

Option	Description
Base Case *(Do Nothing)*	■ Oyster industry continues to stockpile waste oyster baskets until no longer feasible due to regulatory change (assumed to occur by 2018). ■ At this time all stockpiled oyster baskets and future waste baskets must be disposed of within a short time frame, which does not enable the industry to implement a recycling solution (i.e. all waste is disposed to landfill).
Option 1 *(Disposal at least cost)*	■ Disposal of stockpile by the Industry and ongoing future waste generation commences in 2014. ■ Oyster growers make individual choices about whether disposal is to landfill or recycling, which is generally dictated by lowest cost.
Option 2 *(Recycling Stewardship)*	■ Industry commits to recycling (i.e. stewardship) and works together to cooperate and implement a recycling disposal scheme (90% participation). ■ This scheme commences in 2015 and allows all stockpiled and future waste to be recycled
Option 3 *(Recycling Stewardship plus Industry co-investment in a shredder)*	■ Industry introduces the above scheme to achieve majority recycling (90% participation). ■ The industry also cooperates with local government to co-invest in a mobile shredder to achieve more cost-effective volume reduction of waste oyster baskets and help minimize landfill disposal of other waste streams in regional areas.

6 Discounting refers to the process of adjusting future benefits and costs to their equivalent present-day values.

6.4 Key assumptions

The costs and benefits of the project were measured using a 'with' and 'without' project framework, that is, quantification of the incremental changes associated with the options compared with the base case scenario. The method, data sources and assumptions used to quantify these values are described below. Consideration was given to those benefits and costs likely to occur over a 25 year time period.

The major costs and benefits of the project are listed in Table 6.2 (below) and Table 6.3 (overleaf), respectively. The estimation of each of the items is detailed below and was based on technical and cost data presented earlier in this report. For more detail on the quantifiable costs and benefits of each option see the detailed report in Appendix B. In the case of Option 3, a separate analysis was prepared to assess potential additional benefits to the community of co-investment by local government in a shredder. A paper summarising this analysis is included in Appendix B.

Sensitivity analyses were also undertaken to reflect the uncertainty associated with these assumptions.

Table 6.2: Costs of the Oyster Basket Recycling options

Option	Description of Costs	Bearer of Cost	Valued in Monetary Terms
Base Case	Disposal of stockpiles in 2018	Oyster Industry	Yes
	Ongoing disposal of waste baskets	Oyster Industry	Yes
Option 1 (Disposal at least cost)	Disposal of stockpiles in 2014	Oyster Industry	Yes
	Ongoing disposal of waste baskets	Oyster Industry	Yes
Option 2 (Recycling)	Disposal of stockpiles in 2015 and 2016	Oyster Industry	Yes
	Ongoing disposal of waste baskets	Oyster Industry	Yes
Option 3 (Recycling with shredder)	Disposal of stockpiles in 2015 and 2016	Oyster Industry	Yes
	Ongoing disposal of waste baskets	Oyster Industry	Yes
	Cost of mobile shredder	Oyster Industry/Community	Yes
	Shredder operating and maintenance costs	Oyster Industry/Community	Yes

Table 6.3: Benefits of the Oyster Basket Recycling options

Option	Description of Benefits	Beneficiary	Valued in Monetary Terms
Base Case	Potentially lower disposal cost option may arise in the future	Oyster Industry	No
Option 1 (Disposal at least cost)	Avoid "financial shock" - under the Base Case the stockpile, and potential future, disposal cost may result in abandonment for some of the less profitable oyster farmers	Oyster Industry/ Community	Yes
	Some waste being recycled	Oyster Industry/ Community	No
	Improved visual amenity (no stockpiles)	Oyster Industry/ Community	No
	Lower environmental risks (e.g. no burning)	Oyster Industry/ Community	No
	Improved community and customer perception of industry stewardship	Oyster Industry	No
Option 2 (Recycling)	Avoid "financial shock" - under the Base Case the stockpile, and potential future, disposal cost may result in abandonment for some of the less profitable oyster farmers	Oyster Industry/ Community	Yes
	Most waste being recycled	Oyster Industry/ Community	No
	Improved visual amenity (no stockpiles)	Oyster Industry/ Community	No
	Lower environmental risks (e.g. no burning)	Oyster Industry/ Community	No
	Improved community and customer perception of industry stewardship	Oyster Industry	No
Option 3 (Recycling with shredder)	Avoid "financial shock" - under the Base Case the stockpile, and potential future, disposal cost may result in abandonment for some of the less profitable oyster farmers	Oyster Industry/ Community	Yes
	Reduce oyster basket waste volume	Oyster Industry	Yes
	Reduced shredding cost for waste oyster baskets	Oyster Industry	Yes
	Reduce cost for shredding other waste and recyclables for regional local government and other industries in South Australia	Community	Yes
	Most waste being recycled	Oyster Industry/ Community	No
	Improved visual amenity (no stockpiles)	Oyster Industry/ Community	No
	Lower environmental risks (e.g. no burning)	Oyster Industry/ Community	No
	Improved community and customer perception of industry stewardship	Oyster Industry	No
	Reduced waste volumes disposed to landfill increases longevity of local landfills	Community	Yes

6.5 Results

6.5.1 Overview

The results of the analysis have been expressed in terms of one evaluation criteria, the net present value (NPV)[7]. The NPV is a measure of the aggregate, annual net benefits (i.e. benefits – costs) of an option over a 25 year period, discounted (i.e. expressed as a present value[8]) using a discount rate of 7 per cent for the economic analysis. If the NPV for an option is greater than zero (i.e. positive), it indicates that the option is preferred to the Base Case. The NPVs calculated for each of the three options are:

- Option 1: $0.43m
- Option 2: $0.41m
- Option 3: -$1.78m

It should be noted that these estimates do not include a range of other potentially significant (non-quantified) benefits (see Section 6.5.5) that could accrue to the community as a result of undertaking the options.

6.5.2 Option 1

Under Option 1 (least cost disposal) a NPV of around $431,000 would equate to an average annual net benefit of approximately $37,000.

The majority of this benefit would accrue to the oyster industry. This is because avoiding the cost of stockpile disposal is a large part of the Option 1 benefit and the majority of the cost to dispose of the stockpile in 2018 would be borne by the oyster industry. The exception would be the 5 per cent of the stockpile that was assumed to be on abandoned leases and where these disposal costs might need to be met by Government on behalf of the broader community.

Under this assumption, the average annual net benefit of Option 1 for the Oyster industry would be approximately $34,000 (92 per cent of the total) and around $3,000 for the wider community (8 per cent of the total).

As noted above, the principal reason for the positive result under Option 1 is that there will be lower disposal costs for the stockpile and future waste between now and 2018. Additional benefits will accrue because the stockpile “financial shock” to industry will be avoided under Option 1.

6.5.3 Option 2

Under Option 2 (majority of waste recycled) a NPV of around $414,000 would equate to an average annual net benefit of approximately $35,500.

The majority of this benefit would accrue to the oyster industry. As with Option 1, this is because avoiding the cost of stockpile disposal is a large part of the Option 2 benefit and the majority of the cost to dispose of the stockpile in 2018 would be borne by the oyster industry. The exception would

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7 Two other evaluation criterions, the benefit-cost ratio (BCR) and the internal rate of return (IRR), are also commonly used in this type of analysis. The BCR is the ratio of the present value of benefits to the present value of costs and the IRR, is the discount rate at which the NPV of a project is equal to zero. Both measures could not be defined in this analysis.

8 The present value is the value now of a sum of money arising in the future. Money now is worth more than money in the future because it could be invested now to produce a greater sum in the future. The present value of money in the future is calculated by discounting it at a rate of interest equivalent to the rate at which it could be invested. A discount rate of 7 per cent was used in this financial analysis.

be the 5 per cent of the stockpile that was assumed to be on abandoned leases and where these disposal costs might need to be met by Government on behalf of the wider community.

Under this assumption, the average annual net benefit of Option 2 for the Oyster industry would be approximately $32,500 (92 per cent of the total) and around $3,000 for the broader community (8 per cent of the total).

As noted above, the principal reason for the positive result under Option 2 is that there will be lower disposal costs for the stockpile and future waste between now and 2018. As with Option 1, the stockpile “financial shock” to industry will also be avoided under Option 2.

6.5.4 Option 3

The principal reasons for the negative result under Option 3 are: (i) the significant cost outlay for the shredder; and (ii) the high operating and maintenance costs of running the shredder relative to any quantifiable benefits (for both the oyster industry and the wider community). This is reflected in a NPV of approximately -$1.78m or an average annual net loss of $153,000.

6.5.5 Non-Price Benefits

Although the quantitative CBA reported previously indicate a positive result for Options 1 and 2 and a negative result for Option 3, there are a number of other positive non-price values[9] associated with the oyster basket recycling options. These non-price values have not been included in the quantitative analysis but are potentially significant benefits.

Under the Base Case the significant stockpile, and potential future, disposal cost may create a “financial shock” that could be unsustainable for some of the less profitable oyster farmers. The impact of this, in terms of a reduction in direct expenditure and reduced flow-on activity, has been measured under the Base Case as a loss in production. However, this loss in production would also result in a loss of employment, 14 full-time equivalent (FTE) jobs directly from the oyster industry and around 5 FTE jobs in other flow-on industries. This means that under Options 1, 2 and 3 there would be an additional 20 regional FTE jobs compared to the base case.

Other non-price benefits under the three options include:

- **Option 1**
  - Some waste being recycled
  - Improved visual amenity (no stockpiles)
  - Lower environmental risks (e.g. no burning)
  - Improved community & customer perception of industry stewardship
- **Option 2**
  - Most waste being recycled
  - Local landfill capacity is unaffected (& preserved)
  - Improved visual amenity (no stockpiles)

[9] Items of value that cannot be readily priced or for which there is currently no market.

  - Lower environmental risks (e.g. no burning)
  - Improved community and customer perception of industry stewardship

- **Option 3**
  - Most waste being recycled
  - Local landfill capacity is unaffected (& preserved)
  - Improved visual amenity (no stockpiles)
  - Lower environmental risks (e.g. no burning)
  - Improved community and customer perception of industry stewardship
  - More recycling by local government
  - Increased longevity of local landfills due to diversion and more compact waste disposal
  - Revenue from shredder activity contributes to local economy

6.6 Sensitivity Analysis

6.6.1 Overview

The results of the economic analysis were re-estimated using values for key variables that reflect the uncertainty of those variables. The sensitivity analyses included changes in the following:

- Discount rate;
- Loss in production under the base case;
- Premium on disposal costs under the base case; and
- Regional benefit of the shredder.

The range of values used for each uncertain variable and the detailed results of the sensitivity analysis are set out below with some interpretation of the results. Note that the sensitivity analysis was undertaken by assuming that all other variables were held constant at their 'expected' values.

6.6.2 Discount Rates

Costs and benefits are specified in real terms (i.e. constant 2013 dollars) and future values are converted to present values by applying a discount rate of 7 per cent. A sensitivity analysis was conducted using discount rates of 4 and 10 per cent.

The results were shown to be reasonably sensitive to changes in the discount rate (compared to the other factors tested in the other sensitivity analysis). Under the higher discount rate (10 per cent), Option 2 becomes the preferred option.

6.6.3 Loss in Production

The results of the analysis were based on the assumption that under the Base Case the loss in production as a result of the stockpile disposal "financial shock" would represent approximately 5 per cent of regional production (or a loss of 2 financially poorly performing farms). A sensitivity analysis was undertaken to highlight the effect of a 2.5 per cent loss in production (1 farm) and a 10 per cent loss in production (4 farms).

The results were shown to be reasonably sensitive to changes in the production loss (compared to the other factors tested in the other sensitivity analysis) but do not change the outcome (positive or negative NPV) or the ranking of the options.

6.6.4 Premium on disposal costs

The results of the analysis were based on the assumption that under the Base Case the disposal time imperative creates additional disposal cost premium (10 per cent). A sensitivity analysis was undertaken to highlight the effect of no disposal cost premium and a 20 per cent disposal cost premium.

The results of the analysis were shown to be fairly insensitive to changes in the disposal cost premium for the Base Case (compared to the other factors tested in the other sensitivity analysis).

6.6.5 Regional benefit of shredder

The results of the analysis were based on the assumption that under Option 3 the regional benefit of the shredder would amount to almost $353,000 per annum. A sensitivity analysis was undertaken to highlight the effect of 20 per cent increase and decrease in the benefit of the shredder.

The results (for Option 3) were shown to be reasonably sensitive to changes in regional benefit of the shredder (compared to the other factors tested in the other sensitivity analysis) but even with a 20 per cent increase in expected regional benefits, Options 1 and 2 and the Base Case are still preferable to Option 3.

6.7 Key findings

The three options ranked in order of preference from this CBA assessment, in terms of the highest NPV over 25 years, are:

- Option 1, disposal at least cost: $0.43m
- Option 2, majority of waste recycled: $0.41m
- Option 3, majority of waste recycled with the purchase of a shredder: -$1.78m

Sensitivity analysis suggests that key factors influencing costs and benefits for each option would not change the above ranking, except in the case of a higher discount factor applied to the NPV analysis. Given the closeness of the results for Options 1 and 2 and the uncertainty of the data used in the analysis, it is difficult to be conclusive about which is the preferred option. However, setting aside the non-priced benefits and taking account of only the quantifiable costs and returns, it is clear that Options 1 and 2 are preferable to the Base Case and Option 3.

7 KEY FINDINGS & RECOMMENDATIONS

7.1 Key findings

The key findings obtained in this study are summarised below. Presentation of the findings below has generally been aligned with the project objectives (as listed in Section 0).

Project Objective:	Key finding(s):
What materials are used in the manufacture of oyster baskets?	• These materials depend on the type of oyster basket design or technology, of which there are four main types: two-setter; pillow; manufactured; or Aquatray. • The main body of oyster baskets is plastic – either HDPE or PP – which are recyclable • This plastic main body usually constitutes > 90% of a basket's weight, except for two-setters which have substantial (40-60%) timber composition. • Baskets also include wire, clips and other components made from other plastics (acetal, nylon) and metal.
Effective life cycle of the materials	• Most oyster basket types can last between 5-15yrs, but some can last up to 20+ yrs. • The following precedence applied to how long different basket types last: Aquatray (20-30 yrs) > Manufactured Baskets (10-20 yrs)> Pillow/Two-setters (5-15 yrs) • The life cycle of oyster baskets depends on quality of manufacture, what marine environment they are used in and how they are handled by individual growers. • This study has developed a life cycle model for different basket types which predicts the percentage of new baskets that will reach end-of-life (EOL) after a certain period of service.
Scale of the oyster basket waste	• It is estimated that there is currently a stockpile of up to 1,300-1,500 tonnes of waste oyster baskets across the SA Oyster Industry. • The size of this stockpile varies between main grower areas depending on basket types that have been used and past disposal practices. • This Industry stockpile is growing as up to 150-200 tonnes/yr of waste oyster baskets are being disposed of each year. • This stockpile could grow to over 2,500 tonnes by 2020 if there is no change to current disposal practices.

Who could receive and recycle the waste?	• There are a number of companies/organisations involved with plastic recycling in South Australia.
	• However, the potential contamination in the waste oyster basket material meant there was only one – Plastics Granulating Services (PGS) – that showed interest and had the capability to take the waste to resource-recover and re-process the HDPE or PP plastic so it could be recycled.
	• This company was willing to pay a rebate for the plastic content in the waste – up to $200/tonne – but there would be strict requirements on quality:
	    ○ HDPE and PP in the waste would need to be separated first;
	    ○ Other contaminants would need to be reduced to acceptable levels.
	• Growers would be responsible for preparing and transporting the waste to PGS's site in Kilburn (Adelaide).

Technologies that could minimise the space of the waste for transport purposes	• Trials have already been conducted on baling and shredding. • Shredding was found to offer the greatest potential for volume reduction over baling, and also appears more capable of rapidly processing the different types of waste oyster baskets. • However, shredding would require a specialised mobile industrial-grade unit, which is expensive to hire and operate.

Logistics and coordination of getting the waste to the recycler	• There is range of potential logistical and transportation solutions that could be used to get the waste to the recycler.
	• The most cost-effective solution could be different for each main growing area.
	• The following was identified as a potentially cost-effective approach.
	    ○ Waste is pre-sorted at site to remove contaminants and separate HDPE and PP in the waste (with removed contaminants disposed to a local landfill or transfer station).
	    ○ Waste is shredded at site to reduce volume for transportation.
	    ○ Waste is collected from site and transported to Adelaide by back loading using double tipper trailer road trains that had delivered fertiliser or other agricultural supplies to farmers in nearby regional areas.

Project Objective:	Key finding(s):

Potential costs of recycling disposal	• The costs of the above approach for recycling disposal of waste oyster baskets were assessed for each main grower area.
	• Assuming a rebate on waste plastic material of $100/tonne from PGS, it was found that the total nett cost to growers for recycling disposal could be in the range of $300-$600/tonne, or 40-60¢/basket.
	• This recycling cost was similar for disposal of the current stockpile and for future waste generation.
	• The final recycling disposal cost will be different for each growing area, depending on its:
	  ○ Distance from Adelaide;
	  ○ Basket types being used (or level of contaminants that need to be removed);
	  ○ Plastic content in the waste stream;
	  ○ Costs obtained for sorting, shredding and freight.

Other disposal options	• Other disposal options (besides recycling) were also identified by this study, including landfill disposal and Waste-to-Energy (WtE) • Cost assessments on these options suggest that these may be cheaper or equivalent in cost to recycling disposal in some oyster growing locations.

Best possible options for the oyster industry identified by cost-benefit analysis (CBA)	• Several options for moving towards recycling disposal of waste oyster baskets by the SA Oyster Industry were identified in consultation with the Project Steering Committee:
	  ○ Option 1, Disposal at least cost
	  ○ Option 2, Majority of waste recycled
	  ○ Option 3, Majority of waste recycled and co-investment with local government in a shredder
	• These options were subject to cost-benefit analysis (CBA): Net Present Value (NPV) analysis over 25 years.
	• The results of this CBA suggested that Options 1 and 2 produced positive NPV_{25} outcomes in the order of $0.4-0.5 million dollars whereas Option 3 would have substantially more costs than benefits (i.e. negative NPV) over this assessment time period.

7.2 Recommendations

1. It should be acknowledged that recycling disposal for waste oyster baskets is highly unlikely to be “free” or at “no cost” for oyster growers – and instead could be at least 40-60¢/basket depending on grower location and their waste attributes.
2. Landfill disposal may therefore be a more cost effective disposal solution in some oyster growing areas.
3. The SA Oyster Industry should look at commencing disposal of its waste oyster basket stockpile immediately to avoid future rises in landfill disposal costs and potential for a financial shock in the event that stockpiling suddenly becomes no longer allowed at some time in the future.
4. Currently, the least cost disposal option for a grower – whether recycling or landfill disposal or even WtE – would be the most cost-effective approach.
5. The industry should be pro-active in helping oyster growers to start disposing of their waste oyster baskets, which may include providing education and support to oyster growers, and where appropriate, helping them work together to achieve economies of scale and to adopt procurement strategies that minimise their costs.
6. At the same time, the industry should consider the opportunity to introduce a waste oyster basket stewardship scheme where recycling is promoted. There could be potential sustainability and marketing benefits from such a scheme, which if they exist should be explored and quantified. These other benefits may help to justify investment and support for the scheme.
7. In the event that such a stewardship scheme is considered, there could be considerable challenges for designing and successfully implementing such a scheme, especially if a levy-funding arrangement is proposed. These challenges may include the need for regulatory involvement and ensuring that it would be widely accepted and seen by oyster growers as equitable.
8. In view of the above the SA Oyster Industry should pro-actively consider and develop a strategy for its approach to disposal of current stockpile and future waste oyster basket streams. The key steps or actions that the Industry should take or incorporate into this strategy are recommended below.

1. The SA Oyster Industry should discuss and resolve the following key issues.
   - a. **The extent of cooperation achievable between oyster growers in implementing a disposal option, e.g. industry-wide, within grower areas, etc?**
   - b. **Which disposal strategy should be adopted, i.e. least cost option, industry-wide recycling scheme, etc.?**
   - c. **How and who would be responsible for implementing the agreed disposal strategy (or strategies), i.e. individual grower, grower collective(s), SAOGA, etc?**

2. Based on the above decisions, growers should commence disposal of stockpiles or future waste oyster baskets at earliest possible date.

3. SAOGA should support &/or implement the agreed approach, which may include:
   - a. **Helping to identify and develop an industry stewardship scheme for recycling disposal.**
   - b. **Facilitating &/or administering procurement of disposal services on behalf of growers.**
   - c. **Developing & providing information & support for the industry or individual oyster growers.**
   - d. **Monitoring & reporting performance of the waste oyster basket disposal scheme.**

8 REFERENCES

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Appendix A: Cost data from assessments for WtE and Landfill disposal

Table A.1: Cost in $/tonne for landfill disposal of waste oyster baskets for Scenario 1: Current stockpile (commencing in 2014/15)

Recycling Step	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-processing (Shred)	$145	$152	$475	$183	$149	$155	$145	$156
Freight	$65	$88	$119	$102	$62	$63	$81	$91
Gate Rate	$60	$60	$85	$90	$150	$100	$450	$290
TOTAL NETT COST	**$270**	**$300**	**$679**	**$375**	**$361**	**$318**	**$676**	**$537**

Table A.2: Cost in $/tonne for landfill disposal of waste oyster baskets for Scenario 2: Future waste volumes (assuming disposal on a periodic basis every 2-3yrs)

Year	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-processing (Shred)	$155	$175	$284	$174	$157	$170	$274	$187
Freight	$62	$86	$97	$96	$60	$60	$94	$96
Gate Rate	$60	$60	$90	$90	$150	$100	$451	$289
TOTAL NETT COST	**$277**	**$320**	**$472**	**$360**	**$367**	**$330**	**$818**	**$572**

Table A.3: Cost in $/tonne for WtE disposal to SITA-Resource Co. of waste oyster baskets for Scenario 1: Current stockpile (commencing in 2014/15)

Recycling Step	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-processing (Shred)	$145	$152	$475	$183	$149	$155	$145	$156
Freight	$171	$168	$187	$156	$152	$118	$64	$241
Gate Rate	$100	$100	$100	$100	$100	$100	$100	$100
TOTAL NETT COST	**$417**	**$421**	**$762**	**$439**	**$401**	**$373**	**$309**	**$497**

Table A.4: Cost in $/tonne for WtE disposal to SITA-Resource Co. of waste oyster baskets for Scenario 2: Future waste volumes (assuming disposal on a periodic basis every 2-3yrs)

Year	Denial Bay	Smoky Bay	Haslam	Streaky Bay	Coffin Bay	Cowell	Yorke	KI
Pre-processing (Shred)	$155	$175	$284	$174	$157	$170	$274	$187
Freight	$164	$165	$142	$148	$148	$113	$76	$253
Gate Rate	$100	$100	$97	$100	$100	$100	$101	$100
TOTAL NETT COST	**$419**	**$439**	**$524**	**$422**	**$405**	**$383**	**$451**	**$540**

Appendix B: Option 3 additional technical analysis for infrastructure co-investment in mobile shredder

RDA Waste Oyster Basket Recycling Project

Option 3: Infrastructure co-investment in mobile shredder – Analysis & assessment

Context

Option 3 proposes infrastructure co-investment by the South Australian oyster industry and other regional government and/or non-government organisations to purchase a mobile industrial-grade shredder. This shredder would be suitable for processing and volume reduction of waste oyster baskets and other waste materials in regional areas.

The advantages of access to the mobile shredder for the oyster industry are that it could substantially reduce freight costs for transport of waste materials for recycling and/or landfill disposal. The advantages of the regionally co-owned mobile shredder for processing of other waste materials elsewhere in regional areas could include the following.

Reduces shredding cost	• **Many regional Councils and organisation already pay private contractors, generally located outside the region, with mobile shredders a relatively expensive hourly rate to process their waste materials. Hence there is an opportunity to reduce current shredding costs to more affordable rates.**
Accessibility & availability	• As existing mobile shredders are supplied and managed by private contractors, they are not always readily available or accessible. Hence, this discourages opportunity to utilise shredding for resource recovery &/or waste volume reduction – see below.
Higher resource recovery	• More ready availability of a shredder could enable greater resource recovery of some materials currently being disposed of to landfill, e.g. ○ Garden waste & timber materials can be converted into mulch for local disposal; ○ Plastic and other materials can be substantially reduced in volume, which could reduce their freight costs, which in turn may tip the economics of disposal in favour of recycling instead of landfill disposal.
Increased longevity of local landfills	• Shredding can also reduce volume of waste materials destined for landfill disposal, which can extend the life of existing landfills that would otherwise be difficult & expensive to replace.

This paper explores the opportunity, outcomes and potential costs that might be involved with such an initiative.

Regional Interest in Proposed Initiative

Consideration of regional interest in this initiative was limited to Eyre Peninsula and Whyalla region, represented by the Regional Development Australia – Eyre Peninsula & Whyalla, which is administering this project. This region is where the majority of the oyster industry is located. However, other regional areas of South Australia would no doubt also be interested.

Discussions with the Eyre Peninsula Local Government Association suggest there would be strong interest amongst its member Councils for co-investing with the SA oyster industry in such a mobile shredder.

Direct consultations with works or waste depot managers from a number of these member Councils was also undertaken. There was positive feedback indicating that they could utilise such a mobile shredder to improve resource recovery outcomes and reduce waste volumes for landfill disposal. A summary of feedback and comments obtained from these direct consultations is given in Table 1 overleaf. Table 1 includes the list of waste materials identified as being where access to a mobile shredder would be beneficial.

Table 1: Consultation comments & feedback obtained from direct consultations with works or waste depot managers from Councils on the Eyre Peninsula

Waste Material	Consultation comments & feedback
Green Waste	Usually diverted from Landfill and mulched. Majority can be chipped but bushy-type material is stockpiled for shredding, where private contractor must be used.
Timber	Heavier material, e.g. pallets, building timber, fence posts, from tree removal or pruning, etc. Majority can be recycled as mulch & is stockpiled for shredding by private contractor. Other material is disposed to landfill, where shredding would help to reduce volume.
Mattresses	Bulky material that can take up space in landfill. Shredding can reduce volume, may also enable recovery of metal springs.
Plastic material	Range of bulky materials presented in mixed &/or contaminated form, e.g. drums, bumper bars, irrigation hose, demolition waste, furniture, etc. As mostly unrecyclable, usually disposed to landfill where shredding would reduce volume. Shredding might facilitate disposal by Waste-to-Energy is this option was available.
Tyres	Bulky & heavy material. Some sites that can't shred are sending whole tyres to Adelaide (where shredded & recycled or exported for Waste-to-Energy), which is expensive. Other sites would be able to shred & dispose to landfill at lower cost. Shredding would therefore reduce cost by allowing local landfill disposal.
Concrete	Was able to be shredded & turned into fill or road-base material.
CCA Pine Posts	There was interest in whether these could be shredded to reduce cost for disposal in an EPA approved landfill at Inkerman. Shredding this material would require careful consideration of health & safety issues, which may prevent.

Current situation

Based on the Eyre Peninsula's current population[10] and publicly available data on waste and recycling volumes in South Australia and the Eyre Peninsula[11], Table 2 below suggests, at a high-level, the possible level of existing resource recovery and landfill disposal currently occurring in the Eyre Peninsula and Whyalla region. The values in the Table are expressed as a range because publicly available data does not provide accurate localised data for all waste & recycling activities in this region. The quantities of resource recovery and landfill disposal shown would include municipal (MSW), construction & demolition (C&D) and commercial & industrial (C&I) sourced waste materials. C&I materials would include the waste from other aquaculture industries located in the region.

The landfill disposal tonnage in Table 2 overleaf may require about 60,000-80,000m^3/yr of landfill volume or "air space".

[10] Population of Eyre Peninsula & Whyalla in 2011-12 was approximately 56,000 persons (South Australian Local Government Grants Commission, 2013).

[11] Data sources included: Eyre Peninsula Waste Management Strategy (Eyre Peninsula Local Government Association, 2004); 2011-12 SA Recycle Activity Report (Zero Waste SA, 2013); Municipal waste data for relevant regional Councils (South Australian Local Government Grants Commission, 2013)

Table 2: High-level range of likely resource recovery and landfill disposal occurring in Eyre Peninsula and Whyalla region

Resource Recovery	**50,000-70,000 tonnes/yr**
Landfill Disposal	25,000-35,000 tonnes/yr
TOTAL WASTE	75,000-100,000 tonnes/yr

The direct consultations with the works or waste depot managers from Councils in the region also revealed what likely volumes of different materials that are currently or could be processed by a mobile shredder. This information was assessed to consider what volumes are currently being shredded or not, and whether they were being disposed of to recycling or landfill. The results of this assessment are summarised in Table 3 overleaf. Based on this information, the following observations and comments are made.

- The majority of garden waste is either chipped or stockpiled for shredding so it can be recycled as compost/mulch, with very little sent to landfill disposal.
- Some depots are not shredding timber waste and disposing of it to landfill. Some timber waste, even if shredded, would not be suitable for recycling and would still end up in landfill.
- Mattresses are currently landfilled in unshredded form.
- Most mixed plastic materials appear to be currently sent to landfill unshredded.
- Some depots are sending whole tyres (via Adelaide) for recycling at substantial cost. Others are shredding tyres to less than 250mm, allowing more cost-effective disposal to local landfills.

Table 3: High-level assessment of how current waste materials that could benefit from shredding might be currently handled

Waste Material	Recycling (t/yr)		Landfill Disposal (t/yr)		Total (t/yr)
	Shredded	Unshredded	Shredded	Unshredded	
Garden Waste	2900		50	50	3000
Timber	2500		1250	1250	5000
Mattresses				50	50
Mixed plastic material			100	700	800
Tyres		250	250		500
Total	5400	250	1650	2050	9350

Possible changes

It was also discussed during consultation with the works or waste depot managers from Councils in the region what change might occur if they had more ready access to cost-effective shredding. Based on information provided, Table 4 overleaf projects how shredding activity and recycling and landfill disposal practices might alter. In short:

- Garden waste – Any residual material currently sent to landfill would instead be shredded where possible to reduce volume.
- Timber – More depots would shred this material, with greater quantities being recycled. Less unshredded material would therefore end up in landfill (thus reducing landfill space requirement).

- Mattresses – Would be shredded before landfill disposal with some recovery of metal springs for recycling.
- Mixed plastic material – This would be shredded before being landfilled.
- Tyres – Shredding would enable more cost-effective local disposal to landfill.

Table 4: High-level assessment of how current handling practice would change if mobile shredder was readily available

Waste Material	Recycling (t/yr)		Landfill Disposal (t/yr)		Total (t/yr)
	Shredded	Unshredded	Shredded	Unshredded	
Garden Waste	2900		95	5	3000
Timber	3125		1625	250	5000
Mattresses	5		40	5	50
Mixed plastic material			730	70	800
Tyres			500		500
Total	6030		2990	330	9350

Based on Tables 3 and 4, Table 5 below summarises the changes in shredding activity and recycling and landfill disposal that might occur (in the Eyre Peninsula & Whyalla region). These potential changes are also summarised below.

- Total shredding requirement – This could rise to 9020t/yr (up from 7,050t/yr)
- Additional shredding –therefore *ca.* 1,720 tonnes/yr.
- Additional recycling – Potentially another 380 t/yr of recycling; however, recycling of tyres could stop with this material instead shredded and disposed to local landfill as this would be more cost-effective.
- New shredded material now being sent to landfill disposal – This would be the 250t/yr of tyres now shredded instead of being sent whole for recycling.
- Previously unshredded material sent to landfill but now shredded first (before landfill disposal) – This could be up to 1090t/yr.

Table 5: High-level assessment of how current shredding practice would change if mobile shredder was more readily available & cost effective

Waste Material	Total volume shredded	Additional shredding	Additional Recycling	New shredded material to landfill disposal	Previously unshredded material still sent to landfill but as shredded material
Garden Waste	2995	45			45
Timber	4750	1000	625		375
Mattresses	45	45	5		40
Mixed plastic material	730	630			630
Tyres	500	250	-250	250	
TOTAL	**9020**	**1970**	**380**		**1090**

Mobile shredder capability & costs

Discussions were held with private contractors currently supplying mobile shredding services. This includes contractors that had undertaken previous oyster basket shredding trials and were also providing existing contract shredding services to local Councils at waste depots. Based on this information, the type of mobile shredder recommended as suitable to provide the broad range of shredding capabilities needed for relevant waste materials would need to be an industrial grade mobile shredder as used for the oyster basket trial, e.g. TANA Shark waste shredder – see Figure 1 below. This type of shredder would be able to process tyres and timber.

Figure 1: Shark shredder used for oyster basket shredding trial

The estimated cost of such a shredder, fully installed and mounted on a semi-trailer, with additional trailer for compact loader & tipper bin, was estimated at $1.2 million. This shredder could process between 2-10 tonnes/hr depending on type of waste material. Allowing for 50% utilisation (once travel time between sites, repair & maintenance events, etc.), or 960 hrs/yr operating time, this machine could potentially process between 4,000-6,000 tonnes/yr of waste materials, including oyster baskets. This volume is not quite sufficient to meet all of the Eyre Peninsula & Whyalla region's shredding needs but would cover up to 50%, still allowing existing static shredders &/or private contractors with mobile shredders to meet the balance of shredding requirements.

An assessment of the likely cost to users of the new shredder is summarised in Table 6 below. It is estimated that the (average) hourly cost could be about $625/hr, which is approximately 25-30% less than what private contractors appear to be currently charging (ca. $700-800/hr once all equipment hire, fuel, operator labour plus additional travel expenses are considered).

Potential cost & benefits

These were assessed at high-level, for the Eyre Peninsula & Whyalla region & SA Oyster industry, as shown in Table 7 two pages overleaf. This assessment indicates that whilst co-investment in a shredder would not necessarily offer substantial savings for the oyster industry, it could yield a net benefit to the region up to $350k/yr.

Table 6: High-level estimate of regionally owned & operated mobile shredder

Cost parameter	Annual cost ($/yr)
Equipment Cost (Amortised)	$120,000
Management & labour costs	$232,500
Fuel costs	$100,000
Maintenance/repair allowance	$36,000
Travel expenses	$112,800
TOTAL	$601,300
Operating hours (hrs/yr)	*960*
Shred volume (tonnes/yr)	*4800*
Unit processing cost ($/tonne)	*$125*
Hourly processing cost ($/hr)	*$626*

Table 7: High-level assessment of how current shredding practice would change if mobile shredder was more readily available & cost effective

Cost/benefit parameter	Oyster Industry				Region			
	Units	Quantity	Rate ($/unit)	Cost (-ve)/ Benefit (+ve)	Units	Quantity	Rate ($/unit)	Cost (-ve)/ Benefit (+ve)
Saving due to reduced shredding cost @ $40/tonne	tonnes	150	$40	$6,000	tonnes	4,650	$40	$139,500
Additional recycling value @ market value					tonnes timber mulch	625	$25	$15,625
					tonnes metal	5	$90	$450
Avoided L/F disposal @ $100/tonne					tonnes timber & metal	-630	-$90	$56,700
Avoided disposal cost for tyres					tonne tyres	-250	-$500	$125,000
Additional L/F cost for tyres					tonne tyres	250	-$90	-$22,500
Landfill air space saving from better compaction of shredded material					m^3 waste	-1,520	-$25	$38,000
NETT cost/benefit outcome (TOTAL)				**$6,000**				**$352,775**