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**DEVELOPING A FRAMEWORK FOR A SUSTAINABLE FISH  
WASTE MANAGEMENT INFRASTRUCTURE**

*Report prepared by SEPA, National Waste Strategy: Scotland*

*on behalf of*

*The Scottish Fish Waste Management Group*

## CONTENTS

### Executive Summary

1. Introduction
    - 1.1 Industries Profile
    - 1.2 Drivers
    - 1.3 Scope
    - 1.4 Stakeholders
    - 1.5 Core Principles
  2. Key Influencing Regulations
    - 2.1 Animal by-products Regulations
  3. Current Situation
    - 3.1 Waste arisings
    - 3.2 Infrastructure
    - 3.3 Disposal routes
    - 3.4 Infrastructure need
    - 3.5 Technical Options
  4. Strategic Options - Conclusion
    - 4.1 Storage
    - 4.2 Collection
    - 4.3 Treatment
    - 4.4 Facilities mapping
  5. Recommendations
  6. Contacts
- 
- Annex 1 Aquaculture and other fish industry waste arisings (SEPA 2003)
  - Annex 2 Evaluation of Fish Waste Management Techniques (Poseidon 2004)

## EXECUTIVE SUMMARY

Under the terms of “A Strategic Framework for Scottish Aquaculture” (SFSA, SEERAD, 2003) the vision is to have a sustainable, diverse, competitive and economically viable aquaculture industry of which the people of Scotland can be proud. One of the objectives of that Strategic Framework is to develop a collective fish waste management infrastructure, and so a wide range of stakeholders were brought together, under the Chairmanship of SEERAD, to form the Fish Waste Management Group (FWMG) to explore this topic and to provide The Scottish Ministers with recommendations on the best methods of disposing fish waste from the Aquaculture and Fisheries industries in Scotland.

This Report also acts as the Scottish Environment Protection Agency’s phase 2 report for the fish waste national best practice project (NBPP) under the National Waste Strategy: Scotland. This strategy is concerned with wastes from the aquaculture (the rearing of aquatic animals for food) and the off-shore capture sector (wild fish and shellfish caught commercially and landed in Scotland).

The report and the work of the fish waste management group concentrate on mortalities from aquaculture, this being the most difficult waste stream to handle and the one that poses a particular problem to the industry. However, it is recognised that there are a number of other wastes generated by these industries and more work is needed to characterise them and develop solutions for their sustainable management.

The main drivers for change across both sectors are the Animal By-Products (Scotland) Regulations 2003 (APBR): these regulations are intended to safeguard human and animal health by controlling the ways in which animal by-products are handled, treated and disposed of. This severely restricts how fish wastes can be dealt with. It is these regulatory factors that have had the largest impact on the recommended options.

The current situation in respect of fish waste was determined by commissioning two separate projects; a waste arisings project intended to identify the nature and quantities of wastes, disposal routes and data gaps; and a technology project (Evaluation of Fish Waste Management Techniques by Poseidon Aquatic Resource Management Ltd) to identify what technologies, existing and proposed, are capable of dealing with wastes and comparing them for potential usefulness.

The waste arisings project carried out by SEPA identifies, in some detail, the priority wastes from aquaculture (principally mortalities from salmon farming). In 2002 around 5000 tonnes of mortalities arose from aquaculture in Scotland on a routine basis. Considerably more can arise as a result of intermittent ‘event’ mortalities such as disease outbreaks or as a result of algal blooms. Information from the Seafish Industry Authority showed that the largest quantity of waste is produced by the wild caught capture sector and exceeds 140,000 tonnes per year of processing wastes.

The key method of disposal for salmon morts prior to ABPR was either direct disposal to landfill or ensiling<sup>1</sup> and export to Norway. As disposal to landfill will no longer be permitted, and on the premise that having export as the only option for dealing with the wastes is unacceptable, a need for fish waste management in Scotland infrastructure is apparent.

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<sup>1</sup> Ensiling involves macerating the waste in a solution of formic acid to stabilise the waste and assist in pathogen inactivation

A significant number of facilities for treating biodegradable waste are expected to come on line in the coming years as a result of both the implementation of the ABPR and the National Waste Strategy. It is recognised that due to the fact that amendments would have to be sought to the ABPR at a European level, that it is unlikely that the industry would be able to make use of these facilities for mortalities in the short to medium term, but that continuing to pursue the necessary legal changes to permit treatment of mortalities in conventional biowaste facilities such as in-vessel composting would be worthwhile and may prove fruitful in the longer term by increasing the number of techniques by which mortalities may be treated.

This report also recommends that all mortalities are stabilised at the point of production for both animal health and environmental purposes. This would allow short and medium term storage as required.

Also required as a fundamental requirement is a study to look at the logistical requirements of dealing with a large 'event' mortality such as the last outbreak of Infectious Salmon Anaemia (ISA)<sup>2</sup>.

Finally further work is needed to characterise other waste streams arising from fish related sectors and to look at solutions for those wastes in more detail.

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<sup>2</sup> Infectious Salmon Anaemia is a transmissible viral infection with a high mortality rate in fish.

## 1. INTRODUCTION

This is a paper prepared by SEPA on behalf of the Scottish Fish Waste Management Group (FWMG), as operated by the Scottish Executive. It will also form the basis of a phase 2 report for SEPA's National Best Practice Project (NBPP) for fish waste under the National Waste Strategy project: Scotland (NWSS).

As the final report of the FWMG it is principally aimed at providing a briefing to the Scottish Ministers and fulfilling the aims of "A Strategic Framework for Scottish Aquaculture" (SFSA, SEERAD 2003) as regards aquaculture wastes. As an NBPP report, however, it is aimed at all stakeholders involved in and affected by the NWSS project as a whole.

Certain information, regarded by the industries involved as commercially confidential has not been included. The conclusions and recommendations are based solely on the non-confidential material available at the time.

### 1.1 Industries profile

The fish-related industry in Scotland is composed of two sectors - aquaculture and the capture fishing sector. Activities associated with angling are not considered here due to the very small quantities of waste arising.

Aquaculture involves the rearing of aquatic animals for food. In Scotland it is dominated by the Salmon and Trout sectors as well as Shellfish and a small but increasing marine fin-fish sector, supplying cod and halibut.

Salmon farming takes place both in fresh and salt water, with the early life stages being reared in river-based hatcheries and in freshwater cage farms before being transferred to marine cage farms for on-growing in sealochs and voes.

Trout production mainly takes place in fresh water but production methods include both tank and cage rearing, some cage sites being in coastal waters.

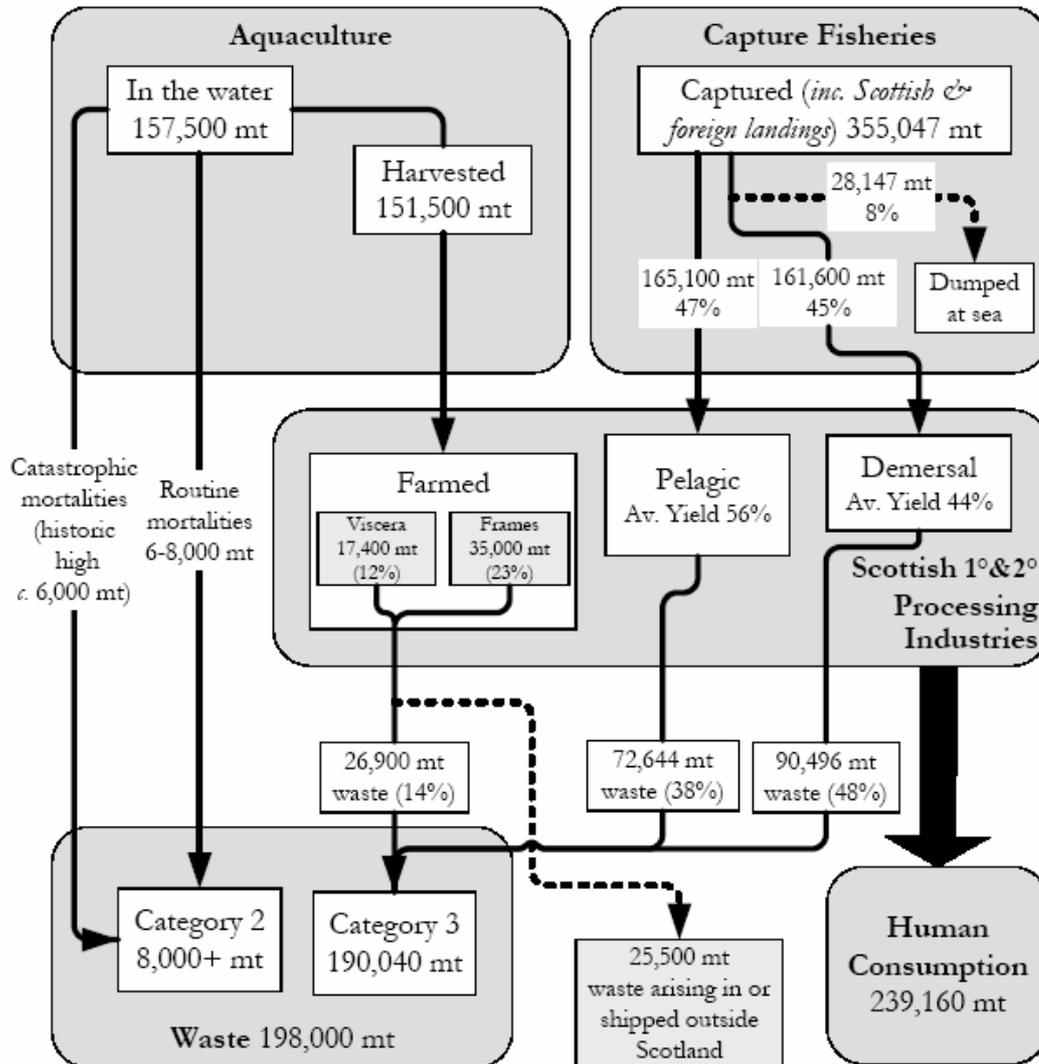
Slaughtering can either take place at the farm, at mobile "harvesting stations" or at fixed purpose-built sites. Gutting, filleting, smoking and other forms of processing of the slaughtered fish take place at a number of factories across Scotland.

Marine cage aquaculture is centred on the northern and Western Isles and along the west coast of Scotland. Trout farming, by contrast takes place mainly in central Scotland and the Borders with some marine farm sites on the west coast. Figure 2 shows the distribution of Marine Cage fish farms across Scotland

The fish capture industry can be divided according to the fish they catch: pelagic (fish that generally live in the middle / surface layers of the sea), demersal (bottom dwelling fish) and shellfish. Pelagic fish are generally landed whole and processed on land. The majority of demersal fish are processed at sea and the resultant waste from these fish is discarded there. Shellfish, particularly Nephrops prawns and scallops, are largely processed on land but there is some processing at sea waste from species such as Nephrops norvegicus (Norway Lobster). Pelagic fish are landed principally in Shetland and north east Scotland: demersal fish landings are widely distributed but with processing centred in the north east: the majority of shellfish landings are in the Highlands and Islands. The majority of the waste from the wild caught sector comes from on shore processing [Seafish SR537 November

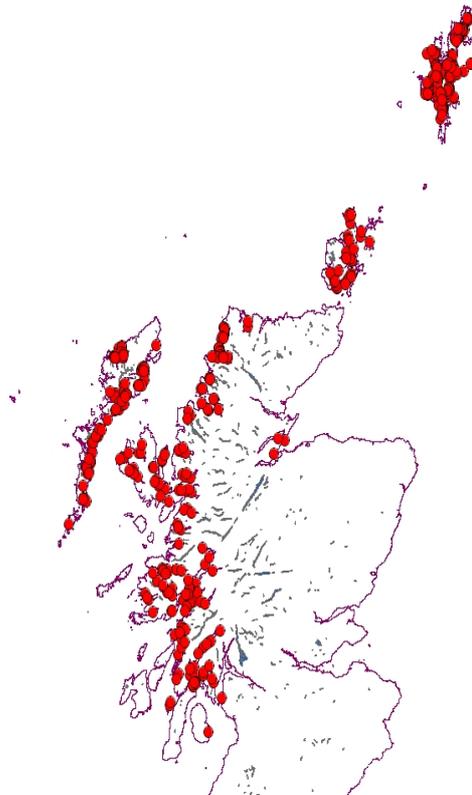
2001]. Figure 1 below shows diagrammatically the finfish waste produced from Scottish Fisheries. (Poseidon Aquatic Resource Management Ltd)

Figure 1: Finfish Waste Production from Scottish Fisheries



Data sources: Various, inc. Scottish Executive (2003), FRS (2003) and SEPA (unpublished)

Figure 2 Location of Marine cage fish farms



## 1.2 Drivers

Of principle concern in the aquaculture industry is waste generated as a result of on-farm mortalities (either routine or catastrophic). Therefore this paper deals principally with this waste.

The management of wastes from the aquaculture industry is constrained primarily by logistical, economic and regulatory factors. The industry's production sites are widely dispersed throughout remote parts of the Highlands and Islands, presenting obvious logistical difficulties in terms of waste collection and transport to disposal outlets. These can be further complicated in the case of catastrophic event mortalities, where the source and quantity of waste material is impossible to predict. These logistical difficulties in turn make the safe storage, collection and transport of fish wastes very costly. The exception to this is export to Norway where the costs are significantly lower. Table 1.2 below gives indicative costs to producers of the various disposal options. Recent implementation of the ABPR has compounded the challenges facing the industry by proscribing specific disposal methods.

With the publication in March 2003 of SFSA, the Scottish Executive made a national commitment to develop a collective waste management infrastructure for the aquaculture industry. At the same time, those involved in delivering the NWSS were beginning to address the strategic development of more sustainable approaches to Scotland's commercial and industrial (non-municipal) waste streams. The two developments were integrated, and a joint approach produced, in order to honour the Executive's commitment and further the NWSS.

Table 1.2 Overall estimated costs to Producers of mortality disposal (Source: Poseidon 2003)

<b>Cost to Producer, £/tonne waste</b>		<b>Ensiling</b>	<b>Transport</b>	<b>Disposal</b>	<b>Tax</b>	<b>Total</b>
<b>Raw Fish Waste</b>	Landfill, W Highlands	n/a	£53	£32	£15	£100
	Landfill Shetland	n/a	£87	£35	£15	£136
	Landfill W Isles	n/a	£10	£98	£15	£123
	Fish meal and Oil Grimsby	n/a	£0	£0	£0	£0
	Incineration Shetland	n/a	£87	£23	£0	£110
<b>Ensiled Waste</b>	Hydrolysis, Rosseyew	£30	£0	-£10	£0	£20
	Norway export, Scanbio Scotland	£30	£21	£38	£0	£89
	Norway export, Hordafor, Shetland	£30	£1	£1	£0	£32
	Incineration, PDM Group Widnes fluidised bed combuster	£30	£43	£33	£0	£105
<b>Both</b>	Norway export, Hordafor, W Isles	£6	£2	£1	£0	£9

### 1.3 Scope

The most pressing strategic concerns relate to mortalities from marine cage aquaculture and trout farming. This is due to an absence of suitable facilities able to take this waste. This specific source of fish waste forms the focus of the recommendations, although clearly future infrastructure developments may offer parallel opportunities to the freshwater, wild catch and processing sectors (better data on arisings in these sectors will facilitate this). Due to a lack of data, Shellfish wastes are not covered by this report.

#### 1.4 Stakeholders

An early stage in the process was the setting up of a national stakeholder group, to involve both fish waste producers and the waste management industry to gain consensus on the way forward. The resulting Fish Waste Management Group (FWMG) has and will continue to be engaged at every step to ensure a degree of 'ownership' of any future development proposals. At present, the FWMG consists of representatives from the following organisations:

- SEPA
- SEERAD (Aquaculture Policy and, Waste Regulation and Animal Health)
- Highlands and Islands Enterprise
- Western Isles Aquaculture Association
- Association of Scottish Shellfish Growers
- Shetland Salmon Farmers' Association
- Scottish Quality Salmon
- Seafish Industry Authority
- Federation of Scottish Aquaculture Producers
- UK Renderers' Association
- COSLA (Animal Health and Welfare Strategy Group)
- Chartered Institution of Wastes Management
- Scottish Environmental Services Association
- Fisheries Research Services
- McKechnie Jess Ltd
- Scanbio (Scotland) Ltd
- British Trout Association
- UK Association of Fishmeal Manufacturers
- The Composting Association
- Hordafor
- WRE Ltd
- Enviro Centre Ltd
- Transfer Systems International (UK) Ltd

#### 1.5 Core Principles

At an early meeting of the FWMG the membership were asked to endorse a proposed approach developed by SEPA in accordance with NWSS principles. The stepwise approach, which was subsequently agreed, composed the following key stages:

1. *Baseline assessment (waste arisings, infrastructure, current practice, trends)*



2. *Technical review of existing / emerging waste management options*

The first stage was intended to characterise and quantify Scotland's fish waste stream, and the way it is currently managed, and also to identify any data gaps. The second stage was intended to investigate in detail the options available for managing fish waste, taking account of process requirements, outputs, costs, regulatory

constraints. There was considerable overlap between these two initial stages, both of which are now complete. The output of these two stages has formed the basis of the recommendations included in this report.

In addition to the adoption of this general process approach, there is also a range of core principles inherent to the NWSS that should guide the assessment of future waste management options. These include:

The Waste Hierarchy – consideration should be given to the reduction of wastes at source, the recovery of value / utility from wastes, and final disposal of wastes in descending order of preference

Proximity Principle – wastes should be managed as near as practicable to their point of production, to mitigate the costs and impacts of transportation

Self-Sufficiency – waste producers within regions that define economies of scale should aim to be self-sufficient in the management of their wastes

## **2. KEY INFLUENCING REGULATIONS**

### **2.1 The Animal By-Products (Scotland) Regulations 2003 (ABPR)**

The APBR implements EC Regulation 1774/2002 which lays down health rules on animal by-products not intended for human consumption.

The regulations break down animal by-products into 3 categories according to risk, category 1 being the highest risk and including Transmissible Spongiform Encephalopathies (TSE) infected carcasses, dead pets and zoo animals and experimental animals. Category 2 includes waste from slaughtered animals not intended for human consumption. Category 3 wastes include wastes from animals which are essentially fit for human consumption and catering wastes.

The methods of treating and disposing of those categories are restricted to those detailed in the regulation. However the regulation does include scope for developing new methods for treating animal by-products, subject to approval from the relevant EU committee.

Fish waste, in the case of aquaculture, is defined as either Category 2 wastes in the case of animals that die for reasons other than slaughter for human consumption - this covers all mortalities from fish farms; or Category 3 wastes in the case of material from slaughtered animals fit or unfit for human consumption. In the case of waste from the wild caught sector, the majority is produced during the processing of seafood which is designated for food use. As such this offshore fishing fleet waste from processing into food is classed as category 3. There are Category 2 wastes from the wild caught sector, namely animals that die during transport. There is potentially Category 1 waste as well; particularly shellfish that may contain excessive levels of algal toxins.

Category 2 wastes, in the case of fish, may only be treated by:

- a. direct incineration;
- b. pre-treatment (using the processes specified in the regulation) followed by incineration;

- c. heat treatment at 133°C and 3 bar pressure saturated steam for 20 minutes followed by treatment in a composting or biogas plant or disposal to landfill, or use as a fertiliser;
- d. composting in accordance with rules which have yet to be established;
- e. alkaline hydrolysis at 150°C for 1 hr at a pressure of 4 bar in a solution of sodium or potassium hydroxide;
- f. For rendered fats, use in an oleochemical plant to produce tallow derivatives for technical use only.

Category 3 wastes may be treated by any of the above processes as well as by:

- a. treating in an approved biogas or composting plant;
- b. processing by any of the methods listed in the regulation in an approved plant (for petfood, biogas, composting or technical use (subject to restrictions identified in the ABPR)).

There are six additional methods of disposal for by those identified in EC/1774/2002 which have been identified as suitable for Category 3 waste, five of which are also suitable for Category 2 waste. One of these five methods has been identified as suitable for Category 1, 2, and 3 wastes.

#### Category 1,2,and 3

- Alkaline hydrolysis

#### Category 2 and 3

- Combustion of animal fat in a thermal boiler;
- High pressure, high temperature hydrolysis;
- High pressure hydrolysis biogas;
- Biodiesel production;
- Brookes gasification

In Scotland the statutory enforcement of the APBR is split between the State Veterinary Service (SVS) and the Local Authorities. SVS is responsible for the provision of advice and for permitting facilities. Local Authorities have responsibility for enforcement.

#### Category 3

As well as the above, Regulation EC/1774/2002 allows for category 3 material to be processed by any method, which is approved by the competent authority and where the final product meets microbiological standards set out in the EC Regulation.

### **3. CURRENT SITUATION**

#### **3.1 Waste arisings**

As part of the first phase of the project as agreed with FWMG, SEPA undertook a data review of fish waste arisings. The findings of that review are included as an Appendix to this report.

Although the data set is not complete, the report did highlight the major waste streams and quantified those wastes that have proven most difficult to handle and dispose.

The report identified approximately 5000 tonnes a year of routine mortalities from marine cage fish farms, approximately 100 tonnes from trout farms. No figures were available for farmed fish processing.

Approximately 140,000 tonnes of offshore fishing processing wastes is generated each year in Scotland, the vast majority in the north east.

The principal waste stream of concern is the mortalities arising from salmonid aquaculture. These mortalities can be broken down into two categories: 'routine' and 'event' mortalities.

Routine mortalities are a normal by-product of fish production and amount to a small percentage of total production each year. The total quantity of routine mortalities should be relatively easy to predict year on year.

Event mortalities on the other hand are large scale kills as a result of disease outbreaks, jellyfish kills, algal blooms etc. These are unpredictable by their nature and can be confined to a single farm or group of farms, or, as in the case of the Infectious Salmon Anaemia outbreak of 1999, can affect the whole of Scotland and beyond. Event mortalities tend to be the result of water-borne vectors and it is marine cage farms that tend to bear the brunt of these event kills. On the whole they produce large quantities of dead fish in a short time.

All mortalities are classified as category 2 animal by-products irrespective of cause or origin.

All processing waste either from aquaculture or offshore fishing is classified as category 3 if produced as a result of normal operation.

### 3.2 Disposal routes

Prior to APBR, mortalities from marine-cage fish farms were either disposed of direct to landfill or the waste ensiled on site and shipped directly to Norway for further treatment. Post APBR, direct landfilling has continued under a temporary derogation.

Ensiling involves macerating the wastes and mixing with a formic acid solution. Ensiling has the advantage of inactivating certain pathogens and also inhibiting putrefaction and therefore odour.

In the northern and Western Isles, the ensiled waste is stored on land or moored ship; on the mainland, the waste is stored at Scanbio's facility at Inverness harbour prior to transportation.

Storage on land is usually in large stainless steel vessels or intermediate bulk containers (IBCs)

In Norway, the ensiled category 3 wastes are subject to a heat separation process that produces a protein feed that can be fed to terrestrial livestock and a high quality fish oil. The process is essentially the same for category 2 wastes, with the exception that no saleable product is produced.

Incineration at the site of production is an option that is being pursued by some producers for both on-farm mortalities and processing wastes. Such units have to be permitted by SVS and are only suitable for waste produced at the site. Total

incineration capacity tends to be rated at less than 50 kg/hr to fall below the threshold for full regulation by SEPA.

No information on the treatment and disposal of trout mortalities is available.

Until the advent of APBR, processing wastes from aquaculture species were sent for pet food manufacture. However, a number of processors have opted for ensiling their waste and spreading or injecting it into agricultural land. However, recent changes to Waste Management Licensing Regulations mean that this would now require a full Waste Management Licence.

A small number of commercial facilities have permission from SVS to treat Category 2 wastes, however, these are principally renders and animal remains incinerators. The two currently operating Rendering facilities in Scotland are not willing at this stage to take fish waste for technical reasons. It is not known whether the animal remains incinerators would be able to take fish wastes, however it is considered likely that they would not be able to take significant quantities due to the wet nature of the waste.

### 3.3 Infrastructure need

At present, the only cost effective option available to the Aquaculture industry, for the disposal of Category 2 fish material, is ensiling and export to Scandinavia. This disposal route operates against the policy of dealing with the waste as near to the point of production and stifles commercial opportunities for creating a useful by-product from aquaculture activity. It also poses a significant risk in that should that disposal route become unavailable at any point in the future, there would be no alternative legal route for disposal of the waste.

A single large purpose built rendering facility, however, is unlikely to prove economic, partly because of the relatively low quantity of routine morts produced in Scotland and partly because of competition with existing facilities in Scandinavia. While export of fish waste will remain the likely option in the short term, it would be potentially advantageous to develop facilities capable of handling mortalities locally as export as a disposal route is reliant on policy and commercial conditions outside of the UK.

### 3.4 Technical Options

The treatment options for dealing with fish waste are restricted to those permitted under ABPR, identified earlier in this paper.

All of these techniques have a proven track record in being able to treat fish wastes or similar feedstock and are permitted techniques in terms of the ABPR, in that the product arising from these plants is considered fully treated and would not be subject to further regulation under ABPR.

Conventional rendering is unlikely to be able to deal with significant quantities of ensiled fish waste due to technical difficulties in treating the wastes.

Similarly, incineration poses problems due to the liquid nature of the wastes.

Given that mortalities have been deemed Category 2 material, processing into animal feed is not an option because only category 3 material can be utilised in fish meal under the ABPR.

#### 4. STRATEGIC OPTIONS - CONCLUSION

##### 4.1 General

Work carried out to date (a Baseline Assessment, and an Evaluation of Fish Waste Management Techniques) suggests that mortalities from marine caged aquaculture are the most pressing strategic concern in terms of managing Scotland's fish waste resource. Further work is required to collate better data in order to identify potential synergies with waste producers in the wild catch and processing sectors.

Mortalities produced from marine cage fish farms on a routine basis are currently managed either by ensiling and exportation to Norway, or by disposal of the raw material to landfill. Landfill of untreated fish waste is prohibited under ABPR, although currently continuing under interim dispensation from the Scottish Executive. Export to Norway may present risk to producers, as it infers considerable dependency on a single treatment route. Export to Norway may also conflict with the fundamental 'proximity principle' as outlined in the National Waste Strategy: Scotland (NWSS), and brings little in the way of socio-economic benefit to Scotland

Although export and/or landfill disposal are likely to remain the only options available to the industry for the immediate (1-2yr) future, neither is thought to offer a sustainable long term solution and alternatives need to be investigated.

##### 4.2 Storage

It is vital that future facilities for managing fish waste are able to deal with ensiled material. Ensiling is not only effective in deactivating some pathogens, it also stabilises the waste material such that it can subsequently be stored at low cost. The ability to store mortalities safely is a key component of any future waste management infrastructure given the highly dispersed and remote nature of the aquaculture industry. Indeed, stabilisation at source becomes critical in the case of catastrophic events such as an ISA outbreak, where there may not be an immediate outlet for a large quantity of contaminated material. With the exception of cases where landfill disposal will continue in the short-term, all mortality wastes should in future be stabilised by ensiling (or an equivalent method) at the point of production.

To prepare for any further large-scale ISA outbreak or similar catastrophic event, a detailed investigation should be carried out to determine whether contingency storage capacity is required.

##### 4.3 Collection

The collection infrastructure required to support new waste management options will ultimately depend on the type and location of any new facilities accepting fish waste. However, in advance of the development of new facilities, there is scope for supporting aquaculture operators through their inclusion in the National Fallen Stock Collection Scheme (NFSCS). However, requirements for the storage, transportation and disposal of fish waste are highly specific, and work needs to be done to ascertain precisely how the Scheme would work. In particular, the precise costs to aquaculture operators, the likely extent to which the scheme would be taken up, and the required logistics in the case of a catastrophic ISA outbreak or similar event need to be determined.

#### 4.4 Treatment

Under the ABPR, all mortalities are designated as Category 2 material which currently means that they can only be fully treated by means of incineration, rendering, biogas or alkaline hydrolysis. However, there is currently insufficient capacity in Scotland to deal with the mortalities produced on a routine basis using these methods.

Both rendering and incineration are expensive treatment options. Although there is believed to be some scope for the limited co-treatment of category 2 mortalities at existing rendering and incineration plant, the costs of this (particularly in light of collection and transportation logistics) are likely to be high, and operators of rendering and incineration plants are unlikely to accept significant quantities of fish wastes due to the technical problems they pose. Alternative infrastructure would therefore be developed. Given current market conditions, and the relatively small amounts of fish waste produced in this country, developing purpose-built facilities to deal with aquaculture mortalities is unlikely to prove an attractive option for potential investors. Alkaline Hydrolysis, although possible on a small scale, appears similarly unlikely to appeal to the waste producers due to its high costs.

Large, centralised facilities, whilst appealing in terms of economies of scale, also present problems in terms of transport logistics – marine cage fish farms are predominantly in the remoter parts of Scotland, and again there is a risk to the industry if all producers are reliant on a single private enterprise to deal with their wastes. As noted above, the principles of the NWSS dictate that where practicable wastes should be recovered as close to the point of production as possible, so that the local area sees the socio-economic benefits of managing waste.

For some time now work has been ongoing in assessing ensiling and composting as an ABPR-compliant means of treating category 2 fish waste. There are also other waste treatment processes, either currently in operation or in development, that have potential to co-treat fish waste with other waste streams. These developments offer the greatest opportunity for developing low cost, localised treatment facilities for aquaculture mortalities (and possibly other fish waste streams).

The National Waste Plan and Area Waste Plans, launched in early 2003 put forward a detailed infrastructure strategy for dealing with municipal solid waste (MSW – i.e. household and trade waste). Implementation of these plans using ring-fenced central government funds will mean that most local authorities in Scotland will be building composting or similar biological treatment plants at some point in the near (1-5yr) horizon. In addition, Scottish Water is actively diversifying the range of waste materials managed at existing sewage treatment plants across the country. In the Northern and Western Isles work is already underway to ensure that these treatment facilities comply with the ABPR standard for treating category 3 wastes. Category 2 wastes have not to date been considered, due, in part, to perceived regulatory hurdles.

Every effort in the short-term should be put into securing formal approval under the ABPR for the methods employed at these existing / planned facilities. The group should also actively engage with the operators of these facilities with a view to securing forward capacity for the management of aquaculture mortalities. Consideration should be given to the capacity of new facilities to deal with large-scale, catastrophic mortalities, as well those of routine origin.

## 5. RECOMMENDATIONS

The following recommendations do not constitute a Best Practicable Environmental Option for managing Scotland's fish waste. They form a short-term (1-2yr) framework within which the aquaculture industry can move towards development of BPEO, based on the data and evidence currently available. The recommendations take forward in more detail the main points raised in the conclusion.

1. *Data recommendations*

Responsibility: SEPA & Industry representatives

2. *Develop policy to ensure storage of aquaculture waste always includes stabilisation at point of production*

Responsibility: Industry Representatives, SEERAD

3. *Carry out detailed feasibility assessment – identifying likely uptake, costs and logistics - of extending NFSCS to include fish waste in Scotland.*

Aquaculture wastes will fall under the National Fallen Stock Collection Scheme, however, a detailed costs scheme is still needed and there is still the issue of how the scheme will operate in the case of a large-scale event mortality.

Responsibility: SEERAD

4. *Clarify current status (timescales) of approval process for available fish waste recovery options – composting, anaerobic digestion, lime pasteurisation.*

Currently work by FRS and CEFAS has concentrated on assessing composting and ensiling on their ability to neutralise fish pathogens. This work is important on animal health grounds, however, there may be means by which other methods can bring these processes under ABPR as approved methods. In any case details of the work involved, any funding required and projected timescales are needed.

Responsibility: SVS, SEPA and SEERAD

5. *Carry out a detailed assessment of the storage and collection logistics required to deal with large-scale event mortalities.*

This study should look at the infrastructure required to deal with a large-scale mortality in terms of containment, transport, storage and treatment facilities required. It should also include detailed costs.

Responsibility: FRS

6. *The Scottish Fish Waste Management Group to meet to discuss its future role*

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Tel: 01224 876544

*McKechnie Jess Ltd*

Port Glasgow Road  
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PA15 2UW  
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Tel: 01475 742528

*British Trout Association*

Bow Business Centre,  
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Tel: 020 8980 2456

*UK Association of Fishmeal  
Manufacturers*

2 College Yard  
Lower Dagnall Street  
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AL3 4PA  
Hertfordshire

Tel: 01727 842844

*The Composting Association*

Avon House  
Tithe Barn Road  
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Northamptonshire  
NN8 1DH

Tel: 0870 160 3270

*UK Renderers' Association*

C/o Argent Group  
The Rural Centre  
West Mains  
Ingliston  
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EH28 8Lt

Tel: 07736 723 740

*Hordafor A.S.*

NO-5397  
Bekkjarvik,  
NORWAY

Tel: 47 56 18 18 50

*Enviro Centre Ltd*

Wolfson Centre  
106 Rottenrow East  
Glasgow  
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Tel: 0141 553 4128

*Transfer Systems International (UK)  
Ltd*

Burghmuir Place  
Blackhall Industrial Estate  
Inverurie  
AB51 4FW

Tel: 01467 672000

*Scanbio Ltd (Scotland)*

Ben Nevis Industrial Estate  
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PH3 36RU

Tel: 01397 703752

*Federation of Scottish Aquaculture  
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15 Shielhill Park  
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PH1 4QT

01738 828170

*WRE Ltd*

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G81 4SA

Tel: 0141 951 5980

*Association of Scottish Shellfish  
Growers Association*

Mount View  
Ardvasar  
Isle of Skye  
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Tel:01471 844324

*Scottish Environmental Services  
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C/o Viridor Waste Management  
Dunbar Landfill  
Oxwell Mains  
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EH42 1SW

Tel: 01368 865095

*Scottish Quality Salmon*

The Durn  
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Tel: 01738 587009